Faculty of Graduate Studies

Master Program in Water and Environmental Engineering

Assessing the Potential for Internalizing the Pollution Costs from Palestinian Dairy Industry: a Case Study

تقييم إمكانية استيعاب تكاليف التلوث في مصانع الالبان الفلسطينية: حالة دراسية

A Master Thesis

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BIRZEIT UNIVERSITY

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The findings, interpretations and conclusions expressed in this study do not necessarily express the views of Birzeit University, the views of the individual members of the M.Sc. Committee or views of their respective employers.

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اهداء

الى من لا يطيب الليل الا بشكره، ولا تطيب اللحظات الا بذكره، ولا تطيب الاخرة الا بعفوه، الى صاحب الفضل الاول والاخير

الله عز وجل

الى من يذكرهم القلب قبل ان يكتب القلم، من تسعد عيني برؤياهم، ويطرب قلبي بنجواهم

زوجي الغالي، وابنائي "علي، ماسة، يوسف"

الى من احمل اسمهم بكل افتخار، من كان دعاؤهم سر نجاحي، أقرب الناس الى قلبي

والداي الأعزاء

الى سندي وعزوتي، شركاء نجاحي

اخوتي واخواتي

شكرا لكل من ساندني طوال مسيرتي الدراسية، لكل من قدم لي النصيحة او كلمة طيبة او دعم ساعدني للوصول الى هدفي، الشكر الأكبر الى مشرفي الفاضل الدكتور ماهر أبو ماضي لما ابداه من جهود علمية واراء سديدة اغنت البحث، شكرا لزملائي واقاربي واهل زوجي

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Abstract

Despite the positive role the industrial growth in the West Bank plays in the prosperity of the state; it has become a serious part of the environmental degradation problem in the country. Accordingly, there has become more attention towards finding economic and environmental solutions to the various industrial waste problems.

This research, presents a study on the possibility of internalizing environmental pollution in its various forms “solid, liquid, gas”, resulting from dairy products in Palestinian dairy factories. This, by applying the concept of including pollution price in the product price. The research studies the annual quantities of pollution resulting from the manufacture of dairy products in the factory, and estimates the costs of pollution resulting from manufacturing.

The research shows that internalizing environmental pollution is necessary and possible in principle. But, the possibility of fully applying it within the cost of the product requires a large increase in the value of production, of approximately 8.5%. The research also presents two questionnaires, one for industry owners, and one for policy makers and experts. It shows the weakness in the environmental monitoring process in the region, the different opinions about the possibility of applying the concept of including the pollution price in products price, and the incentives required from both parties.

الملخص

ان النمو الصناعي في الضفة الغربية وبالرغم مما يمثله من دور إيجابي في الازدهار الاقتصادي للدولة، الا انه أصبح يشكل جزء كبيرا من مشكلة التدهور البيئي في البلاد. وعليه أصبح هناك توجه كبير واهتمام أكثر نحو ايجاد حلول اقتصادية بيئية لمشاكل المخلفات الصناعية المختلفة.

يقدم هذا البحث دراسة حول إمكانية استيعاب التلوث البيئي بأشكاله المختلفة "سائل، صلب، غاز" والناجم عن منتجات الالبان في مصانع الالبان الفلسطينية، وذلك عن طريق تطبيق مفهوم ادماج سعر التلوث في سعر المنتج. البحث يدرس كميات التلوث السنوية الناتجة عن تصنيع منتجات الالبان في المصنع، ويقدر تكلفة التلوث الناجمة عن التصنيع.

يوضح البحث ان مفهوم استيعاب التلوث البيئي للمصانع ضروري وممكن من حيث المبدأ، ولكن إمكانية تطبيقه بالكامل ضمن تكلفة المنتج تتطلب زيادة كبيرة بنسبة تقارب ال 9% الى قيمة الإنتاج. كما يعرض البحث استبيانين، الأول خاص بأصحاب الصناعة والثاني بأصحاب القرار والخبراء، ويبين نقاط الضعف في العملية البيئية والآراء المختلفة حول إمكانية تطبيق مفهوم ادماج تكلفة التلوث في سعر المنتج وما يطلب من حوافز ودعم من كلا الأطراف.

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List of Abbreviations

BOD	Biological oxygen demand
CBA	Cost- Benefit Analysis
CIP	Cleaning in place
CNIEL	Centre National Interprofessionnel de l'Economie Laitiere
COD	Chemical oxygen demand
DM	Dry matter
DPWTS	Dairy processing wastewater treatment sludge
E P&L	Environmental profit and loss method
EFA	Economic Feasibility Analysis
EPA	Environmental Protection Agency
EQA	Environmental Quality Authority
FAO	The Food and Agriculture Organization
IDF	International Dairy Federation
ILS	Israeli New Shekel
IOS	International Organization for Standardization
ISIC	Industrial Classification for Economical Activities
JLMBR	Jet loop membrane bioreactor
LCA	Life Cycle Assessment
MNE	Ministry of National Economy
NF	Nanofiltreation
NH3-N	Ammonia- nitrogen
OM	Organic matter
P2	Pollution Prevention
PCBS	Palestinian Central Bureau of Statistics
PFIU	Palestinian Food Industries Union
pH	Negative log of the activity of the hydrogen ion
PO4-P	Orthophosphate
RO	Reverse osmosis
SBR	Sequencing batch reactor

SDG5	The Sustainable Development Goal number 5
sMBR	Submerged membrane bioreactor
SPSS	Statistical Package for the Social Sciences
TDS	Total dissolved solids
TSS	Total suspended solids
UASB	Anaerobic sludge blanket
UHT	Ultra-high Temperature Treatment
USDA	The United States Department of Agriculture
VAT	Value Added Tax
WHO	The World Health Organization

Chapter One: Introduction

1.1. Background and Problem Statement

Starting from the industrial revolution, and in line with the irrational economic growth, pollution rates are exaggerating. This evolution is at the expense of our health, environment and natural resources (Slocock and Sowinski, 1996). Fortunately; people started to pay more attention to the environment. But here; the conflict and the gap have appeared between environmentalists and economists. Many challenges encounter solving the industrial pollution problem; and maybe the most significant obstacle; is on how to adapt the financial burden associated with it.

Industries in general are the main polluters as a result of the open discharges of wastes into the open environment. In the developed countries, the industries bear full responsibility of the pollution costs associated with damages as well as control. This is done through internalization of the costs associated with the externalities. Internalization implies that industries invest in technological and management solutions that minimize the discharge of pollutants into the environment. Alternatively, the polluting industries may pay to the governments which in return manage the damages caused as well as find solutions for minimizing future pollution (Abu-Madi, 2006; Von Blottnitz et al., 2006; Kosugi et al., 2009). In either cases, this implies increasing the productions costs and thus might have a significant influence of the products' prices.

Environmental costs are often hard to define from a business stand point. In the past they are more likely to be qualified as a subset of the costs of operating a business. When substances are released into the air, water or land, the resulting pollution used to be considered a social cost, an externality. But some of the new regulations have resulted in internalization of some of these environmental externalities, through, for example, requirement of additional investment in equipment and training, or for fines and fees resulting from noncompliance. As environmental externalities become internalized, and investors start to pay attention to the environmental risks of their "investments" new costs emerge. These new costs must be captured by the traditional cost accounting system, so that product costs remain accurate enough to facilitate sound decision making by policy makers and business managers. For example, how should the cost of improved waste treatment (wastewater plants, incinerators, etc.) be reflected in the costs of the products responsible for waste generation? (Abu-Madi, 2006).

Introducing the concept of “internalizing pollution” to the industrial field is important in providing managers a real view of their businesses, and broadening the understanding of sustainability in industrial operations (Eidelwein et al., 2018; Dahlman, 1979; Daly and Farley, 2010). Managers of companies need to understand that their businesses are dependent on the nature and its resources, consequently; environmental awareness must become a part of the agenda of the directors to maintain corporate success and continuity (Eidelwein et al., 2018).

The increase of environmental pollution produced by Palestinian industries is threatening. Legislation in terms of environment exists but is not fully enforced. According to the environmental law NO. (7) of the year 1999 imposed by the Environment Quality Authority (EQA); articles 74 and 76, the removal of the environmental damage is the responsibility and at the expense of the violator, otherwise the violator shall be bound to compensate and pay penalty (EQA, 2016). Moreover, the industrial sector lacks technologies and strategies to face the problem.

Dairy industry is of great importance in the Palestinian economy. Aaccording to the Palestinian Food Industries Union (PFIU, 2019), the number of dairy factories which are in operation is 41, some of them have their own cows and poultry farms and employing more than 1,754 workers. The investment in this industry is more than $ 67 million and the dairy products' market share is 45% from the total market size (PFIU, 2019). This sector is considered the least qualified in terms of international quality certificates and in terms of exportability.

In regard to water consumption, dairy industry is one of the most volume polluting food industry worldwide (Vourch et al., 2008). In Palestine, wastewater from dairy factories is either untreated or partially treated. Consequently, when discharged to the environment, it may cause severe problems. Concerns over the state of environment have grown in the past few years. The existing laws and legislations have proven to be ineffective to conserve the environment and protect human health (Agalgatti, 2008). There is an insisting need for a general law that co-ordinates the activities of the organizations and regulates the discharge of environmental pollution.

This research provides an assessment for the potential of internalizing the pollution costs in industries, with a case study from Palestinian dairy industries. Internalizing pollution costs presents a sustainable development method balancing between economic development and environmental protection. Conceptually, evaluating industrial practices, collecting data and analyzing it, is part of the study, on the other hand, the extent to which stakeholders are interested in collaboration is very essential, raising awareness among them on the importance of their cooperation and its impact on the social and environmental aspects is a real challenge.

1.2. Aim and Objectives

This research aims to study the potential of applying the internalization of pollution costs as a sustainable solution for pollution reduction in Palestinian industrial sector, with emphasis on the dairy sector. The specific objectives are:

- To estimate pollution costs associated with the dairy industries.
- To study the feasibility of internalizing pollution costs for dairy industries.
- To assess the level of stakeholders’ acceptance on the application of internalization of the pollution costs in Palestine.
- Understand the factors that drive decisions of the dairy industries regarding internalization of pollutions costs.

1.3. Research Questions

This research will try to answer the following questions:

- What are the pollution costs associated with the dairy industries?
- Is the internalization of pollution costs a feasible solution to an integrated eco-social system?
- What is the level of stakeholders’ acceptance on the application of internalization of the pollution costs in Palestine?
- Will the firm take initiative to internalize environmental pollution while facing the challenge of cost competitiveness?
- Why and how should the government offer incentives to internalize environmental pollution?
- Do you pay any taxes to the government in return of pollution?

1.4. Thesis Outline

Chapter one provides an introduction and problem statement with research objectives and questions. Chapter Two presents a literature review. Chapter Three explains the approach and methodology. Chapter Four presents and discusses the results. Chapter Five summarizes the key conclusions and recommendations.

Chapter Two: Literature Review

2.1. The Global Dairy Sector

2.1.1. General Background

Global dairy sector is growing so fast. It complies with the rising demand on dairy products. In 2019, milk production has reached 852 million tons with an increase by 1.4% from 2018 (FAO, 2019). The Food and Agriculture Organization (FAO) has reported that dairy sector is projected to a steady and continuing increase at an average growth rate of 1.8% until 2025 (FAO, 2016).

Demand on dairy products in developing countries is encouraged by urbanization, the rising income and population growth (IDF, 2013). While shifting towards healthier lifestyle and changing in taste are things promoting dairy products in developed countries (OECD/FAO, 2018).

Across countries; India, European Union and United States have registered the highest milk outputs in volume by approximately 186, 167, and 97 million tons, respectively. It reflects to higher improvements in different production processes and increase in per cow yield compared to other countries (FAO, 2019). As a result, dairy/milk products' economic value have increased worldwide, and according to the United States Department of Agriculture (USDA), the dairy/milk commodity ranked the fourth with 9.5% (35,244,314 dollars) out of the total United States (US) share (USDA/ERS, 2019).

Being a major producer doesn’t mean a major exporter. While India owing the largest share in milk production; the vast majority of it is consumed domestically and fresh by local population. On the other hand, trading in milk products has been estimated as 75 million tons “milk equivalent”, with New Zealand and European Union being the world’s major milk suppliers “exporters” by approximately 19 million tons (FAO, 2019).

Globally, cows are the highest milk producing species, after that comes buffalos while the least yields come from goats, sheep and camels (IDF, 2016). Common milk products as classified by The World Health Organization (WHO) are: fresh milk, preserved and other milk products, cheese, eggs and egg-based products, and butter and margarine.

2.1.2. Importance of Dairy Sector

Perhaps the importance of the dairy sector lies to a large extent to the nutritional value of dairy products. Milk and milk products are good sources of calcium, vitamin B2, vitamin B12, protein and carbohydrates. They form a good choice for healthier lifestyle as many reviews have shown “consuming dairy products protects from weight gain and obesity” (IDF, 2019). It has also become the preferred animal protein in India rather than meat (OECD/FAO, 2018).

Another important aspect of dairying, is the huge role it plays in eradicating poverty. Over 500 million poor people depend on small to medium size dairy goat/buffalo farms. It provides direct and indirect employment opportunities for them, raising the household and the whole community welfare (FAO, GDP and IFCN, 2018). Douphrate et al., (2014) also clarified that milk production provides great job opportunities; it is labor- intensive at the level of the farm, transport, processing of milk, the agricultural supplies and services. In addition, dairy industry plays a big role in women empowering; socially and economically. It directly contributes to the

Sustainable Development Goal number 5 (SDG5) that aims to achieving gender equality (FAO, GDP and IFCN, 2018).

Given the importance of the dairy sector, a number of national and international institutions have been established that are concerned with the development of dairy standards, policies and regulations. Some have even made relationships, joint ventures and working programs to strengthen their work. International Dairy Federation (IDF) has been recognized as one of the most prominent organizations that contributes actively in the development of the science-based standards for the dairy sector. It has made formal status with other governmental organizations like WHO, FAO and the International Organization for Standardization (IOS).

Dairy Australia is a model of national institution that is involved in the development of the tools and services that assist dairy farmers and support industry sustainability. Centre National Interprofessionnel de l'Économie LaitièreCNIEL (CNIEL) is another example of a French organization that have created relations between milk producers, cooperatives and private companies to promote the economic development of dairy industry. The list has many others, each of which has a significant role in the improvement of dairy industry.

2.1.3. Current Status of Palestinian Dairy Industry

Dairy industry is considered one of the old industries in Palestine. In the West Bank, it has started in the early 1980’s with nearly three establishments using traditional tools and gradually developed until it reached about 105 establishments (involving large cattle and poultry farms) using modern machinery and equipment by 2017 (PCBS, 2019).

The Palestinian dairy factories specialized in dairy and cheese production are 14. The majority are located in Hebron, and others are in Ramallah, Nablus, Jericho and Jerusalem (AlEzareyye)

(PFIU, 2019). They vary in their production capacities; “AlJuneidi, AlJebreeni and Hammoudeh” are in advanced category in terms of quantity of production. While “Peenar, Almarae, AlSafa, and AlRayyan” are considered junior in terms of quantity of production and use of milk (Aliqtisadi, 2016).

In the local market and according to the Ministry of National Economy (MNE), the Palestinian dairy products account for 80% of the Palestinian market share, and the production capacity of the dairy factories is about 550-600 tons per day according to the PFIU (Ajyal, 2018). The Director of the Palestinian Food Industries Union, Eng. Bassam Abu Ghalyoon confirmed that the milk utilized by Palestinian dairy factories is 100% local milk from Palestinian farms, and that many dairy companies have their own farms that provide the necessary quantities of milk for their production.

According to the Palestinian Industrial Classification for Economical Activities (ISIC 4); dairy industry is classified as (1050). And it includes: liquid and powder milk, yogurt, labneh, cheese, butter, ice cream and others (PSCB, 2014). The aggregate value of production in dairy industry includes the value of the raw materials which may be produced locally or imported from abroad, therefore the real increase in the industrial activity is represented by the added value which is the net increase in production value (Al Raeye, 2004).

At the level of the sub food industry; dairy industry has shown a significant increase in the number and the percentage of the employees of the total sector in years 2007 and 2017; (970 employees, 11.08% in 2007) and (1968 employees, 11.19% in 2017) (MAS, 2019). And the value of dairy production has developed from 35444.2 thousand dollars in 2007 to 128070.4 thousand dollars in 2018 (PSCB, 2019). In spite of this clear growth in dairy sector; the exports level have decreased due to the validity sensitivity of dairy products which is only several days. Therefore the dependence on the local market is more (MAS, 2019).

Many challenges and difficulties facing dairy industry in Palestine. Most notably, the smuggling of many Israeli products to the local market, and the disregard for a number of other products that do not meet Palestinian specifications. This creates unfair competition between both parties (MAS, 2019). Another persistent obstacle identified by Al Raeye (2004), that was and still affecting dairy factories, is the lack of confidence in local products which affects the production capacity and the development of this field.

With regard to environmental pollution, there is a significant degradation and alerting pollution rates with an increase in water scarcity in Palestine. Therefore, besides emphasizing the importance of industries in developing our national income (PCBS, 2016), we should not abandon its huge role in the increase of the environmental pollution.

2.1.4. Common Dairy Processes

Typical milk processing chain includes:

- Receiving and weighting raw milk.
- Preliminary analytical testing for acidity, antibiotics, added water, fat and protein content.
- Cooling and storing in milk silos.
- Separation, clarification and centrifugation.
- Pasteurization.
- Standardization.
- Homogenization.
- Coagulation.

- Evaporation and drying.
- Ultra-high temperature treatment (UHT).
- Filling and packaging.

To comply with the discharge standards imposed by governments; many dairy industries have adopted an elaborate effluent treatment protocol. Furthermore, possibilities of reusing or recycling dairy wastewaters have been widely investigated by researchers and applied by many factories. This is due to the fact that dairy wastewater does not contain toxic chemicals like those listed under Environmental Protection Agency (EPA)'s Toxic Release Inventory, and because of the huge effluent's quantities discharged from dairy plants (Sarkar et al., 2006).

2.1.5. Inputs and Outputs of Dairy Manufacturing

Dairy manufacturing inputs are: water, raw milk and minor ingredients, energy, detergents and sanitizers, refrigerants and packaging materials. Outputs from dairy manufacturing include wastewater, dairy products, solid waste, air emissions, noise and odors (Durham and Hourigan, 2007).

According to (Tiwari et al., 2016), the maximum amount of water consumption in dairy factories account for cleaning in place (CIP) and floor wash (1200 m^3 of water per day in Amul dairy factory), after that comes boiler feed and cooling tower makeup, operational processes, crate wash and railway tanker wash. (Dairy Australia, 2006) have also shown that the highest amount of water is consumed in the CIP and pasteurization processes, by 28% and 28% respectively, while the least consuming processes are trade waste and manual washing by 4% and 6% respectively.

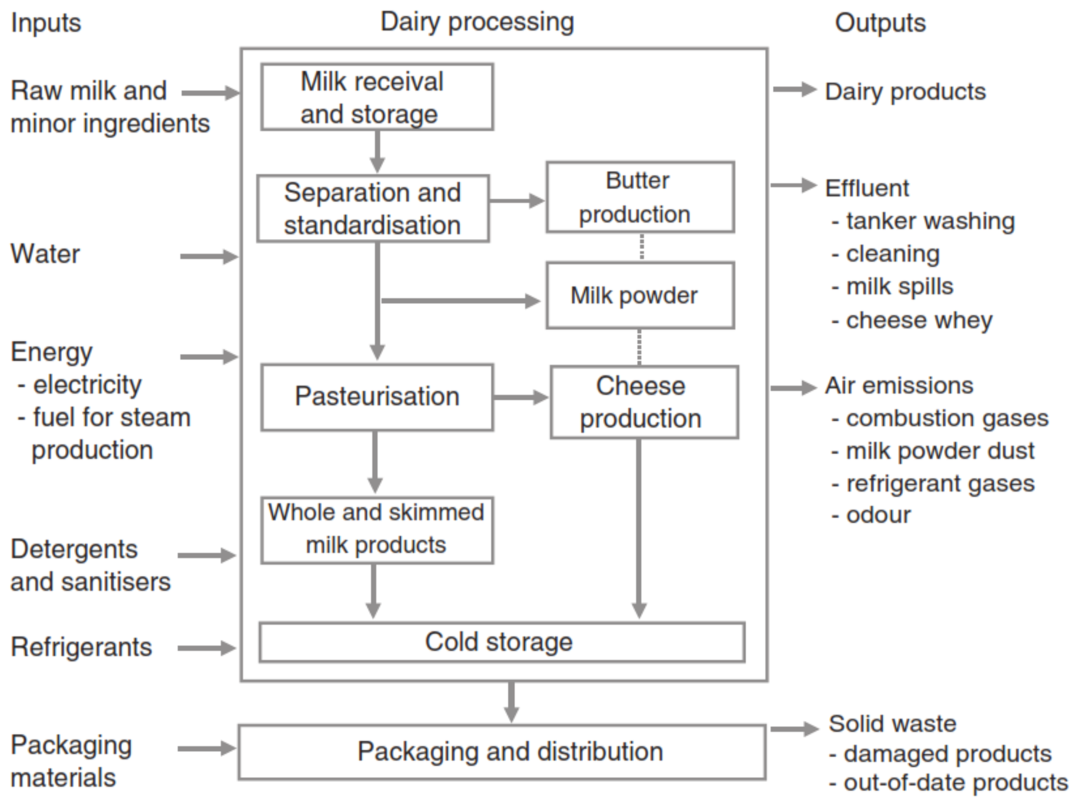

Figure 1: Inputs and outputs of dairy processing (Durham and Hourigan, 2007).

Wastewater from dairy processing factories is primarily generated from cleaning and washing operations (Kushawaha et al., 2011). It is the major type of output/pollution produced by dairy industry, since water is used in most of the dairy production process such as heating, sanitization, cooling and cleaning (Erkan et al., 2018; Sarkar et al., 2006; Chen and Liu, 2012).

The composition, concentration and volume of dairy plant's effluents depends on the type of products to be produced, the production program, operation methods and the design of the processing plant (Farizoglu and Uzuner, 2011).

It has been estimated that 1.44 liter of water per liter of processed milk is consumed for the production of drinking milk, and 1.6-2 liter of water per liter of processed milk is consumed for the production of cheese; 80%-90% of the used water ends up as wastewater (Kozłowski et al., 2019). In India, wastewater of dairy industry is 10L per 1L of milk processed, twice greater than in developed countries (Tiwari et al., 2016; Kolhe et al., 2002).

Table (1) includes a set of wastewater values produced in dairy factories in relation to the amount of processed milk in several literature references.

Table 1: Wastewater from dairy manufacturing.

Amount of wastewater per milk	**Reference**
1.1-6.8 L of wastewater per L of milk	(Briao and Granhen Tavares, 2007)
0.2-10 liters of wastewater per liter of processed milk	(Wang and Serventi, 2019; Gosta, 1995) (Vourch et al., 2008)
An average of 2.5 liters of wastewater per liter of processed milk	(Kushawaha et al. (2011); Ramasamy et al., 2004)
2.5-3 liters of wastewater per liter of processed milk	(Erkan et al. (2018); Singh et al., 2014)
2.71± 0.9 liters of wastewater per liter of raw milk processing	(Ashekuzzaman et al., 2019)
10 liters of wastewater per 1 liter of milk processed	(Tiwari et al., 2016; Kolhe et al., 2002)

2.1.6. Typical Characteristics of Dairy Pollution

Pollution from dairy industry may be in solid, liquid or gaseous form. Pollution in liquid form is expressed as wastewater. Typical wastewater effluent from a dairy factory is characterized by high organic matter “high biological-oxygen demand (BOD) and chemical oxygen demand (COD) concentrations”, nutrients, fats and residual cleaning agents (Erkan et al., 2018).

Dairy industry does not contain any hazardous wastes, but in term of the physico-chemical characteristics of the waste, it contains large amounts of organic matter that can lead to eutrophication and degrade water quality; for this reason, dairy industry is considered environmentally harmful and need to be controlled (Kozłowski et al., 2019).

Significant variations in wastewater's characteristics have been reported by researchers for the dairy industry. BOD, COD, Total Suspended Solids (TSS) and pH values in raw wastewater from a dairy factory in Istanbul were 4,900 mg/l, 7,136 mg/l, 1,820mg/l and 5.59 as reported by (Erkan et al., 2018). A cheese factory in Balikesir/Turkey supplied dairy wastewaters including 921 mg/l of total COD, 483 mg/l of BOD, 398 of SS and 5.63 of pH (Farizoglu and Uzuner, 2011). Fluctuations in COD and BOD concentrations originated from the ratio of cheese whey introduction. Raw dairy wastewater collected from the A.P Dairy in India had bad smell and was light greenish in color. BOD, COD, Total Dissolved Solids (TDS), TSS and pH values were 350–600 mg/l, 1,500–3,000 mg/l, 800–1,200 mg/l, 250–600 mg/l and 5.5–7.5 respectively (Sarkar et al., 2006).

The most significant pollution parameters (BOD, COD, PH, TSS, TDS, chloride, phosphorus, nitrogen, wastewater, oil and grease, air emissions, noise and temperature) were discussed in details by Shkoukani (2008). As by the research, typical pollutant load of Palestinian dairy industry BOD_5 is about 307 kg/day, COD is about 537 kg/day; phosphorus is almost 235.7 mg/l and 2,000 mg/l of suspended solids.

Dairy manufacturing produces another very polluting white liquid waste, it is called whey. It contains high concentrations of BOD and COD, 50 times higher than the typical urban waste, and fat sludge in small amounts (Kozłowski et al., 2019). Whey is a waste that is not allowed to be pumped to the environment. Results showed that the Palestinian dairy industries produce almost 38,000 ton of whey annually and that is 27% of the wastewater content in (Shkoukani, 2008).

Another kind of pollution, a solid-liquid fraction known as “dairy processing wastewater treatment sludge (DPWTS)”, is produced in large amounts when conventional biological and chemical process are used in the treatment of dairy wastewater. The main problem with this fraction is its disposal process that costs up to 50% of the operation cost (Chen et al., 2017; Fraga et al., 2017). A study done on nine dairy factories in Ireland have shown that DPWTS generation rates in 2017 were 25.5% more than those obtained in 2012; it has also presented the variations in the concentrations of “dry matter (DM), organic matter (OM), pH, nutrients and trace elements” of the sludge samples according to the treatment process obtained from (Ashekuzzaman, 2019).

Air pollution emitted from dairy plants is caused by means of energy. CO_2, CO, NO_x and SO_2 are some gasses that may be discharged from dairy factories (FAO, 1996).

Figure 2 shows the different characteristics of dairy wastewater by several references.

Table 2: Dairy wastewater characteristics (Younes, 2019).

Waste Type	COD	BOD	pH	TSS	TS	References
Milk and dairy products factory	10251.2	4840.6	8.34	5802.6		(Cristian, 2010)
Dairy effluent	1900-2700	1200-1800	7.2-8.8	500-740	900-1350	(Deshannavar et al., 2012)
Arab dairy factory	3383 ±1345	1941±864	7.9 ± 1.2	831±392		(Tawfik et al., 2008)
Dairy waste water	2,500- 3,000	1,300-1,600	7.2-7.5	72000-80000	8000-10000	(Qazi et al., 2011)
Dairy effluent	1120-3360	230-1750	5.6-8	28-1900		(Lata et al., 2002)
Whey	71526	20000	4.1	22050	56782	(Deshpande et al., 2012)
Bhandara co-operative dairy industry wastewater	1400 -2500	800- 1000	7.1-8.2	1045-1800	1100-1600	(Gotmare et al., 2011)
Cheese whey pressed	80,000-90,000	120000-135000	6	8000-11000		(Baroudi et al., 2012)
Aavin dairy industry wastewater	2500-3300		6.4 -7.1	630-730	1300-1400	(Sathyamoorthy and Saseetharan, 2012)
Dairy industry wastewater	2100	1040	7-8	1200	2500	(Arumugam and Sabarethinam, 2008)

2.1.7. Control of Dairy Pollution

A large body of literature contains studies, researches and experiences that include different pollution's control approaches. The primary of all is implementing a wastewater treatment plant. Predominantly, factories are obligated to use appropriate treatment methods that meet the effluent discharge standards (Kushawaha et al., 2011). A variety of methods were used to treat and pretreat dairy wastewaters. Biological processes, chemical processes and even a combination of them was mostly preferred.

Pollution prevention (P2) is another approach that has been implemented successfully in many industries and achieved economic, environmental and social benefits. However, the success is often a one-time experience with many difficulties in achieving the necessary organizational learning (Aikenhead et al., 2015; Pojasek and Metcalf, 2001). As a result, many researchers have made adjustments on the P2 method. (Aikenhead et al., 2015) applied “the process maps, semi structured interviews and casual loop diagrams” methodology to develop the P2 approach in small to medium industry (dairy industry). This method emphasizes the importance of enhancing the engagement of all the frontline employees in the enterprises in the determination of the areas of inefficient resource use (water, energy, etc.) and pollution prevention opportunities. The research shows the interdependence of the production processes, and their impact on resource efficiency and pollution prevention strategy. The study resulted in significant cost reduction (175,000 dollars per year) related to water savings and BOD surcharge fines.

Shkoukani (2008) discussed the importance of using the cleaner production method in dairy industry in Palestine as an effective waste management method. The study indicated the sources of environmental pollution in manufacture processes, presented some management methods and emphasized the importance of reduction at source based on the idea that generation pollutant can be reduced or eliminated by increasing efficiency in using raw materials, energy, water and other resources, then the waste load shall be reduced, that could be achieved through control the uses of resources such as raw materials and water (Shkoukani, 2008; Cagno, et.al, 2005; DELTA, 2004).

For energy saving and reducing electricity costs, a cost analysis study in Poland on the feasibility of installing a biogas plant in a dairy factory showed that; financially, the project cannot be viable without external support (i.e. governmental support); while economically (environmental and societal terms), it is significantly worthy (Kozłowski et al., 2019). Therefore, when financially supported, the study showed that implementing a biogas plant in a dairy factory producing (400Mg whey, 26Mg dairy sludge and 0.8 Mg fatty sludge per day)/ (1.72MW of electricity power of and 1.84MW heat) can be constructed. This can replace 45% of factory maximum power demand supplied by national grid (Kozłowski et al., 2019).

Thi et al. (2016) have presented the economic feasibility of two approaches of internalizing the pollution costs in the prices of products. The first is to introduce a corrective tax to adjust the marginal private costs of goods in such a way as to internalize externalities, and the second, to apply reduced Value Added Tax (VAT) rates on green goods based on their relatively low environmental externalities compared to alternatives

2.1.8. Treatment of Dairy Wastewater

Considering the complexity and the high strength of dairy wastewater, dairy manufactories should use effective treatment technologies before discharging effluents to the environment (Erkan et al., 2018). Studies showed that there is a noticeable difference in effluent analysis between dairy factories having a wastewater treatment plant and factories without. BOD and COD values were significantly greater for those without (BOD more than 2,000 mg/l and COD more than 8,000 mg/l) as indicated by Shakhatreh et al., (2015) in Jordan.

In developed countries; and like most of the food industries; dairy plants usually include a final treatment process for dairy effluents/wastewaters before being discharged. Wastewater treatment for water reuse can lower the total effluent volume of industrial plants (Vourch et al., 2008).

Various methods have been used in the treatment of dairy wastewaters. Biological treatment such as: “activated sludge process, aerated lagoons, trickling filters, sequencing batch reactor (SBR), anaerobic sludge blanket (UASB) reactor, and anaerobic filters” is often applied. But sometimes physico-chemical treatment methods such as “coagulation/flocculation by various inorganic and organic natural coagulants, and membrane processes like nanofiltration (NF) and/or reverse osmosis (RO)” can be used (Kushawaha et al., 2011; Demirel et al., 2005).

Farizoglu and Uzuner (2011) examined the performance of jet loop membrane bioreactor (JLMBR) in the treatment of dairy wastewater. High purification results were obtained in terms of COD; removal efficiency was up to “96-99%”. (Erkan et al., 2018) investigated using an aerobic submerged membrane bioreactor (sMBR) in treating a pre-treated dairy wastewater. Results emphasized its suitability in the removal of organic matter and nutrients; with COD, ammonia-nitrogen (NH3-N) and orthophosphate (PO4-P) removal efficiencies of approximately 98.2%, 95.4% and 88.9%, respectively. A thorough pretreatment studies using the coagulant treatment “with different coagulants” followed by activated charcoal treatment have shown a significant improvement in effluent’s quality with complete removal of odor and color (Sarkar et al., 2006).

2.2. Internalization of Environmental Pollution

2.2.1. General Background

Since the beginning of the twentieth century, pollution has been considered as one of the main market failure components. It has been recognized within the term "externality". An expression of market failure that arise when there is a difference between social costs and private costs leading to losses or gains in the welfare of a party resulting from the activity of another party (Eidelwein et al., 2018; Dahlman, 1979; Daly and Farley, 2010). This market failure occurs when the firm produces pollution that costs the producer nothing while costing the environment society a great deal (Ding et al., 2014). It is due to the fact that prices do not account for the actual environmental costs imposed on society. Thi et al., (2016) have also clarified that this failure occurs when a transaction imposes costs on a third party (not the buyer nor the seller) and who is not compensated.

In the past, most companies excluded externalities from their measurements; they had no, or little impact on their cash flows (KPMG, 2014). In regular market, prices of products typically include private cost only "cost of material, energy, labor, transport etc." and ignore social costs (Thi et al., 2016; Kostas, 2011). Although enterprises pay fees to local authorities for several services, the real cost for environmental impacts remain unaccounted for.

In 2010, Youli and Xiongyi have set an equation for the environmental costs. According to them, environmental costs include costs of resource consumption, costs for maintaining environmental quality and costs of environmental losses (Youli and Xiongyi, 2010).

The total environmental costs

$$EC_i = ER_i + EW_i + ED_i$$

In there EC_i - the total environmental costs in *i* year;
ER_i - the value of environmental resource consumption in *i* year;
EW_i - investments for maintain environmental quality in *i* year;
ED_i - environmental loss costs in *i* year.

Figure 2: Environmental costs equation (Youli and Xiongyi, 2010).

Economic Feasibility Analysis (EFA), and the recently much more used Cost-Benefit Analysis (CBA) to evaluate the economic feasibility of projects, both ignore the environmental pollution produced by the enterprises in their calculations (Youli and Xiongyi, 2010). Thus, a variety of techniques were developed to assess the environmental externalities, one of which is the life cycle assessment (LCA); a worldwide highly structured method that evaluates the environmental impacts generating through the whole life cycle of a product or activity (Thi et al., 2016).

“Internalization of pollution costs”, is a sound recent concept that creates harmony between the development of economy and environmental protection. The origin of the concept was developed by the British economist Arthur Cecil Pigou in his book The Economics of Welfare. Pigou believes that taxing polluters is the right solution to internalize the environmental pollution costs and equalize the gap between private and social costs. The concept has then fully expanded by several economists and researchers.

Internalization of environmental costs of projects is a major step to integrate environmental protection and economic profit and therefore maintain sustainable development of society, environment and economy (Youli and Xiongyi, 2010). Internalization of pollution costs means taking the external environmental pollution costs as part of the total cost of the product and making it as much important as the labor, capital and technology costs (Long et al., 2012). Some have discussed the challenge of internalizing the pollution costs in the price of the manufactured goods in a way that protect environment from further degradation (Thi et al., 2016; speck, 2007).

This concept becomes a preference by organizations when managers start to feel the risks of natural degradation on their businesses (Eidelwein et al., 2018). Corbett and Wassenhove (1993) pointed to conclusion that it's the firm's managers' responsibility to develop an approach that deals with the existing and arising environmental issues in a way that is efficient and consistent with its long term goals. Additionally; they clarified that operationalizing the environmental issues, alongside internalizing, allows for faster and more effective results.

2.2.2. Initiatives to Internalize Externalities

Several studies have directed the attention to discussing the concept of internalizing environmental externalities. One of the earliest studies was in 1978, by Hochman and Ofek, who have proposed an internalization method that can be achieved by either imposing pollution taxes or zoning. For them; municipal governments (without the intervention of federal government), have a strong incentive to internalize pollution externalities at the short and the long run (Hochman and Ofek, 1978).

According to Wesseh et al. (2016), full internalization of industrial pollution damages, calls for raising the tax rates in some sectors and lowering it in others. The study suggests a set of optimal emissions fees that is relevant to the country's level of income (low/medium/high).

Table 3: Initiatives to internalize environmental pollution.

Initiative	**Description**	**Source**
B Impact Assessment	Standards, benchmarks and tools enabling companies to assess, compare and develop improvements in social and environmental impacts over time	Bia (2015)
Environmental profit & Loss (EP&L) Statement	Pioneering development to assign monetary value to environmental impacts generated along the supply chain of a company	BSO/Origin (2015); Puma (2011); Høst-Madsen et al. (2014a)
Kpmg True Value	Method that allows companies to (i) evaluate their real earnings, including externalities,(ii) understand future gains at risk, and (iii) develop applications that generate business and social value	Kpmg (2014)
Natural Capital Protocol	Framework to measure natural capital in investor decision-making	Ncp (2015)
Redefining Value	Work program to support member companies of the World Business Council for Sustainable Development (WBCSD) to standardize tools to measure and manage their social and environmental impacts	Wbcsd (2015)
Shared Value	Focused management strategy to create value through identification and mitigation of social problems	Sv (2015)
Social Return on Investment (SROI)	Framework based on accounting principles to support the understanding and management of social, economic and environmental results of companies	Sv (2015)
Total Impact Measurement & Management (TIMM)	New language to support companies in understanding the full impact of their activities	Pwc (2015)
True Price	Social company that helps organizations (multinationals, small and medium-sized companies, NGOs and governments) to quantify and measure their economic, environmental and social impacts, particularly focusing on product level	True Price (2015)

Various recent advancements in the evaluation of environmental pollution have been made. In 2011, PUMA, "one of the most famous and desirable sport lifestyle companies", has made a successful attempt in internalizing its environmental impacts. It has used environmental profit and loss method (E P&L) to measure and monetize environmental impacts through its operation and supply chain. Then embed these values in their decision making process (PUMA, 2011).

2.2.3. Quantifying and Evaluating Environmental Pollution

Until recent, externalities have not been in consideration because they have had no influence on the main corporate values: costs, revenues and risk. But because of the damaged ecosystem and the frightening pollution rates and the increasing public awareness, it became impossible to ignore what is happening. And the cost of environmental damage must be calculated and estimated.

To sense the importance of the ecosystem and its close relationship with economic activity; monetary values must be established for the different environmental externalities. The values might not be a 100% accurate, but good enough to be dealt with a language familiar to managers (Bartelmus, 2010; Elkington and Zeitz, 2014; Larkin, 2013; Puma, 2011).

Several studies identified monetary values to quantify and evaluate environmental externalities and their effect on social welfare imposed by different companies' activities (Eidelwein et al., 2018, Høst-Madsen et al., 2014b; Puma, 2011). KMPG's 2012 report "expect the unexpected" revealed that the environmental damage produced by 11 industries equal 41% of their pre-tax profits (Figure 3).

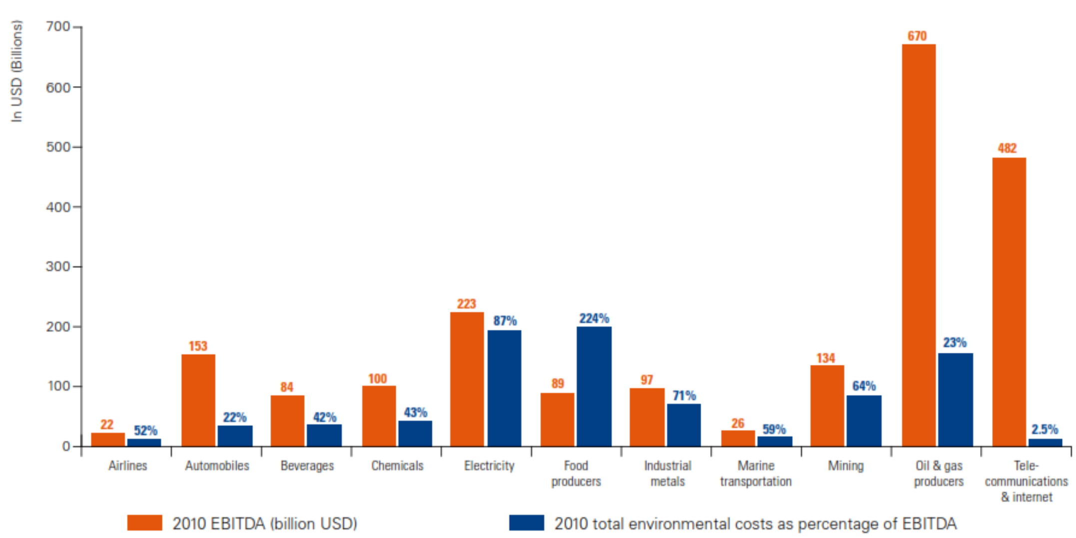

Figure 3: Environmental damage produced by 11 industries (KMPG, 2012).

Chapter Three: Approach and Methodology

In order to achieve the research objectives; the methodology is explained in Figure (4).

Figure 4: Research methodology.

3.1. Collecting Data about Palestinian Dairy Factories

A preliminary study for dairy factories in the West Bank was conducted first. The study aims to carry a comprehensive assessment of the economic and environmental status of Palestinian dairy factories. At this stage, and due to the limited availability of data and information at the governmental institutions and their official sites; Palestinian Central Bureau of Statistics (PCBS) was selected as the main source of information.

The visit to the institution, (PCBS), included an interview with Dr. Saleh Al-Kafri, the General Director of Economic Statistics Directorate in addition to a tour to the

Economic Studies Department, the Prices Department, and the Environmental Economic Department. Valuable information, and a file with the available unpublished raw data was obtained through the visit.

The year 2017 was chosen for analysis because it includes the products' economic values, and it is the latest year of the environmental economic surveying of industrial facilities in the institution. The SPSS (Statistical Package for the Social Sciences) file was filtered to get the needed data. Then a number of calculations was conducted for generation of data needed for the final evaluation.

Unfortunately, in the survey, the Environmental Economic Department kept the information about the type of economic enterprise, and therefore it was not able to determine the dairy industry enterprises. In addition, the environmental form did not contain information about quantities of wastewater or gases produced by industries, and focused on the issue of solid waste specifically.

In 2017, the PCBS economic statistics survey series for the main economic activity, "manufacture of dairy products (ISIC 1050)", included 49 dairy enterprises as a statistical unit, out of 91 enterprises. Each enterprise has a weight depending on the selection probability (systematic random sampling). Thus, for each dairy enterprise surveyed, and from the economic surveys series, the following was calculated:

- The number of employees in dairy enterprises and the total of their wages and compensations.

- The value of production inputs from raw materials, fuel and other materials.
- The amount of taxes paid.
- The value of goods produced during year 2017.

These data are necessary for calculation of the total production costs in an attempt to estimate the financial and economic costs including the costs of pollution.

The original plan was to estimate the pollution costs caused by each of the dairy products. Unfortunately, the collected data are not sufficient to do so. Therefore, the entire production from the studies Palestinian dairy industry was calculated, followed by the pollutions costs associated with this industries. Accordingly, the pollution cost was calculated as a percentage of the private costs. This approached proved to be convenient and sufficient to generalize over the different dairy industries in Palestine.

3.2. Questionnaire Surveys Targeting Dairy Industries, Policy Makers, and Experts

In order to understand the perceptions of industry owners, policy makers and experts, two forms of questionnaire were designed and developed, as follows:

- A questionnaire was directed to the major dairy factories in the West Bank. The questionnaire aimed to know the extent of environmental monitoring in dairy factories. The extent of interest in finding solutions to the environmental pollution produced by them. Their acceptance of the idea of increasing the prices of products to internalize environmental pollution. And finally, what are the solutions and incentives from their point of view.

- The second was directed to the policy makers and experts. The questionnaire aimed to know the effectiveness of environmental laws and control over dairy factories. The effectiveness of implementing the internalization concept and its obstacles. The role of government in the success of this concept. And finally, future plans from their environmental point of view.

For the first questionnaire, the sample included the main 12 factories in Palestine, in terms of production quantities. The form was answered by the responsible person in the factory, and the most of them were quality and development engineers. As for the second questionnaire, the sample was 45, with a percentage of 75.9% holding a master's degree, and 16.2% holding a PhD degree, from various institutions including: The Environmental Quality Authority, the Palestinian Water Authority, the Palestinian Standards Institution, the Ministry of Health Organization, Ministry of Economy, Universities and others.

The first questionnaire was filled out either directly over the phone, or via email; according to the preference of the responsible person at the factory. The second questionnaire was either sent by email to the policy makers directly, or posted on environmental and economic pages. After that a preferred analysis of the results was done.

3.3. A Palestinian Dairy Industry as a Case Study

Data collection was the most difficult part of this research. All the targeted Palestinian dairy industries were very conservative and reluctant to provide the required data, especially the amounts of production and costs for each of the dairy products. Nevertheless, we succeeded in getting sufficient data to achieve the research objectives.

- First: The difficulty of transportation and movement, due to the global circumstance, “the spread of Corona epidemic”, the recurrence of home quarantine, and the tightening of health restrictions.

- Second: The difficulty of obtaining a lot of information due to the fact that factories have reservations about many information related to production quantities, in addition to the unavailability to many other information because they are not measured by the factories or other responsible institutions.

Two case studies were identified for the research, one high and one medium factories in terms of production quantities. In the beginning, contact was made with the responsible persons in the factories by phone. A brief overview of the research topic was given, and a visit to the factory was requested to complete the research requirements. Here, the factories' reactions were completely unexpected. It was clear that there was a great apprehension because the thesis discusses an environmental economic issues.

The visit date was evaded for long periods. And after several attempts, a visit to one of the factories was done, but unfortunately, the basic information necessary to complete the research was reserved by the factory. And therefore, the first case study was cancelled because of the unavailability of the information.

The second factory site visit took even a longer time. At the end an interview with the Research and Development Manager Engineer was done. A lot of information and a detailed explanation of the environmental and economic issues related to the dairy plant were obtained during the interview.

Calculation method for dairy wastewater:

- Amount of product produced per year in ton x 1000 = Amount of product produced per year in kg

- Amount of product produced per year in kg x Amount of wastewater produced per kg of product = Amount of wastewater produced per year from the production

- For "cheese and labaneh"; the amount of wastewater is multiplied by 30% only; because 70% of the wastewater is recycled

Calculation method for CO_2 produced:

- The production of 1 kg of: milk, yogurt, butter milk and flavored milk requires 1 kg of raw milk

- The production of 1 kg of cheese requires 4 kg of milk

- The production of 1 kg of labaneh requires 2.5 kg of milk

Amount of CO_2 produced from the production of each product = Amount of required milk x 15%

- Referring to a project done by the manufacture as a part of SwitchMed programme, the estimated cost for reducing 962 ton of CO_2 is 335,500 Euro

- The investment cost for 1 ton of CO_2 = 335,500/ 962 = 348.75 Euro

- The investment cost for reducing CO_2 for the case study = Amount of CO_2 produced by product x investment cost for 1 ton of CO_2

- Thus, 9,042 ton of CO_2 requires an investment of 3,153,316 Euro = 12,359,197 ILS

Chapter Four: Results and Discussion

4.1.Characteristics of the Palestinian Dairy Factories

Through analyzing the data about Palestinian dairy factories from the PCBS in 2017, it can be concluded that Palestinian market for dairy products is divided into three types of manufacturers: High category factories, which are few in number, but high in terms of the number of workers and production quantities. Medium category factories, whose number is more than the previous category, but medium in terms of the number of workers and production quantities. Low category, which includes home dairy industry, their number is very large, but their production quantities constitute a very small percentage compared to the other categories.

The production costs of the plant without profit are the sum of employees' wages and compensations, the production inputs "raw material, water, electricity, fuel", other expenditures, taxes and the annual fees. Tables including the value of each cost was created for all enterprises in the survey.

The total wages and compensations of the factories were 34,498,189 ILSs with 7 factories owing 86% of the share. The goods production inputs value including raw material, water, electricity, fuels was 162,474,748 ILS.

Table 4: Value of production inputs (by the auther).

Production input	Raw material	Water	Electricity	Fuel	Total
Value (ILS)	134,169,428	1,723,088	11,113,947	15,468,285	162,474,748

The factories incur many other expenses that must be taken into consideration, which are: maintenance and repair of machines and equipment, maintenance and repair of buildings and construction, advertising, computer consulting services and some might include renting of buildings and others. The sum of these expenditures in the survey was 22,471,901 ILS. The value of taxes, fees and subsidies on production was 11,239,511 ILS.

Another table was created including the enterprises in the survey, their production values of all goods multiplied by its weight to get the total production value of dairy products in the Palestinian market that is 449,785,854 ILS.

This stage of the study clarified the most important economic influencers on the price of commodities without profit. And they are from high to low influencer: the raw material, employees' wages and compensations, fuels, electricity, water, taxes and other fees.

4.2. Perceptions of Dairy Manufacturers and Policy Makers/experts

4.2.1 Perceptions of dairy owners

Analysis of the results for the questionnaire directed to the industry professionals revealed the following:

- Most of the answers revealed the weakness or lack of the environmental monitoring for dairy factories by the responsible governmental institutions. Moreover, the factories confirmed that no samples have ever been taken for examination by the government, and any testing is done independently by the manufacture itself.

- Most of the factories expressed interest in environmental pollution and a desire to find solutions to it. Several factories disclosed that they have conducted studies and cooperation with international institutions to reduce pollution produced by them.

- Factories agreed 100% not to accept the idea of treating or investing in pollution solutions at the expense of increasing the price of the product. And any increase in the price, calls for a detailed and accurate study to accept it. Some expressed that the treatment could be done with other solutions, rather than increasing the products' prices.

- Results indicated that competitiveness is locally between Palestinian factories themselves. But in the case of a price increase there will be concerns about Israeli products.

- The factories emphasized that this concept could not take place without governmental support, either in terms of treatment costs, tax relief, annual contributions or other incentives.

4.2.2 Perceptions of policy makers and experts

Research sample consisted of two categories, experts and policy makers. The sample size was 45, from PWA, Ministry of Health, EQA, Palestinian Standard Institution (PSI), Union of Palestinian Water Services Providers, Municipalities, Universities, and different water contracting companies. Analysis of the results for the questionnaire directed to the policy makers/experts revealed the following:

- About 71% of the respondents believe that there is an environmental control over dairy industry.

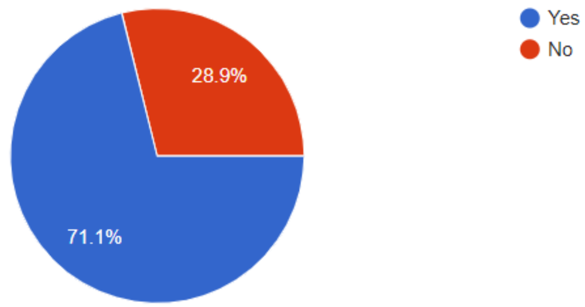

Figure 5: Percentage of those who believe that there is environmental control over dairy industry.

- About 53% believe that samples of wastewater and industry pollutants are examined and tested. Also, about 47% believe that penalties and fines are in effect for environmental violators.

- About 78% are aware of the importance of internalizing the environmental pollution and have been exposed to the term incorporation of pollution costs to the product costs.

- Results regarding the possibility of implementing the concept of internalizing the environmental pollution, varied between 53.3% who are not sure, 37.8% believe it is possible, and 8.9% think it is impossible to be implemented.

- The results showed that there is hesitation about the possibility of applying the concept by all parties in general.

- The lack of environmental awareness and support occupied the first place in the obstacles to implementing this concept, the absence of governmental support in the second place, and the fear of losing competitiveness with the industry owner opposition took the last place.

- The proportions for the role of the government in implementing this concept were fairly close between controlling smuggled and illegal goods, educating and training stakeholders, establishing restrictions against imported goods, and supporting and motivating stakeholders financially.

- Financial contribution to setting up environmental pollution treatment units, and reducing taxes, were dominating in the incentives that governments can provide to the owners of industries in order to encourage internalizing environmental pollution.

- Most of the results assured that the government has to compensate the stakeholders affected by pollution.

- And the most also thinks the role of the government is very important in the success of this concept.

- As for the future trends of the governmental institutions in the environmental aspects; the policy makers emphasized that there are new strategies and strict policies for implementing environmental laws. And the application of deterrent penalties for environmental violators. In addition to developing plans to increase environmental awareness at the level of industries and individuals.

- For the experts, it is clear that there is optimism towards the government in terms of the monitoring process, enacting laws and implementing the imposed sanctions. However, they stressed the importance of the awareness- raising for industries in order to implement laws without harming national industries or causing harm to citizens’ health.

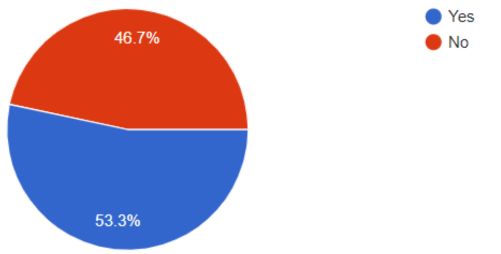

Figure 6: Percentage of who believe that wastewater samples are tested

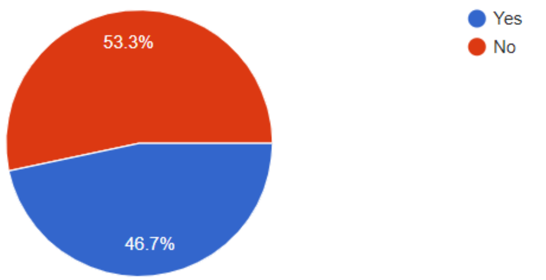

Figure 7: Percentage of who believe that penalties and fines are in effect for environmental violators

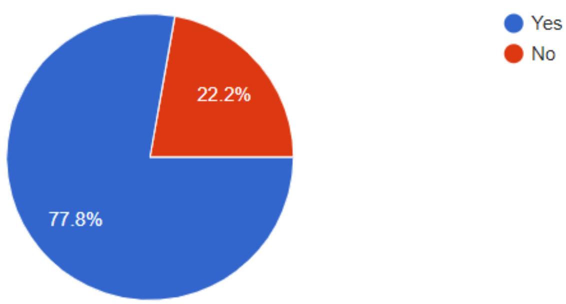

Figure 8: Percentage of who have been exposed to the term incorporation of pollution costs to the products cost.

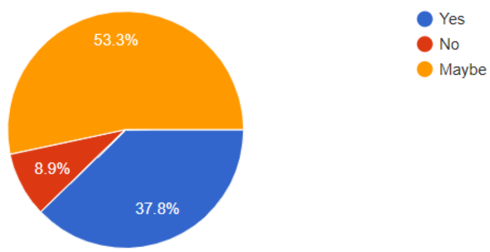

Figure 9: Opinions about the possibility of implementing the concept of internalizing environmental pollution.

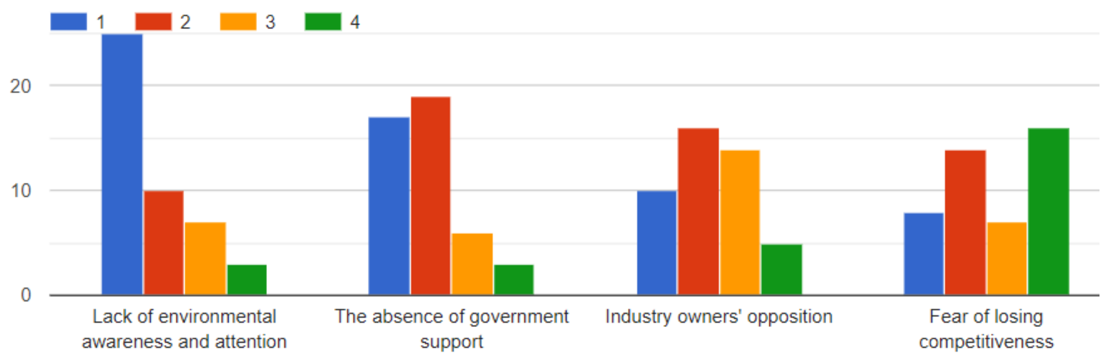

Figure 10: Obstacles to implementing the internalization concept.

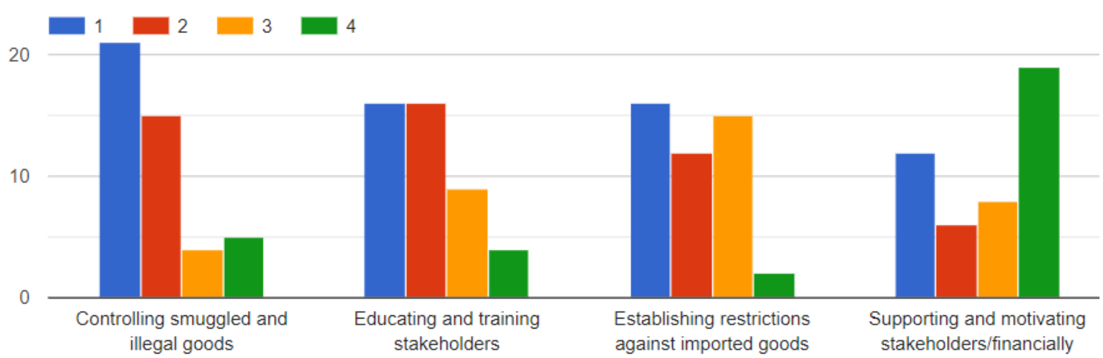

Figure 11: The role of the government in implementing the concept.

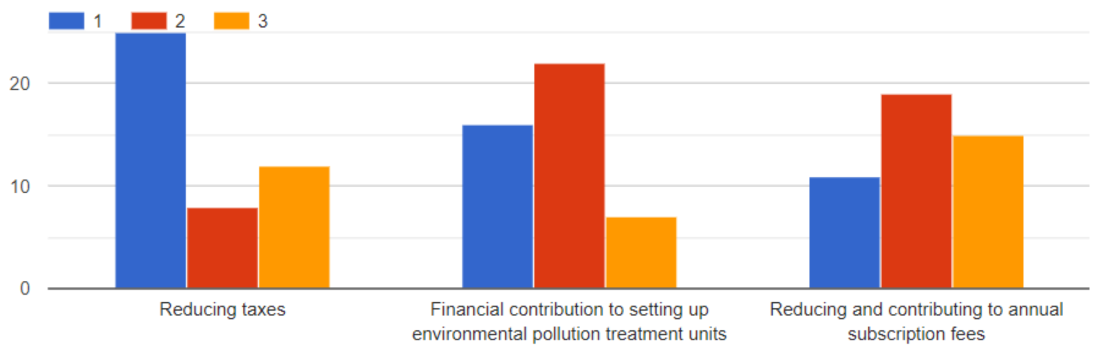

Figure 12: Incentives to internalize the environmental pollution.

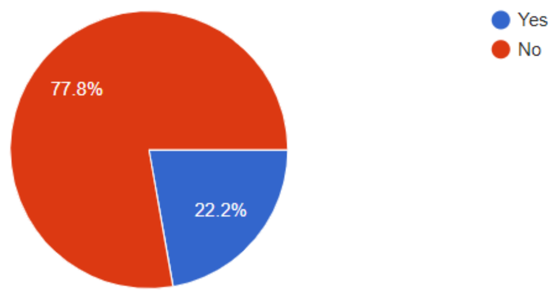

Figure 13: Percentage of who believe that the government should compensate the stakeholders affected by pollution.

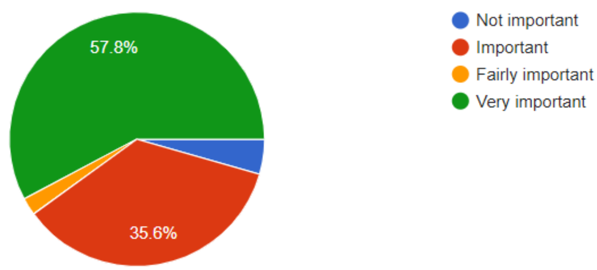

Figure 14: Importance of the government role in the success of the concept.

4.3. A Case Study

After the site visit and according to the meeting with "the research and development manager" of the factory; the following was obtained:

It is one of the largest factories in terms of production quantities in Palestine. The number of workers in the factory is approximately 450 employees. The milk sources of the factory are private farms belonging to the Company. The water resources of the factory are municipal water in addition to water tanks from a spring belonging to Company as well. The factory's main products are: milk, yogurt, butter milk, labaneh, flavored milk, cheese, pudding, salads, drinks and sour cream. The research will refer to dairy products only, without salads and the other drinks. The annual production quantities of each product are shown in Table 5.

Table 5: Annual production quantities in the factory (Factory, 2018).

Product	**Amount (ton)/year**
Milk	7,488
Yogurt	5,990
Butter milk	3,744
Labaneh	3,744
Flavored milk	3,744
Cheese	7,488
Pudding	3,744
Salads	4,992
Drinks	1,560
Sour cream	1,498
Reworked products	187
Total	***44,179***

Milk quantities required to produce the main products:

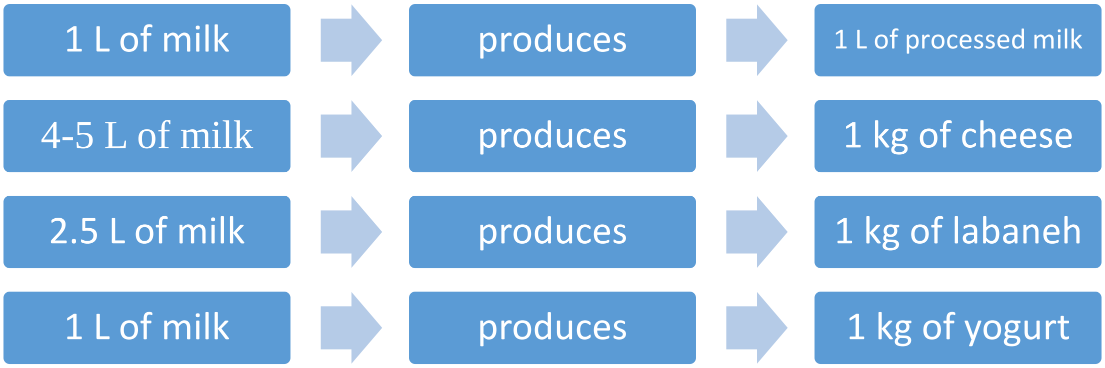

Figure 15: Milk quantities required for production

Wastewater produced by the factory

Calculating the amount of wastewater produced by the factory was rather complicated, because there is no previous data recorded by the factory, or the competent authority. Thus, the calculation process was partly based on the literature review, and a part is calculated based on the information provided by the manufacturer. Results of the last wastewater sample test are shown in Table 6.

Table 6: Wastewater sample results.

Measure	H_2S ppm	CO ppm	NH_3 ppm	NO_2 ppm	SO_2 ppm	VOC ppm	*BOD5: mg/l.*	*TDS: ppm.*
Min.	0	65	0	0	0.1	0	*91.755*	*3,310*
Max.	1.3	251	0	0	0.5	0		
Avg.	0.2	149	0	0	0.2	0		

Major products producing wastewater are cheese, labaneh, yogurt, milk, flavored milk and buttermilk. And according to the Engineer; the production of 1 kg of cheese produces 4 liter of wastewater; 99.99% of it is whey, and 0.001 is solid waste "small crumbs leftovers from the cheese". 70% of the 99.99% is recycled by re-manufacturing or is used for the company farms. While the other 30% goes to the sewer network.

- From Table (5), the factory produces 7,488 ton of cheese per year, so the amount of whey produced by the factory per year is:

  7,488 ton x 1,000 = 7,488,000 kg of cheese per year

  7,488,000 kg of cheese x 4 = 29,952,000 liter of wastewater per year

  29,952,000 liter of wastewater x 99.99% = 29,949,005 L of whey produced per year

  29,949,005 L x 70% = 20,964,303 L of whey recycled per year

  29,949,005 L/whey produced – 20,964,303 recycled = 8,984,701 L of whey to sewer network

  So, the amount of whey that goes to the sewer network per year is 8,985 m^3/year

- The amount of wastewater and whey produced from the production of labaneh is:

  3,744 ton x 1000 = 3,744,000 kg of cheese per year

  3,744,000 ton of cheese x 4 = 14,976,000 liter of wastewater per year

  14,976,000 liter of wastewater x 99.99% = 14,974,502 L of whey produced per year

14,974,502 L x 70% = 10,482,152 L of whey recycled per year

14,974,502 L/whey produced – 10,482,152 recycled = 4,492 L of whey to sewer network

So, the amount of whey that goes to the sewer network per year is 4,492 m^3/year

- The amount of wastewater produced by milk, yogurt, butter milk and flavored milk is estimated from literature.

  According to the literature, 1 liter of milk processed produces 7 liter of wastewater.

  The amount of wastewater produced by milk, yogurt, butter milk and flavored milk per year equals 20,966 ton.

  20,966 x 1,000 = 20,966,000 liter of milk

  20,966,000 x 7 = 146,762,000 liter of wastewater per year

  So, the amount of wastewater is 146,762 **m^3/year.**

- Reported data suggests 50 liter of wastewater per day for each person.

  So, the amount of wastewater produced is 50 x 450 workers x 363 = 8,213 m^3/year.

Table 7: Wastewater produced from products

Product	Amount of wastewater produced per year (m^3)
Cheese	8,985
Labaneh	4,492
Milk, yogurt, flavored milk and butter milk	146,762
Domestic	8,213
Total	***168,452***

To calculate the cost of treating one cubic meter of wastewater generated from the factory, previous local and non- local studies were referred to. KPMG estimated the cost of treating one cubic meter of wastewater by 1.21 US dollars (KPMG, 2017). And according to a study in Palestine, the cost of treating one cubic meter of wastewater is estimated by 6 NIS/m^3 if full recovery fulfilled (pS-Eau, 2005).

Thus; treating **168,452** m^3 of wastewater costs **168,452 x 6 = 1,010,712 ILS**

<u>CO_2 produced by the factory</u>

There is no recent information about the quantities of air pollution resulting from the factory. As reported, the production of one liter of milk generates 1 kg of carbon dioxide. 85% of it from the farm, and 15% from dairy processing and transportation.

As for the case study:

7,488 ton of milk produces 1,123.2 ton of CO_2

5,990 ton of yogurt produces 898.5 ton of CO_2

3,744 ton of butter milk produces 561.6 ton of CO_2

3,744 ton of labaneh produces 1,404 ton of CO_2

3,744 ton of flavored milk produces 561.6 ton of CO_2

7,488 ton of cheese produces 4,492.8 ton of CO_2

Total CO_2 produced by the mentioned products is 9,041.7 ton of CO_2.

Solid waste produced by the factory

It is the least pollutant in terms of quantities, generated from the factory.

The factory compresses the solid waste coming out using special equipment, and takes most of it for use in farms. The remaining is almost 1-2 tons per month and is sent to the landfill (Alminya). According to the factory, the estimated cost is 500 ILS per month, and 6,000 ILS per year. It is worth mentioning that the costs of solid waste management are already internalized and thus included in the overall financial plans of the industries>

- **The total pollution cost is as follows:**

In general, the total pollution cost includes air, water and solid pollution costs. In our case study; the solid waste cost is paid by the factory, and therefore it is excluded from calculation. Thus;

The pollution cost = Water pollution + air pollution = 1,010,712 + 12,359,197 = 13,369,909 ILS

In order to know how pollution cost reflect on the market prices of products; the value of production in the factory is calculated first. Referring to the PCBS data. An interpolation was made between enterprise No.11 and No.30 for each table of value and the result are:

The value of wages and compensation equals 11,692,614 ILS

The value of raw material, electricity, water and fuel equals 65,845,586 ILS

The other expenditures equal 1,217,706 ILS

Taxes and fees equal 7,209,467 ILS

The production value equals 157,641,908 ILS

Table 8: Interpolation between enterprise 11 and enterprise 30

Enterprise	Economic activity	No. of Employees	Wages	Wages+ Compensations
1	1050	3	60,000	60,000
2	1050	4	48,000	51,600
3	1050	9	144,000	169,000
4	1050	1	0	0
5	1050	2	8,000	8,100
6	1050	1	0	0
7	1050	2	0	0
8	1050	4	24,000	24,000
9	1050	4	64,800	64,800
10	1050	68	2,016,000	2,016,000
11	1050	214	4,500,000	4,577,000
12	1050	5	48,000	48,000
13	1050	6	37,500	37,500
14	1050	2	0	0
15	1050	3	9,000	9,000

16	1050	4	0	0
17	1050	3	0	0
18	1050	2	0	0
19	1050	5	142,400	142,400
20	1050	60	1,800,000	1,876,000
21	1050	93	2,790,000	3,134,100
22	1050	11	180,000	180,000
23	1050	69	2,438,000	2,452,800
24	1050	7	126,000	126,000
25	1050	0	0	0
26	1050	2	0	0
27	1050	3	0	0
28	1050	2	0	0
29	1050	15	306,000	306,000
30	1050	520	13,803,178	13,803,178
31	1050	39	364,915	364,915
32	1050	6	129,600	129,600
33	1050	9	108,000	118,000
34	1050	3	19,200	19,560
35	1050	35	420,000	428,400
36	1050	30	360,000	369,000
37	1050	7	72,000	72,000
38	1050	28	460,800	513,216
39	1050	0	0	0
40	1050	40	480,000	488,000
41	1050	25	300,000	305,000
42	1050	33	384,000	441,600
43	1050	2	3,600	3,600
44	1050	8	60,000	65,000
45	1050	5	19,000	21,000
46	1050	130	1,825,200	1,868,100
47	1050	15	180,000	187,000
48	1050	4	18,720	18,720
49	1050	1	0	0

➢ **Now by adding the pollution cost, the production value is:**

157,641,908 + 13,369,909 = 171,011,817 ILS.

So internalizing the pollution costs generated by the dairy factory will increase the production value by (12,359,197/157,641,908) *100 = **8.48%**

➢ **Calculating pollution cost from production value separately:**

Internalizing water pollution= 1,010,712 / 157,641,908 = 0.64%

Internalizing air pollution= 12,359,197 / 157,641,908 = 7.84%

Internalizing solid waste pollution= 6,000/ 157,641,908 = 0.0003%

The results reveal that the total pollution costs of the dairy industry will increase the private productions costs by 8.48%. Water and solid waste pollution seem to be very minimal compared with the air pollution, as they mount 0.64%, 0.0003%, and 7.84%, respectively. The low water and solid waste pollution is attributed to recycling that takes place at the dairy industries, leaving the air pollution as the major concern.

However, the results reveal that all dairy industries oppose the idea of internalizing these costs to become part of the production costs and they oppose the idea of increasing the market prices of the products. The main reason for these negative attitudes is the fear from losing their market under conditions of high competition. In addition to the dairy product that are imported from other countries, the Israeli products invade the Palestinian market. This leads to the conclusion that any initiatives that aim to internalize pollution costs will not succeed under the prevailing market conditions and without sincere interference from the concerned institutions and sufficient level of control and monitoring.

Chapter Five: Conclusions and Recommendations

5.1. Conclusions

- The Palestinian market for dairy products is divided into three types of manufacturers in terms of the number of workers and production quantities: High, Medium and Low. The low category includes home dairy industry, their number is very large, but their production quantities constitute a very small percentage compared to the other categories.

- The dairy industry plays an important role in the Palestinian economy in terms of labor force and production value.

- There is weakness or lack of the environmental monitoring for dairy factories by the responsible governmental institutions.

- Dairy owners do not accept the idea of treating or investing in pollution solutions at the expense of increasing the price of the product. And any increase in the price, calls for a detailed and accurate study to accept it. Some expressed that the treatment could be done with other solutions, rather than increasing the products' prices.

- Competitiveness is between Palestinian dairy factories exists, but there is a great concern for the Israeli products that enter the Palestinian market.

- The dairy owners emphasized that concept of internalizing pollution costs will not succeed without governmental support, either in terms of treatment costs, tax exemptions, annual contributions or other incentives.

- Most policy makers and experts are aware of the importance of internalizing the environmental pollution and have been exposed to the term incorporation of pollution costs to the product costs.

- There is hesitation about the possibility of applying the concept by all stakeholders in general.

- The role of governments in implementing this concept was fairly close between controlling smuggled and illegal goods, educating and training stakeholders, establishing restrictions against imported goods, and supporting and motivating stakeholders financially.

- Financial contribution to setting up environmental pollution treatment units, and reducing taxes, were dominating in the incentives that governments can provide to the owners of industries in order to encourage internalizing environmental pollution.

- The largest cost of environmental pollution is the cost of air pollution which represents 7.84% of the total production costs. The reason for this, is the high cost of investment in units to treat, mitigate or reduce air pollutants. In addition to the association of air pollution with energy, transportation and others.

- The cost of water pollution is considered average in relation to the production quantities in the factory, pollution which represents 0.64% of the total production costs. It is possible to invest in treatment unit and recover the investment cost after a certain period and after conducting a detailed economic study.

- As for the solid waste pollution, it is not of a big concern to the dairy factories, due to its low quantities, the possibility of recycling it, in addition to the low cost of its disposal and treatment in comparison to other pollution types. Solid waste pollution costs represents 0.0003% of the total production costs.

5.2.Recommendations

- Many interesting research opportunities remain in this field. More work is needed to study the possibility of internalizing pollution costs by investing in internal treatment units.

- An important issue is related to the impact and role of regulations and policy incentive in the factories' environmental performance. The government should establish a more stringent environmental regulatory and management system. Beside educating and training stakeholders in environmental issues, as well as their engagement and participation in making decisions.

- The problem of deficiencies in environmental data must be addressed, solving this problem facilitates the process of making appropriate environmental decisions.

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Annexes:

- PCBS analyzed raw data

Enterprise	Taxes and Subsidies(ILS)	Enterprise	Taxes and Subsidies(ILS)
1	17000	26	0
2	960	27	365
3	150	28	2500
4	0	29	17600
5	0	30	9059776
6	0	31	65727
7	750	32	1000
8	3750	33	25100
9	3300	34	1000
10	85900	35	10000
11	1005000	36	13000
12	0	37	0
13	200	38	20400
14	0	39	0
15	0	40	3500
16	700	41	16000
17	1690	42	6100
18	2250	43	300
19	13868	44	700
20	603000	45	500
21	136000	46	36520
22	21600	47	11350
23	44585	48	370
24	7000	49	0
25	0		

Enterprise	Value of Raw Material(ILS)	Value of Electricity(ILS)	Value of Water(ILS)	Value of Fuels(ILS)	Total(ILS)
1	633760	42000	24000	0	699760
2	360000	18000	6000	27600	411600
3	1870000	14400	2400	62400	1949200
4	81000	1200	500	500	83200
5	1400	1200	600	0	3200

6	10800	2400	300	2880	16380
7	35200	12000	2400	10800	60400
8	0	1080	1200	10560	12840
9	642300	30000	3000	24000	699300
10	6978000	270000	225000	552000	8025000
11	15485600	2700000	250000	910000	19345600
12	236400	3600	960	27120	268080
13	312000	3000	800	3000	318800
14	24480	2400	1200	6200	34280
15	117000	7200	240	19000	143440
16	176700	4000	600	10100	191400
17	12150	3600	1200	0	16950
18	14450	3600	1200	25752	45002
19	868476	80000	5600	44600	998676
20	6930000	420000	72000	1116000	8538000
21	2520000	1080000	240000	1800000	5640000
22	778000	36000	6000	105000	925000
23	4369103	434990	93115	400322	5297530
24	300000	18000	1800	12000	331800
25	0	0	0	0	0
26	72000	2400	4500	0	78900
27	99000	8040	5160	26200	138400
28	75000	2400	1200	10200	88800
29	611800	120000	84240	235200	1051240
30	69985509	3628810	488553	5535083	79637955
31	1818300	524507	6550	26808	2376165
32	72000	4800	5000	7000	88800
33	500000	24000	6600	244600	775200
34	263000	12000	3600	30600	309200
35	1416200	72000	90000	252000	1830200
36	3012000	480000	6000	1807000	5305000
37	331600	19200	0	74580	425380
38	1152000	108000	54000	460200	1774200
39	0	0	0	0	0
40	709500	84000	9600	276000	1079100
41	610000	80000	1000	265000	956000
42	4150000	120000	0	282000	4552000
43	12300	1800	1200	120	15420
44	375500	1800	350	27100	404750
45	179300	12000	360	26500	218160
46	4918000	560000	8400	309500	5795900
47	960000	54000	6000	391600	1411600
48	68000	4800	360	11160	84320
49	21600	720	300	0	22620

Enterprise	other production expenditures(ILS)	Enterprise	other production expenditures(ILS)
1	99200	26	3700
2	8160	27	18520
3	8000	28	16216
4	500	29	139300
5	2300	30	17714701
6	270	31	114977
7	8500	32	20800
8	2850	33	168600
9	5600	34	7400
10	236000	35	242200
11	1217400	36	117600
12	8956	37	27700
13	1700	38	152690
14	1680	39	0
15	2700	40	309660
16	750	41	145900
17	15440	42	88300
18	3800	43	7800
19	47550	44	47650
20	172400	45	10800
21	598300	46	178200
22	113000	47	32880
23	312601	48	13150
24	23700	49	1800
25	0		

Enterprise	Economic activity	No. of Employees	Wages(ILS)	Wages+ Compensations(ILS)
1	1050	3	60000	60000
2	1050	4	48000	51600
3	1050	9	144000	169000
4	1050	1	0	0
5	1050	2	8000	8100
6	1050	1	0	0
7	1050	2	0	0
8	1050	4	24000	24000
9	1050	4	64800	64800
10	1050	68	2016000	2016000
11	1050	214	4500000	4577000
12	1050	5	48000	48000
13	1050	6	37500	37500
14	1050	2	0	0
15	1050	3	9000	9000
16	1050	4	0	0
17	1050	3	0	0
18	1050	2	0	0
19	1050	5	142400	142400
20	1050	60	1800000	1876000
21	1050	93	2790000	3134100
22	1050	11	180000	180000
23	1050	69	2438000	2452800
24	1050	7	126000	126000
25	1050	0	0	0
26	1050	2	0	0
27	1050	3	0	0
28	1050	2	0	0
29	1050	15	306000	306000
30	1050	520	13803278	13803178
31	1050	39	364915	364915
32	1050	6	129600	129600
33	1050	9	108000	118000
34	1050	3	19200	19560
35	1050	35	420000	428400
36	1050	30	360000	369000
37	1050	7	72000	72000
38	1050	28	460800	513216
39	1050	0	0	0
40	1050	40	480000	488000
41	1050	25	300000	305000
42	1050	33	384000	441600
43	1050	2	3600	3600
44	1050	8	60000	65000
45	1050	5	19000	21000
46	1050	130	1825200	1868100
47	1050	15	180000	187000
48	1050	4	18720	18720

49	1050	1	0	0

Ent.	product	Value(ILS)	product	Value(ILS)	product	Value(ILS)	product	Value(ILS)	product	Value (ILS)	Total Value(ILS)
1	2225	1010880		0		0		0		0	1010880
2	2223	800000		0		0		0		0	800000
3	2225	3120000		0		0		0		0	3120000
4	2223	162000		0		0		0		0	162000
5	2227	8000		0		0		0		0	8000
6	2221	11232	2221	18720		0		0		0	29952
7	2221	28000	2225	30000	2221	18000		0		0	76000
8		0		0		0		0		0	0
9	2225	1200000		0		0		0		0	1200000
10	2221	6000000	2223	3000000	2225	696000		0		0	9696000
11	2227	46050000		0		0		0		0	46050000
12	2225	334000	2221	1344	2221	5000	2221	4000		0	344344
13	2225	500000		0		0		0		0	500000
14	2333	115000		0		0		0		0	115000
15	2391	400000		0		0		0		0	400000
16	2223	330000	2223	18500		0		0		0	348500
17	2221	25000	2221	10000		0		0		0	35000
18	2221	46000		0		0		0		0	46000
19	2223	1364359		0		0		0		0	1364359
20	2223	10000000	2221	6000000	2221	6000000		0		0	22000000
21	2221	9000000	2223	1000000	2221	9000000	2221	25000000		0	44000000
22	2223	1600000		0		0		0		0	1600000
23	2223	6003580		0		0		0		0	6003580
24	2225	180000	2223	84000	2223	84000	2225	60000	2224	60000	468000
25		0		0		0		0		0	0
26	2221	90000	2221	50000	2221	15000		0		0	155000
27	2221	133000	2221	103500		0		0		0	236500
28	2225	160000		0		0		0		0	160000
29	2221	450000	2221	360000	2221	320000	2399	300000	2225	260000	1690000
30	2223	127020322	2399	38919935	2449	4831089		0		0	170771346
31	2227	2049207	2399	1366138		0		0		0	3415345
32	2221	150000	2221	100000		0		0		0	250000
33	2225	1050000	2223	450000		0		0		0	1500000
34	2225	736400		0		0		0		0	736400
35	2227	2400000	2343	250000	2343	220000		0		0	2870000

36	2227	7200000		0		0		0		0	7200000
37	2227	994800		0		0		0		0	994800
38	2227	6369000	2449	660000		0		0		0	7029000
39		0		0		0		0		0	0
40	2227	2000000	2449	40000	2343	40000	2343	34000		0	2114000
41	2227	630000	2343	520000	2399	350003	2449	200000		0	1700003
42	2223	6000000	2139	1250000		0		0		0	7250000
43	2449	24000	2227	12000		0		0		0	36000
44	2223	780000		0		0		0		0	780000
45	2225	343200		0		0		0		0	343200
46	2227	8000000	2342	4500000	2367	1762200		0		0	14262200
47	2227	1824000		0		0		0		0	1824000
48	2449	82800	2227	60000		0		0		0	142800
49	2225	43200		0		0		0		0	43200

- Industry professional questionnaire

Industry Professional/Owner Questionnaire

نشكر لكم تعاونكم في تعبئة هذه الاستمارة والتي تهدف لقياس اراء اصحاب صناعات الالبان الفلسطينيين وتوجهاتهم بخصوص التعامل مع التكاليف الناتجة عن التلوث الناتج عن هذه الصناعة. ياتي هذا البحث ضمن متطلبات رسالة ماجستير للطالبة شروق الزير من جامعة بيرزيت وباشراف الدكتور ماهر ابو ماضي. سيتم التعامل مع البيانات بسرية تامة ولن يتم نشر اسماء الصناعات ولن تتم الاشارة اليها. سيتم استخدام البيانات لغايات البحث العلمي فقط.

Factory: ……………………………………………………………….

Person Interviewed: …………………………………………….

Date: …………………………………………………………………….

1.	Is the factory subject to any kind of environmental monitoring by governmental institutions? هل يخضع المصنع لأي شكل من اشكال الرقابة البيئية من قبل هيئات حكومية؟	
2.	Are samples of wastewater or solid waste taken and examined by any institution or by you? هل يتم اخذ وفحص عينات من المياه العادمة او النفايات الصلبة من قبل أي هيئة او من قبلكم؟	
3.	Does the factory pay a price for the environmental pollution it causes/produces? هل يدفع المصنع مبلغا ثمن للتلوث البيئي الناجم عنه؟	
4.	How much attention do you pay, as a producer, to the industrial environmental pollution? ما مدى الاهتمام "كمنتج" الذي تبدونه اتجاه التلوث الصناعي البيئي؟	1. very low, 2. low, 3. Medium, 4. high, 5. Very high
5.	Has the factory included among its objectives, the concern towards the environment? هل يضع المصنع من ضمن أهدافه الاهتمام بالبيئة؟	

6.	Have you ever financed or supported projects promoting any type of environmental sustainability? هل سبق وان مولت او دعمت مشاريع تروج لأي نوع من أنواع الاستدامة البيئية؟	
7.	What, in your opinion, the level of environmental pollution, the dairy factory causes? ما برايك مستوى التلوث البيئي الذي يسببه مصنع الالبان؟	1. very low, 2. low, 3. Medium, 4. high, 5. Very high
8.	Do you have a desire to find solutions to reduce the environmental pollution produced by the factory? هل لديك الرغبة بإيجاد حلول للحد من التلوث البيئي الناتج عن المصنع؟	
9.	Have you ever heard about the" internalization of environmental pollution" concept? هل سمعت يوما عن مفهوم "استيعاب التلوث البيئي؟	
10.	Do you accept/ is it possible for you to invest in treating and reducing environmental pollution caused by the factory, in return for a product price increase? هل تقبل/ هل من الممكن ان تقوم باستثمار لمعالجة وتقليل التلوث البيئي الذي يسببه المصنع مقابل زيادة سعر المنتج؟	
11.	Do you expect that increasing the price of product to influence the marketing of your products? هل تتوقع ان الزيادة في سعر المنتج سيؤثر على عملية التسويق للبضائع؟	
12.	Are there regional or international competitors to your product in the Palestinian market? هل هناك منافسون محليون او غير محليون لمنتجاتكم الفلسطينية؟	
13.	What increase in the product price is acceptable for the manufacturer? لأي حد/نسبة تعتبر الزيادة في سعر السلعة مقبولة بالنسبة للمصنع؟	

14.	Do you prefer to pay pollution tax to the government "the government treats" rather than treating by yourself? هل تفضل دفع بدل تلوث للحكومة "الحكومة تقوم بالمعالجة" بدل المعالجة الذاتية للمصنع؟	
15.	If the government puts in place incentives to reduce pollution, do you invest in treating pollution? في حال وضعت الحكومة حوافز لتقليل التلوث, هل ستستثمر في المعالجة؟	
16.	What incentives do you expect from the government? ما هي الحوافز التي تتوقعها من الحكومة؟	

- Policy maker/expert questionnaire

Policy maker/ expert questionnaire

نشكر لكم تعاونكم في تعبئة هذه الاستمارة والتي تهدف لقياس اراء صناع القرار / الخبراء في قطاع صناعة الالبان الفلسطينيين وتوجهاتهم بخصوص التعامل مع التكاليف الناتجة عن التلوث الناتج عن هذه الصناعة. ياتي هذا البحث ضمن متطلبات رسالة ماجستير للطالبة شروق الزير من جامعة بيرزيت وباشراف الدكتور ماهر ابو ماضي. سيتم التعامل مع البيانات بسرية تامة ولن يتم نشر اسماء الصناعات ولن تتم الاشارة اليها. سيتم استخدام البيانات لغايات البحث العلمي فقط.

* Required

1. Gender/ الجنس *

Mark only one oval.

- ( ) Male
- ( ) Female

2. You age group/ العمر *

Mark only one oval.

- ( ) 18-30
- ( ) 30-45
- ( ) 45-60
- ( ) 60 and older

3. Education level/مستوى التعليم *

Mark only one oval.

- ⬭ Bachelor's degree
- ⬭ Masters degree
- ⬭ PhD degree

4. Your institution/المؤسسة *

____

5. Job title/المسمى الوظيفي *

____

6. Are there environmental laws and regulations activated for industrial pollution/As far as you know? هل هناك قوانين و أنظمة مفعلة بالنسبة للتلوث الصناعي/بناءا على خبرتك؟ *

Mark only one oval.

- ⬭ Yes
- ⬭ No

7. Is there an environmental monitoring on diary industries/ As far as you know? هل هناك رقابة بيئية على صناعات الالبان/بناءا على خبرتك؟ *

Mark only one oval.

- ⬭ Yes
- ⬭ No

8. Are samples of wastewaters taken and examined of different industries/As far as you know? هل يتم اخذ وفحص عينات مخلفات ومياه عادمة من الصناعات المختلفة/بناءا على خبرتك؟ *

Mark only one oval.

- Yes
- No

9. Are there fines and penalties in effect for environmentally violating industries/As far as you know? هل هناك غرامات و عقوبات مفعلة للصناعات المخالفة بيئيا/بناءا على خبرتك؟ *

Mark only one oval.

- Yes
- No

10. Have you ever heard about the" internalization of environmental pollution" concept? هل سمعت يوما عن مفهوم "استيعاب التلوث البيئي؟ *

Mark only one oval.

- Yes
- No
- Maybe

11. Are you aware of the importance of the internalization of environmental pollution? هل مدرك لأهمية استيعاب التلوث الصناعي؟ *

Mark only one oval.

- Yes
- No

12. Have you been exposed to the term incorporation of pollution costs to the product cost? هل تعرضت لمصطلح/مفهوم ادماج تكلفة التلوث في سعر المنتج؟ *

Mark only one oval.

- Yes
- No

13. Do you think it is possible to apply this concept in Palestine? هل باعتقادك من الممكن تطبيق هذا المفهوم في فلسطين؟ *

Mark only one oval.

- Yes
- No
- Maybe

14. Rank the obstacles to implement this concept/ from most to least important. رتب المعوقات لتطبيق هذا المفهوم من الاهم للاقل اهمية *

Mark only one oval per row.

	1	2	3	4
Lack of environmental awareness and attention				
The absence of government support				
Industry owners' opposition				
Fear of losing competitiveness				

15. Are there concerns for imported products? هل هناك مخاوف بشأن تأثير المنتجات المستوردة؟ *

Mark only one oval.

- Yes
- No
- Maybe

16. Do you think it is possible to find a plan and strategy to deal with Israeli and imported goods?هل باعتقادك انه يمكن ايجاد خطة للتعامل مع البضائع الاسرائيلية والمستوردة *

Mark only one oval.

- Yes
- No
- Maybe

17. Rank the role of government in implementing such concept/ from most to least important. رتب دور الحكومة لتطبيق هذا المفهوم من الاهم للاقل اهمية *

Mark only one oval per row.

	1	2	3	4
Controlling smuggled and illegal goods				
Educating and training stakeholders				
Establishing restrictions against imported goods				
Supporting and motivating stakeholders/financially				

18. Does the government involve stakeholders in decision making? هل تشرك الحكومة أصحاب المصلحة في صنع القرار *

Mark only one oval.

- Yes
- No
- Maybe

19. Rank the incentives the government can provide to the owners of industries to encourage internalizing the environmental pollution/ from most to least important. رتب الحوافز التي ممكن ان تقدمها الحكومة لأصحاب الصناعات لتشجيع استيعاب التلوث البيئي من الاكثر الى الاقل اهمية *

Mark only one oval per row.

	1	2	3
Reducing taxes			
Financial contribution to setting up environmental pollution treatment units			
Reducing and contributing to annual subscription fees			

20. Does the government compensate the stakeholders affected by pollution? هل تعوض الحكومة أصحاب المصلحة المتضررين من التلوث *

Mark only one oval.

- Yes
- No

21. What is the role of the government for the success of this concept/ in terms of competition with Israeli and imported goods? ما هو دور الحكومة في إنجاح هذا المبدأ/ من ناحية التنافسية مع البضائع الإسرائيلية والمستوردة *

Mark only one oval.

- Not important
- Important
- Fairly important
- Very important

22. What are the future trends of the governmental institutions in the environmental aspects? ما هي التوجهات المستقبلية للمؤسسات الحكومية في الناحية البيئية؟ *

- Site visit questionnaire

<u>Site visit questionnaire</u>

Factory:
Visit date:
Location:
Responsible person:

1) Dairy production processes:

- ☐ Receiving and weighting the raw milk.
- ☐ Preliminary analytical testing for acidity, antibiotics, added water, fat and protein content.
- ☐ Cooling and storing in milk silos.
- ☐ Separation, clarification and centrifugation.
- ☐ Pasteurization
- ☐ Standardization
- ☐ Homogenization
- ☐ Coagulation
- ☐ Evaporation and drying
- ☐ Ultra-high temperature treatment (UHT)
- ☐ Filling and packaging

Notes:

2) Major products:

Notes:

3) Dairy employees:

Waste water flow (domestic):

Notes:

4) Production quantities:

Notes:

5) Water unit price:

Notes:

6) The amount of water consumed:

Notes:

7) The amount of solid waste produced:

Notes:

8) Inputs, outputs and pollution of the different processes:

Process	Inputs	Outputs	Pollution	Quantity	Notes
Receiving and weighting the raw milk					
Preliminary analytical testing					
Cooling and storing in milk silos					
Separation, clarification and centrifugation					

Pasteurization					
Standardization					
Homogenization					
Coagulation					
Evaporation and drying					
Ultra-high temperature treatment (UHT)					
Filling and packaging					

Notes:

9) Presence of treatment operations:

Notes:

10) Initiatives to reduce pollution:

Notes:

11) The responsible party to measure pollution:

Notes:

12) Production prices:

Notes:

13) Characteristics of dairy wastewater:

Parameter	**value**
pH	
Conductivity (μS/cm)	
COD (mg/l)	
Suspended solids (mg/l)	
Total dissolved solids (mg/l)	

Notes:

14)