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Development of Management Options for Industrial Wastewater in Nablus City

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Development of Management Options for Industrial Wastewater

In Nablus City

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Dedication

Dedicated to my beloved husband, my dear mother,

my sister, my two wonderful children, and my friends.

Aknowledgements

Thanks to Dr. Hafez Shaheen for his guidance and supervision. I owe a great debt of gratitute to Dr. Rashed Al-Sa'ed for his great assistance in supervision and guidance. Thanks also extend to Dr. Anan Jayyousi for his help and kidness. I have sincere gratitude for my beloved husband, for his kindness and support, for my dear mother for her love, my sister for her encouragement, my two wonderful daughters, and my friends for their encouragement. Thanks also to the staff members of the Environmental Quality Authority and the Ministry of Industry for being cooperative.

Table of Contents

List oF Abbreviations

Symbol	Meaning
ARIJ	Applied Research Institute in Jerusalem
BOD	Biological Oxygen Demand
COD	Chemical Oxygen Demand
CPRS	Center for the Palestinian Research and Study
CPT	Clean Production Technology
EMS	Environmental Management System
EQA	Environmental Quality Authority
EPA	Environmental Protection Agency
ISO	International Standard Organization
MEnA	Ministry of Environmental Authority
MoI	Ministry of Industry
OA	Oxygen Absorbed
PCBS	Palestinian Central Bureau of Statistics
PE	Population Equivelant

Symbol **Meaning**

PES	Palestinian Environmental Strategy
PNA	Palestinian National Authority
PRG	Pollution Reseach Group
PWA	Palestinian Water Authority
SS	Suspended Solids
TC	Total Carbon
TDS	Total dissolved Solids
TKN	Total Kjeldahl's Nitrogen
TS	Total Solids
TSS	Total Suspended Solids
USAID	US Agency for International Development
WWTP	Wastewater Treatment Plant

List of Tables

List of Figures

List of Charts

Appendices

Abstract

Severe water shortage, threat of pollution to its limited resources, lack of national environmental enforcement measures and a concentrated and ever growing urban population are common features in Palestine. Low water consumption rates associated with high strength municipal wastewater production and lack of adequate municipal wastewater management exacerbate the situation. Efforts to reduce industrial pollution in Palestine like other developing countries, have focused on environmental institutions and legal frameworks, largely by establishing command-and-control regulations. However, formal regulations alone were not very effective in reducing industrial pollution in these countries. Although there is no substitute for an environmental regulatory regime, there is a need to focus on incentives for action by the industrial sector. In this research study, management options for the industrial wastewater from the western and eastern areas of Nablus city are developed. These options including managerial and technical frameworks are based on the results obtained from field surveys, site visits, and data analysis of available literature as well as findings of the distributed questionnaires. Major findings obtained revealed that large quantities of industrial wastewater input and through-put features, such as sinkholes and waterways to the sensitive recharge areas of the aquifer system for Palestine. This unconscious practice would cause severe quality degradation to the groundwater and surrounding environment. Several innovative approaches emerged as effective ways to improve

environmental compliance were analyzed and discussed. These approaches are based on: (1) introduction of cleaner production principles to reduce or minimize pollution loads discharged from coming out from industrial enterprises; (2) adoption of better environmental management practices to cope with different situations; (3) an elastic legal approach expressed through the state-of-art regulations; (4) introduction of new role of government to address the interaction between community and industrial market. However, to achieve the major aims set by these approaches, it is very important to involve the local government, industrial sector, local unions and NGO's in preparing guidelines for an integrated environmental compliance. The potential heavy polluters related to industrial wastewater are determined at generation source and pollution type, the polluting practices, the existing effluent control, raw materials used and the end products. The results however suggest that the introduced technical and managerial frameworks entail the adoption of ISO 14000 for Environmental Management System (EMS), the implementation of low cost Cleaner Production Technology (CPT), the new governmental role to embark on information to address interaction between community and industrial market. Pollution discharge permits; formal monitoring and inspection, and Palestinian environmental roles were also introduced and discussed.

Chapter One

Introduction

1. Introduction

1.1 Background and Problem Definition

Water pollution loads are usually classified to coming from two separate types of sources: point and non-point. Non-point sources are generally more diffuse, and include domestic and municipal discharges from housing, public and commercial developments, industrial sites, roadways and parking lots. Pollutants associated with these sources include pesticides, fertilizers, silt and sediment; chemicals (such as motor oil and antifreeze) that drip from motor vehicles onto driveways and streets, and pet wastes **(EPA and LARWQCB, 2000).**

According to NJIT (1999), New Jersey Institute of Technology, point (non-diffuse) sources like chemical discharges from factories, effluent from sewage treatment plants and agricultural drainage, flow directly into receiving water bodies. Non-diffuse sources are easier to identify and control. In general, point sources pollution emissions can be regulated through state and local mandates to reduce point and non-point pollution sources. Onsite treated industrial wastewater is considered as point sources **(NJIT, 1999).**

Most of the populated areas in the West Bank are mounted above the recharge areas to the groundwater resources (e.g. aquifers). The effective use of fresh water supplies is being impaired through quality deterioration brought about by the discharge of non or partially treated industrial wastewater. This industrial liquid flows freely on the ground surface and waterways. Industry, in general, discharges many substances, which are resistant to degradation by conventional biological treatment and the self-purification processes of the water environment. Wastewater containing intractable, toxic or carcinogenic substances should not be permitted to enter clean water supplies or water reclamation systems.

In the sense of defining the fate of the industrial effluent wastewater, dscharges of industrial wastewater to a sanitary sewer system are referred to as indirect discharges (non-point) and are to be regulated by industrial regulations. While the treated wastewater flowing directly to the waterways or water bodies is referred to direct discharge. As reported by PRG (1999), the Pollution Research Group, the industrial wastewater discharging to municipal sewers must be controlled, and the contaminants paramenters are limited to a certain standard. It is literatured that combined treatment of industrial discharges with domestic sewage in municipal wastewater treatment plants is economically and technically feasible, but the industrial effluent parameters should be controlled to limited parameters that can be handled as a domestic parameters **(PRG, 1999)**. For example, the high BOD industrial effluent could be counted for as a number of equivelant population, then it can be discharged to the domestic treatment plant.

In conventional municipal treatment plant as that proposed at Deir-Sharaf in the western part of Nablus, biological treatment is applied to remove organic material (BOD_5), suspended solids (SS) and nutrients (nitrogen and phosphorus) from the wastewater stream. However, some industrial discharges contain toxic pollutants, which might inhibit the microbial activity in sewage works and may cause a treatment process failure or may pass through the treatment plant. Some pollutants may harm the sewerage facilities and impose public and treatment system workers to health risks. Furthermore, some toxic substances may harm the utilization of treated effluent and stabilized bio-solids (sludge) for agricultural purposes **(EPA1, 1993).**

1.2 Existing Conditions of Palestinian Industrial Wastewater

The quality and quantity of industrial wastewater depends on the type of industrial sectors charging within a specific area. In Palestine, suitable infrastructure facilities for industrial sector do not exist; the industrial wastewater is largely discharged to the environment with little or without pretreatment, causing soil, surface and ground water pollution. Industrial wastewater contains heavy metals, toxic materials, high BOD and COD, salts alkalis, dyes, synthetic sizes **(Morris and Abu Orf, 1998).**

Mubarak (2003) is conducting a research study on the fate of heavy metals at Al-Bireh sewerage works. The major aim of this study is to investigate the impact of heavy metals content and fate in the stabilized sludge. The ultimate content of these metals will decide the potential utilization of the biosolids in agriculture as a fertilizer. Therefore, industrial discharge regulations may be required depending on the raw wastewater characteristics or pollution load **(Mubarak, 2003)**.

1.2.1 Industrial Use of Water

The use of water in the Palestinian industry is summarized by the following:

1. Industry requires water for process water, product washing, plant and equipment washing, cooling systems and personnel consumption and sanitation.

2. Cooling system, human consumption and certain stages in the production industries require water of potable or higher quality, while water of lower quality may be employed for other uses.

3. In stone cutting industry, water is mainly used for cooling process and lubricating the cutting saws.

4. Food industries process water for washing, desalting, cleaning solutions and grinding olive process.

5. Tanning industry process water in washing, NaCl is added to wash-water, de-hairing process water plus $Ca(OH)_2$ Na_2 S, then rinsing, de-liming, pH adjustment with water and chemical addition **(Al-Sous, 2000).**

6. Metal plating industries process water for rinsing, rinsing in a low pH - basin, chromium treatment, pH adjustment.

1.2.2 Types of Pollution in Industrial Waste Discharges

Industrial water effluent pollution is characterized by physical, chemical, organic, toxic and alkali changes. These water pollutants are related to each industry as follows:

- Color and Odor: Pulp and paper, textiles, abattoirs and dairy cause watercolor, which is visually objectionable Department of Water Affairs and Forestry **(DWAF, 1993).**
- Solids: Pulp and paper mills, textile factories, tanning and canning industry cause blockage of sewer lines and equipment.

- Organic wastes: Pulp and paper, textiles and tanneries cause overloading to conventional sewage treatment plant.
- Oil and grease: Tanneries, metal finishing, workshops and car washing cause Blockage of sewer lines and equipment, unpleasant smell and attraction of flies.
- Heavy metals and Cyanide: Chemical, food and textile factories and metal finishing cause toxic to bacterial and aquatic life.
- Chemical wastes. Chemicals and plastic industries cause toxic aquatic life, un-pleasant taste and odor.
- Acids and Alkalis. Food processing, metal plating, textile, water softening and pulp mills cause brake conditions for water due to imbalance of ions, and this water is not suitable for irrigation.

1.2.3 Types of Industries

The major industrial facilities in Palestine are categorized in terms of their pollution potential in a certain area. The size of these facilities varies between small, medium and large. The sophistication of industrial operation has a wide range of variety. In general, most of them are considered small relative to other industries in developing countries due to the number of workers and the size of capital investment.

There are three major industrial groups in Nablus district. The first one includes; stone-cutting and tiles which form the basic part of construction and building materials. Second group is the food industry; sweets, tahinah, vegetable oil, and olive oil processing. Third group consists of metal finishing, chemicals, tanning, textile, shoe factories and miscellaneous.

Stone cutting industry is considered a major industry in Palestine. Moreover it is one of the heaviest water consuming industries, United States Agency for International Development **(USAID and DAI/SBSP, 1995).**

Food industry and olive mill processing have substantial organic load and suspended solids impact on the industrial effluent **(PWA, 1999).**

Tanning, metal plating, shoe factories, textiles, mining process, detergent industry and workshops are of vital importance, since these industries are major in Palestine. At the same time they are heavy consumers of water, and their contaminant effluent create problems in terms of water quality protection, since the resulting effluent appears to be contaminated, with high BOD content **(Al-Sous, 2000).**

1.3 The Need for Management Concept

1.3.1 Impact of Improper Management of Industrial Wastewater

Surface and groundwater pollution have become the core problems to be solved. Industrial wastewater contributes to a major extent in the pollution of surface and groundwater, as it discharges non or sub-standard effluent that flows on the ground-surface or Wadies.

The. industrial effluent discharged from the processes, if not properly disposed will cause adverse impact upon the water resouces through penetrating the aquifers.

The industrial wastewater finds its way to the waterbody by running over-land (runoff), by entering a storm sewer, or by percolating through soil into groundwater. There are two major watersheds sourrounding the Nablus district, one in the eastern slope and the other in the western slope **(Husary *et al.*, 1995).**

The effective water use per unit production is an important issue. The improper water resource management will cause water shortage and impose negative impacts on domestic water availability to human needs.

Regional water pollution from industrial wastewater discharge; threaten the biodiversity because of the unsound development of biological resources and ecological degradation. Unsound land utilization causes deforestation; land degradation and soil erosion. Vegetation will fail, toxic and bio-cumulative chemicals resulting from various industrial effluent will threat human life, suspended solids from stone cutting industry will produce clogging and complexity of the public domestic facilities, and harm the soil. Food industry will cause significant organic load, and should not be mixed with the proposed treatment plant of domestic use **(MEnA, 1999).**

Biodiversity is threatened severely. Due to the industrial activities, the irrational exploitation of natural resources (i.e. stone quarries) and shifting cultivation. it has affected extremely various living beings and threatened to the biodiversity in the cultural area as stated by the MEnA in the main report **(MEnA, 1999).**

Serious destruction of the ecological environment. The natural ecological destruction and the trend of the environmental deterioration in the eastern and western parts of the Nablus district are very serious. The areas of soil erosion are increasing, see photographs in the appendices.

1.3.2 Objectives of Proper Management of Industrial Wastewater

Proper Environmental Management System innovations replace many of the time-consuming, labour-intensive field verifications, data collection and laboratory testing tasks that are fundamental to a traditional environmental compliance program. It creates a web of information that gives managers and plant personnel remote monitoring, control, and response capabilities that were previously unheard of an industrial environmental management system.

The discovery and corrective action not only saved thousands of dollars in water charges, but also minimize pollution at it's source.

Proper industrial wastewater management technically aims at the following:

1. Minimize or prevent surface and groundwater pollution by industrial wastewater discharge.
2. Prevent harmful effects on the public collection sewers and the existing or proposed domestic wastewater treatment plants (WWTP).
3. Optimize the use of raw materials which are not retained in the final products.
4. Minimize and optimize the use of water in the industrial processes. Since water is scarce and pollution is a fresh water consumer, unwise and inefficient use of water has the impact of water quality degradation.
5. Provide a tool for controlling the industrial pollution.

6. Rule and control the disposal of industrial wastewater.

Recent results obtained by Al-Sa'ed (2001) showed that high contents of fat and grease of industrial origion, lack of fat and grease separator at Al-Bireh sewage works and inadequate preventive maintenance were behind poor settling efficiency of sludge in the settling tank and sludge foaming in the aeration tank **(Al-Sa'ed, 2001).**

Most of the industrial establishments in Palestine are small to medium size; firms with less than 500 employees **(Crick and Chaudry, 1998)**. The small amount of industrial production and wastewater effluent compared to the total domestic effluent could be used as another character to indicate the size of the industrial facility. For example, in the los angeles area, about 85 % of the flow to the treatment plants is domestic sewage, and about 15 % is industrial **(EPA and LARWQCB, 2000).** While in Palestine, as a developing country the percent of industrial wastewater compared to domestic wastewater is very much less than the aforementioned percent. The third critera is that the small and medium firms do not have internal fomal or administrative system. This formulates a great difficulty to introduce these factories to the Environmental Management System, but it can be done. The task in this thesis is to introduce management tools, practices, duties to be performed by the administrative staff and employees in small and medium industrial establishment to achieve cleaner environment through the following:

* On-site identification of specific pollution prevention and waste reduction alternatives.

* Development and implementation of policies to encourage small to medium sized companies to employ pollution prevention.

1.4 The Study Area

Palestinian industries contributes up to 17% of the total national product and employs 16% of the working forces for the year 1998, as stated by the Center for the Palestine Research and Studies for economics department **(CPRS, 2001)**.

The major industrial activities are stone-cutting and tile flooring industry; the. stone industry constitutes a major component of the construction industry in Palestine. Food and olive oil processing are of a major concern in the Palestinian economy. Metal plating, tanning, chemical detergents, shoe factories are of local important concern.

This current study relates specifically industrial and economic assets centered in the Nablus city. Most of the major Palestinian industrial activities are represented in Nablus City. Besides, it has the highest population and the largest area among other Palestinian cities. According to Palestinian Census Burue for Statistics **(PCBS, 1997)** about 251392 inhabitants were registered in Nablus district. assuming an annual growth rate of 3.5 %, by 2002 the total population would be around 299000 inhabitants. The population density is about 630 people/km^2 as 70 % of the land (1580 km^2) is still under Israeli control.

In this study, an industrial survey will be conducted in the western and the eastern parts of Nablus which are located in the middle of the most densely populated areas. Based on the population cenus made by the PCBS (1997) and assuming an annual growth rate of 3 %, the West Bank population has been estimated at about 1.9 million people by 2002. Nablus district will be having 15.7 % of total West Bank population.

1.4.1 Location

As described by PCBS (1997), the Palestinian Central Bureau of Statistics, Nablus district is located in the northern part of the West Bank. It is bounded by Jenin district from the north, Tulkarem district from the west, Ramallah and Jericho from the south and the Jordan River from the east. Figure 1illustrates the location of the Nablus district **(PCBS, 1997).**

1.4.2 Land Use

Nablus district, with a total area of 158 thousands hectares, has nine distinctive major land uses. According to ARIJ (1997), the Applied Research Institute in Jerusalem, these include the Palestinian built up areas, Israeli settlements, closed military bases, nature reserves, forests and cultivated areas. Table (1) illustrates the percent of each of the aforementioned areas in the Nablus district **(ARIJ, 1997).**

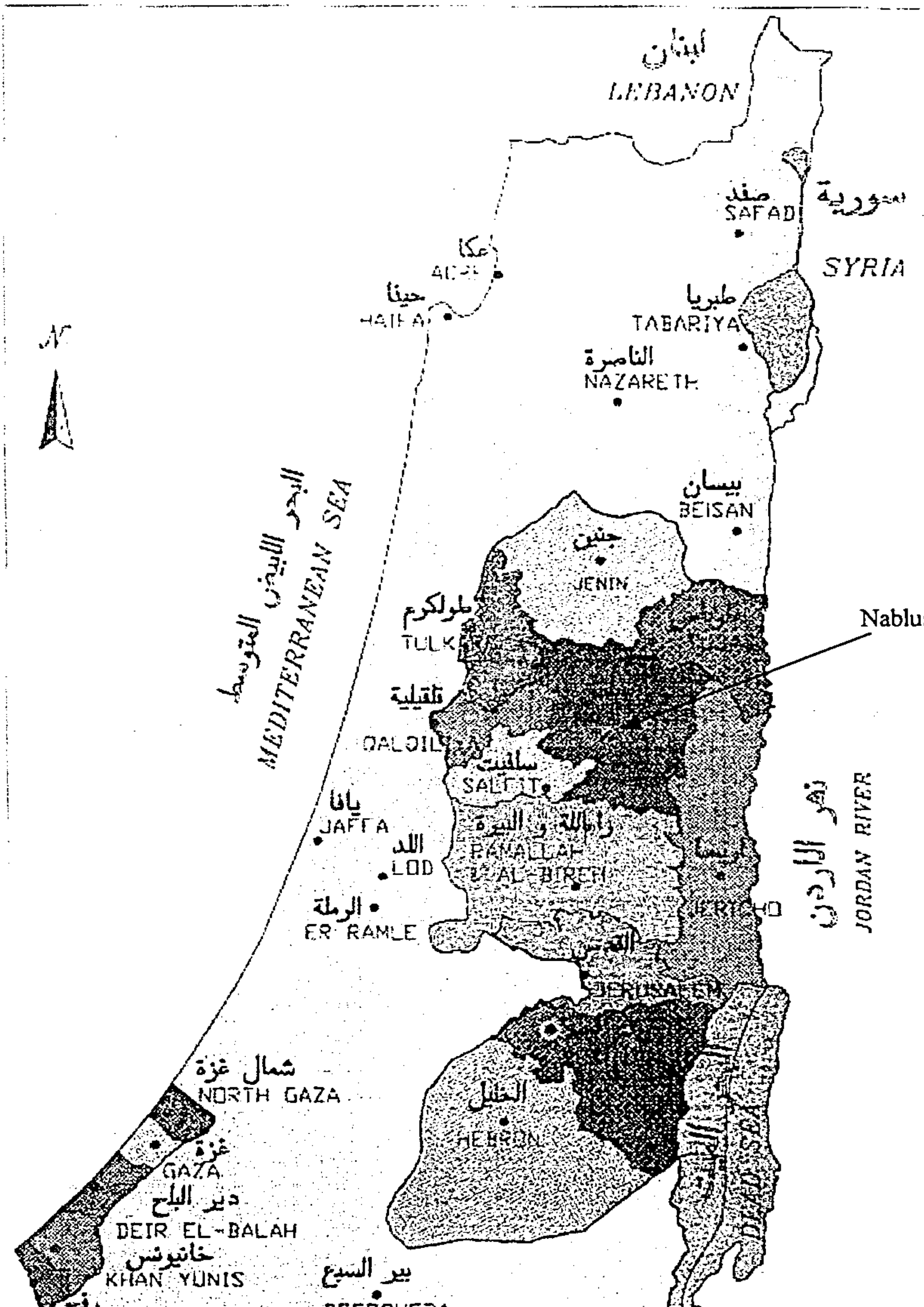
Around forty five percent (45%) of the industrial facilities in Nablus district are located in industrial areas, 28% are located in residential areas, and 27% are located in commercial areas **(ARIJ, 1997).**

Table 1: Land use classification in the Nablus district (ARIJ, 1997).

Land Use	Area (Hectares)	% of Land
Palestinian Built-up Areas	"4,127.10"	2.6
Israeli Settlements	"2,427.80"	1.5
Closed Military Areas and bases	"41,624.30"	26.7
Nature Reserves	"16,661.20"	10.5
Forests	526.9	0.3
Quarries	300.9	0.2
Cultivated Areas	"28,992"	18.4
Industrial Areas	124.1	0.08
Others*	"62,683.40"	39.7
Total	158022.4	100%
* Not including roads, unused land, or land used for grazing."		

It is noted from the above table that the Industrial Areas are only 0.08% of the total area.

Figure 1: Location of Nablus city (PBCS, 1997).

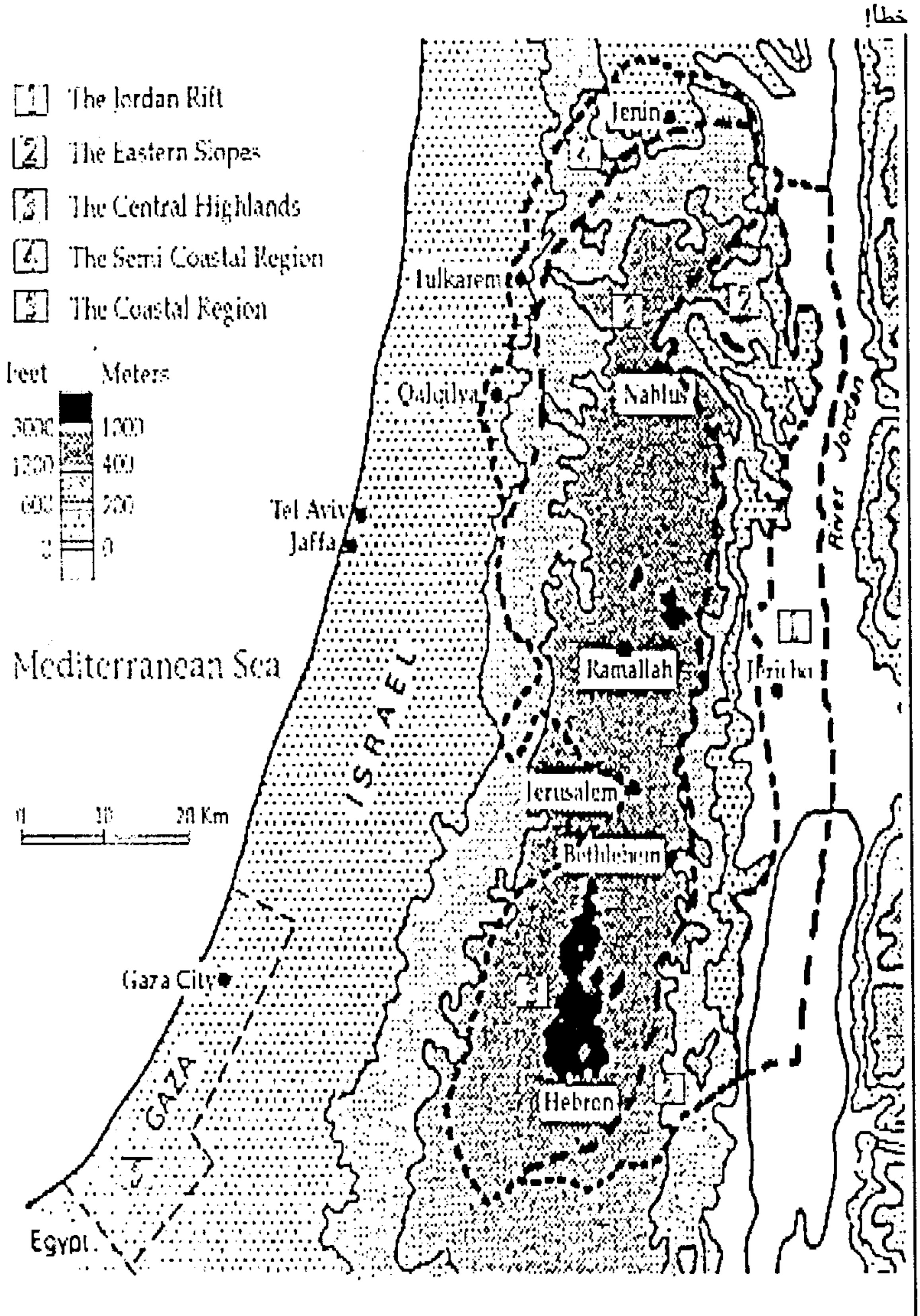


1.4.3 Topography, Climate and Drainage

Groundwater is the main source of water in Palestine. Nablus location has a significant importance when considering the West Bank aquifer systems. The mountains of the Nablus city supplies and recharges the Western basin located within the boundaries of the West bank and Israel. The Northerneastern Basin, which is located near Nablus and Jenin and drains into Eocene and Cenomarian – Turonian aquifer undr the north and of the West Bank **(Abu Zahra, 2000).**

The topography of the Nablus district can be divided into four parts: Jordan valley, the eastern slopes, mountain crests and western slopes, Figure 2. The Jordan valley is located between Jordan River and the eastern slopes with elevation ranges between 349m below sea level to 100m above sea level, Applied Research Institution in Jerusalem **(ARIJ, 1997)**. The eastern slopes are located between the Jordan valley and the mountains. They are characterized by steep slope, which contribute to forming young Wadis such as Wadi Al-Sajour. Mountain crests form the watershed line and separate the eastern and western slopes. Elevation ranges on average between 750 and 800 meters above sea level. Western slopes characterized by gentle slopes, with elevation ranges between 250 and 500 meters above sea level **(ARIJ, 1997)**.

Figure 2: The topograghy of Nablus district according to aquifer system within the West Bank (Abu Zahrah, 2000).



Two main drainage systems are distinguished in Nablus district. The first system runs to the west including Wadi Qana, Wadi Rabah, Wadi Khalifa and Wadi Masha. While the second system runs to the east or south east, including Wadi El Maleh, Wadi Dura, Wadi El Far'a and Wadi Al-Ahmar (**Husari** *et al.*, **1995**).

The un-controlled and un-treated industrial wastewater discharges freely into the previous mentioned wadies, causing surface water and soil pollution, and polluting the eastern and western groundwater basins. This discharge could be considered a point source discharge, which is the end of the pipe effluent, or water running onto the surface of the industrial facilities. The industrial cluster zone in the western part of Nablus City discharges its effluent wastewater into Wadi Zeimar Basin.

1.5 Objectives of the Study

1.5.1 Main Goals

The overriding objective of this research is to develop a culture that fosters improved environmental compliance, through establishing guidelines and environmental management system for the commercial and industrial enterprises taking Nablus City as a case study. The main goals are:

- **Reduction of Environmental Impacts**

Industrial wastewater discharge standards are being based on water quality effects.

Treatment costs to meet these standards are increasingly expensive, and in some cases, technically unachievable. It is very difficult, or could be impossible to reclaim a groundwater aquifer if it is contaminated by continuous leakage of industrial liquid effluent from the surface water.

- **Improving Global Competitiveness**

It is true that most manufacturing wastes consist either of inefficiently utilized raw materials or products that are flushed down the drain, shipped to a landfill, or blown out into the air. Throwing them away costs money, increasing product costs and hurting our competitiveness.

Industrial products can reinforce the consumption pattern that is polluting or protecting our environment. The use of environmental lable on consumer products is considered as the soft instrument of environmental policy.

Waste reduction and product quality are not mutually exclusive. The most successful waste reduction projects have resulted in product quality improvement and waste reduction. The endorsement of "Eco – lable" made in Germany (On-Kwok, 1993) have made a possitive impact on the interaction between greener production and consumption. He reported that through eco – lable products, environmental protection could be achieved.

- **Improving Working Conditions**

Improving product quality and productivity has been effected by blurring of responsibility and authority between labor and management. Involving workers in waste reduction efforts has had similar benefits and really is an extension of the quality circle approach to manufacturing. In industrial firms, reducing worker exposure to toxic materials will reduce illness among workers. This translates into better working relations, reduced sick leave, and lower health insurance costs.

The main objectives are:

- Collect the necessary information, review the existing environmental problems and develop a list of critical problems related to the industrial sector.
- Develope a culture of industrial environmental compliance that will focus on incentives for action by industry.
- Application of feasibility of the Cleaner Production Techniques (CPT) as a tool to reduce the pollution loads from existing industrial enterprises and to minimize the impacts of new instrial establishments.
- Design products to minimize the environmental impacts in production use and disposal, prevent pollution, reduce waste and consupmtion of resources (water, energy, material).
- Competitiveness to global Market (certification) Environmental Management System (EMS) is a contractual requirement in United States of America (USA) and Europe for customers. So the EMS has been introduced to improve environmental compliance in Palestinian industrial enterprises through introducing and encouraging them to adopt the ISO 14001 suitable for the industrial categories, to control pollutants in the industrial wastewater and to share the global Market in this competition.

1.5.2 Target Objectives and Goals

The target objectives that this research is supporting and encouraging are:

1. The use of new technologies and technology transfer to promote waste reduction in the industrial effluent water through production steps.

2. Optimize industrial processes for increasing the efficient use of water; i.e. to effect maximum production per unit volume of water; by ensuring maximum re-use of water in some industries.

3. Material substitution and process modification to production steps so as to reduce pollution.

4. Reduce or eliminate the use of toxic chemicals that causes environmental pollution by chemicals that are friendly to environment.

5. Introduce administrative practices adopting ISO 14000 series Environmental Management System (EMS) and technologies so developed to industry by the way of guides for the management of industrial wastewater.

6. Establish monitoring system and control addition to ensure improvement in environmental performance is developed.

7. Minimize the environmental impact of new developments.

8. Promote environmental awareness among employees and the community

Chapter Two

Literature Review

2. Literature Review

2.1 General

Since the beginning of the 1970's, governments of developed and developing countries have enacted or amended a large number of environmental laws and regulations often directed at controlling the industrial emissions of air and water pollution. However, imposing a ceiling on a plant's emissions does not necessarily imply that emissions will fall and environmental quality improves. For the objectives of the regulation to be attained, the behavior of the regulated community has to be monitored, and compliance with environmental standards has to be enforced **(Pollution Research Group, 1999)**.

Although much can be learned from the experience of countries with more mature programs, simply importing systems developed elsewhere has often not been effective. Effective environmental regulations must first reflect their own context and compatible with the administrative capabilities of regulatory agencies. Regulatory meant for industrial countries are inherently unforeseeable in the developing countries, where institutional capabilities are weak. The success of environmental regulations also depends on the culture of compliance that is the result of a country's legal traditions, the maturity of its institutions, the available resources, and the capacity and support of citizens and the private sector. Compliance does not automatically happen when requirements are legislated and issued;

rather it is achieved as a result of targeted efforts that encourage behavioral changes on the part of polluters **(World Bank Group, 1998).**

Several mechanisms are now emerging as effective ways to improve environmental compliance in countries that lack the necessary institutional capabilities for formal regulations. These ways are not alternatives to environmental regulations, but they are pathways for achieving environmental goals within the legal framework by developing a culture of compliance **(World Bank Group, 1998).**

Environmental regulatory compliance, monitoring and enforcement issues have attracted relatively little research effort. Moreover, the bulk of the literature on these issues has been of a theoretical nature. Few have technically or administratively analyzed the impact of monitoring and enforcement activities on the environmental performance of polluters. Most of all existing studies have been performed in the context of developed countries **(Cropper and Oates, 1992)**.

While the monitoring of industrial polluters and the enforcement of compliance are both crucial components of a credible regulatory program, monitoring and enforcement issues have attracted little research effort. In a recent survey of the environmental regulatory compliance, Cropper and Oates (1992) wrote: "The great bulk of the literature on the economics of environmental regulation simply assumes that polluters comply with existing directives" **Cropper and Oates (1992).**

2.2 Compliance to Environmental Regulations in Palestinian

The Palestinian Ministry of Environmental Affairs (MEnA), at present Authority of Environmental Quality, had developed the Palestinian Environmental Strategy **(MEnA, 1999).** The objective of this PES is to identify, analyze and control environmental problems.

2.2.1 Palestinian Environmental Strategy

The PES indicated that lack of efficient industrial wastewater control and management is linked to the depletion of water resources and deterioration of water quality in Palestine. The PES had set-forth measures to control the out-coming threats to the environment from industrial processing. The measures include setting industrial wastewater standards. This will include pre-treatment requirements and standards for discharge into sewer system, as well as full-treatment requirement for direct discharge. It also include setting up monitoring and enforcement systems that supports these measures. In Palestinian Ministry of Environment, resources devoted to monitoring and enforcement are insufficient relative to the complexity and extent of the task.

The PES introduced strategy element allocated to industrial pollution control through setting regulations and industrial standards for wastewater to be discharged on the sewer system, or directly over the land or into the sea or reused for irrigation purposes.

2.2.2 Industrial Wastewater Regulations and Standards in Palestine

The industrial effluent standards are particularly for the chemical industry, tanning industry, textile dyeing industry, metal and electroplating industry, the olive oil mills, and the quarrying and stone cutting industry. These standards, according to PES, should include pre-treatment requirements and standards for discharge into sewer system, as well as full treatment for direct discharge. As stated by the representatives of MEnA, The minstry intends to set regulations for industrial zones, including the establishment of common environmental protection measures, also to set up a monitoring and enforcement system that supports the previous measures in addition to promoting of relocating pollution industries by moving them away from residential areas to industrial zones.

Standards for industrial wastewater effluents are expressed as concentrations of salinity, chemical and biological parameters. The parameters issued by the Palestinian Standard Institution (PSI) were adopted; these standards are referred to in **appendix 1**. The physical, chemical, toxic and biological standards indicated in the appendix are not specified for each separate industry, and this makes the auditing process a conflicting job **(Palestinian Standard Institution PSI, 2002)**.

Environmental Quality Authority (EQA) has set environmental statutory inspections to promote environmental performance, the formal inspection form is shown in **appendix 2.** This inspection is performed only when an environmental upset occures, and does not include a monitoring program of the industrial effluent.

The PES policy prohibits any disposal of hazardous wastewater or waste to the sewer system and/or directly onto ground surface. They made formal notice of this prohibition stated in the Palestinian Environmental Law (PEnL). The polluter can face significant penalties for violation as stated by the PEnL in the year 1999.

2.3 Environmental Management in Palestine

In environmental regulatory compliance, researches had focused on formal enforcement to regulatory compliance and end-of-pipe treatment. Regulatory incentives by industry have attracted relatively little research effort. Moreover, the bulk of the literature on environmental compliance has been of a theoretical nature, and concentrated on partial treatment of waste effluent for certain industries to achieve regulatory standards. These studies had made a wise step towards introducing cleaner technology. In the year 2000, Al-Sous had conducted a detailed study for chromium removal and recovery from tannery effluents in Hebron. 30% of the chromium used by tannery was disposed in the effluent wastewater. This research proposed the chromium removal by precipitation, then dried, and after then reused. Thus, the toxicity of effluent wastewater is reduced, and effective use of raw material is achieved **(Al-Sous, 2000).**

Morris and others (1998), had developed a management process for the industrial wastewater effluent in Hebron city, funded by the united States of America for International Development (USAID). The case was that industrial wastewater was collected in the municipal domestic sewers, then discharged to the existing treatment plant in Hebron, causing complexes and failure. The study aimed at management options applied to the factory effluent before discharged to the treatment plant to avoid the sewer plugs and reduce complications of the working treatment plant **(Morris and Abu Orf, 1998).**

The end-of-pipe solutions to the industrial effluent problem are insufficient alone; most of the treatment plants in Palestinian are not working, or not operating at its theoretical full efficiency. Also, the formal monitoring of industrial discharges and enforcement of environmental laws and regulations do have many deficiencies in environmental compliance. While these two approaches are often necessary, the integrated management must include the monitoring of regulatory compliance and continual evaluation of the enforcement activities, incentives for action by industry, and the technical solutions.

Among existing facilities in the West Bank, there are 21 facilities had standard product quality system and formally registered in ISO 9000, and this is a different issue from Management Standard ISO 14000, but it is a prerequisite to register in ISO 14000.

2.3.1 Government Monitoring in Palestine

On the governmental level, the compliance of the industrial establishment to the regulatory standards in Palestine must be monitored. Optimization of monitoring efforts in Palestine is still undergoing development.

Industrial Wastewater discharge permits are proposed. These permits must be monitored through sampling programs. Laboratory analysis is necessary to demonstrate permit compliance frequently as every six months or as often as monthly. Also charges against industrial polluters must be applied in a more effective manner.

Some of the developing countries like China, Philippines, Malaysia and others made a step that have been very effective in applying some regulatory approaches that weren't considered to be feasible for them in the past, like pollution charges. According to RIET (2001), the Regional Institute of Environmental Technology, this is an idea that is very popular in Europe. To charge people per unit of pollution, and they have to take the charge into account as an economic cost, and that has a very salutary effect on management. Once it's part of the management calculation, people take it seriously and they reduce pollution quickly **(RIET, 2001).**

For example, in Malaysia they had a huge problem from palm oil production in the 1970s. Palm oil is a very large commodity in international trade, and it is very highly polluting for water. The Malaysians did a remarkable job of cleaning that up in a period of 10 years, partly due to instruments like pollution charges **(RIET, 2001).**

The situation in Palestine is different, there have been no effective enforcement apparatus. The courts were frequently corrupted. There were no effective fines. So the rules were there, but enforcement was practically null. We realize at this time we didn't have the whole package, and we can't make it work.

2.3.2 Difficulties in Implementing Environmental Regulations

The following are the difficulties that have and are facing the implementation of the Palestinian Environmental Regulations:

1. Weak public administration has long been recognized as a key obstacle for the achievement of environmental development objectives.

2. Compliance and enforcement functions are split among the Ministry of Industry, the Ministry of Environmental Affairs and the Ministry of Health

3. As a result, non-compliance by polluters is widespread and the current enforcement mechanism suffers from inadequate procedures, institutional overlap, insufficient staff capacity, and a lack of incentives and weak monitoring and reporting capability.

4. Objectivity in judging and controlling the environmental impacts is an important issue. The polluters in Palestine considers the environmental

problems are global in nature, and therefore, outside the ability of their industrial enterprises.

Abu Gharbieh (2002) reported that the Palestinian Industrial sector lack definition for waste types discharged, hence no proper treatment techniques were possible to adopt. He indicated that water conservation is the first step in pollution reduction for industrial sector **(Abu Gharbieh, 2002)**.

2.4 Updates and Trends on EMS and CP implementation in Asia

Most of the developing countries in Asia are still trying to come up to speed on the Environmnental Management System (EMS) through application and certification the standards of ISO 14000 series. For many Asian companies, conducting the certification, documentation, and staff training process is a strong cost saving benefit **(Krut and Gleckman, 1998)**.

2.4.1 Strong Governmental Support

Environmental agencies and industrial ministries all over Asia have recognized the potential benefits of a robust ISO 14000 certification system. Most countries have government-funded ISO 14000 support program in place. Countries in Asia offering technical or financial assistance to companies include: Singapore, China, Japan, Taiwan, Korea, and Thailand **(Tanner, 2001)**.

In China, for example, the state councils advisory committee on ISO 14000 approved an EMS accreditation system with the formation of two competent bodies. One to accredit certified bodies to be called China Accreditation Committee for EMS Certification Bodies and to register individual Environmental Auditors **(Tanner, 2001)**.

In china, the National Environmental Protection Agency sees the ISO standard as a valuable industry support for its policies and reducing its enforcement workload in the long term. Many key issues are important in implementing EMS and CP in China. Among these; the wise use of huge foreign investments in building up environmental structure is an important key issue. Also the enforcement of pollution prevention in large state firms. The reform of consumer pricing for water, waste and power was among the important key issues **(World Bank Group,1998)**..

Examples of Implementing Environmental Management System (EMS) and Cleaner Production (CP), showing cost saving are:

2.4.2 Tunisia

A study of a battery manufacturer employing 200 people, identified 19 production actions. The management system proposes changes in the first 7 changes alone, and offered potential savings of nearly US$750,000 in the first year, with no capital investment required **(World Bank Group,1998)**.

2.4.3 China

At the request of China's National Environmental Protection Agency (NEPA), a US$6 million cleaner production component was included in the World Bank's environmental Technical Assistance Project, approved in 1993. The UNEP Cleaner Production Programme assisted in the design and implementation of the component, which included studies in 18 companies, the training of a cadre of local experts, and the preparation of a Chinese cleaner production manual. A large distillery was one of the plants involved; a first assessment of the bottling plant identified good housekeeping options that cost less than US$2,000 and resulted in savings of over US$70,000. This initial success was followed by de-tailed studies of the alcohol plant that resulted in a number of equipment optimizations (carried out during a maintenance shutdown), producing nearly US$700,000 in savings. Three technology replacement options were also identified, costing up to US$500,000 and with paybacks of one and a half to four and a half years **(World Bank Group,1998)**.

2.4.4 Palestine

The Palestinian National Authority (PNA) has made tremendous efforts to the protection of the environment through the Minstry of Environmental Affairs (MEnA), presently Environmental Quality Authority (EQA). The industrial pollution control is one of the Palestinian Water Authority (PWA) concerns as it is considered as a main environmental polluter.

In Palestine, there are fifteen tanneries, ten of them are in Hebron and five in Nablus district. Nazer *et al.*, (2003) developed a process modification to the method of dehairing of hides in the tanning industry. The study aimed at reducing the environmental impact generated from the use of large amounts of chemicals and huge water volumes. Through recycling of dehairing effluent up to four times, about 38% of the net present value (NPV) could be achieved compared to one-time recycling. The net cash inflows was estimated at 4253 US$ for recycling the effluent 4 times compared to one-time recycle, 2103 US$. There figures were calculated assuming that about 250 tons of hides are processed per year in Hebron district. According to Nazer (2002) the suggested modified method of dehairing process have indicated that between 16.7%-26.7% saving of sulfide and 25%-40% saving of lime could be achieved. These savings were obtained for one and four times recycling of dehairing–deliming process **(Nazer *et al.*, 2003).**

Chapter Three

Research Methodology

3. Research Methodology

3.1 Main Assumptions

The source of pollutants and pollution practices and effluent control are determined through verifying raw materials used, production steps and end products. Then a management strategy and framework are proposed. They should address the impact of improper management of industrial waste upon the environment. Technical tools, plans, and administrative managerial practices carried out on water and effluent problems in the industrial sector are suggested. The following assumptions must be taken into consideration when formulating the management concept:

1. The formal regulations of the Ministry of Environmental Affairs and the Palestinian Environmental Law are the regime of the proposed environmental management system.
2. No new committees or organizations are suggested. The possible roles and responsibilities are proposed to be done by the existing agents and institutions.
3. An effective enforcement mechanism is proposed. The promulgated regulations and standards must be enforced so as the management strategy is applied. Improvements are related to discharge permits, responsibility of polluters, and the fines are tackled.
4. Managerial framework, plans, and practices to prevent or minimize the pollutants and toxic constituents in the industrial wastewater proposed

through production steps. Since it is assumed that the industrial wastewater effluent are partially or totally untreated, and end-of pipe treatment is costly.

5. Several innovative approaches are now emerging as effective way to improve environmental performance. The proposed mechanisms include the Environmental Management System (EMS) adopting the International Standard Organization (ISO 14001) standard, Cleaner Production.

6. The adoption of Environmental Management System (EMS) and Cleaner Production (CP) will depend on the stage of business life cycle and the technology orientation. The industrial enterprises which are in the growth or mature stage of their lifecycle tend to adopt EMS and CP compared to new and small enterprises. The enterprise that produces high technology products will tend to adopt EMS and CP.

7. The need for more effective community participation in development of waste facilities. Especially industrial community, governmental ministries, and NGO's.

8. Water is a limiting source. The research carried out on water and effluent problems in the industrial sector. Water optimization through industrial processes and practices is discussed through cleaner technology.

9. Industrial practicing need permit in order to operate. Permit applications must include a description of the proposed measures to prevent or

minimize emissions from the installation and evidence that the installation meets protective emission limits.

10. The benefits of pollution control outweigh the costs.

3.2 Methodolgy

To achieve the objectives of this research study, the following methodology steps were adopted:

- Thirty field industrial visits for the existing industrial enterprises.
- Technical interviews with the key government personnel of major industries.
- Questionnaire distribution on 40 industrial sites and enterprises which are considered representative to significant environmental impacts on the environment.

These methodology steps were made also to set priorities and help formulate an adequate environmental management system as well as action plans and framework. A detailed description of each step will be presented in the following sections. Industrial survey was executed to exploit the fact that both scales of industrial activity and its sectorial composition (industrial sector) would have high industrial pollution effects.

3.2.1 Targeted Information

Technical interviews were executed to evaluate the effectiveness of existing regulatory monitoring done by the Environmental Quality Authority (EQA) to control wastewater effluent from industrial enterprises. The operating and licensed industrial enterprises was determined by the interview with the Ministry of Industry (MoI).

Survey and identify the industrial categories, define the pollution creation, various properties of wastewater were determined, including how it is generated, what its constituents are, and whether it meets regulatory requirements.

The industrial categories are identified by the type of internal management or formal system for each industry, raw materials, processing steps, type of machines used, quantity of water used, wastewater and solid waste characteristics, and the way in which industrial wastewater is handled.

Next, informations were gathered about the self-monitoring of the industrial facility; the compliance to the Palestinian formal regulations of the industrial establishments. Also the pollution sources or processes were evaluated, as well as the existance of internal formal regulations for the enterprise.

3.2.2 Industrial Survey

Industrial categories are identified according to location, product, raw materials, production processes, disposal of end products, internal management or formal system if any, quantity of water used, and wastewater characters. The number of employees in each facility, their academic and the level of their skills were determined. See the questionnaire and the sample questionnaire in the appendices.

Based on collected data and personal interviews with key governmental and industrial water-use authorities to obtain critical information, it appears that data for water consumption and wastewater generation and their associated engineering characteristics do not exist for industrial sources in Nablus. The data obtained from the industrial interviews were judged to be inconsistent due to attempts to favorably impress the interviewer, key information and data was not systematically collected, and political perspective appear to influence the data recorded.

3.2.3 Industrial Interviews

The MEnA, MoI, Chamber of Commerce, and PSI were interviewed to gather information about industrial categories, licenses, environmental checklists and approvals.

Among the key information gathering, interviews were applied to:

1. Ministry of Industry, Nablus office, now is the Ministry of Trade and Industry.

2. Ministry of Environmental Affairs (MEnA), which is at present Environmental Quality Authority (EQA).

3. Palestinian Standard Institute (PSI).

4. Chamber of Commerce

5. Ministry of Agriculture, Nablus office

6. Ministry of Health, Environmental Health Department

7. Olive Oil Council

8. Nablus Municipality

3.2.4 Questionnaires

Questionnaires have been applied to 40 operating factories in the industrial zone and other residential areas within the research area. 10 questionnaires of these 40 were considered as trade facilities rather than industrial facilities. The questionnaire included informations about the factory owner, type of industry, the branch, the raw materials, production steps and the out product.

The questionnaire included informations about the quantity of industrial use of water, the wastewater effluent characteristics if nanalyzed at the labratories, as well as the treatment method for industrial effluent, and general comments where proper management can be defined or used. Photos attached in the appendices partially reveals something about the improper practices in handling water and wastewater in operating factories. The questionnaire used for on-site visit is attached in the **appendix 3**, and two samples of the questionnaired facilities in Nablus district are attached in **appendix 4**, one of them is a tannery facility, and the other is a shoe making factory.

Information gathered included the formal management system if found in the factory, the certification to product quality management (ISO 9001 or 9002) if any; it tends to be a prerequisite to ISO 14001 registration. The ISO 14001 is a different issue than the ISO 9000 series. ISO 14000 series are seen as mechanisms for achieving improvements in environmental performance and for supporting the trade prospects of “clean” firms. The ISO 14000 series is based on the overall approach and a broad success of the of the quality management standards prepared and issued as the ISO 9000 series **(EPA2, 1997).**

The ISO 14001 allows an enterprise to understand and track its environmental performance. It provides a framework for implementing improvements that may be desirable for financial or other corporate reasins or that may be required to meet regulatory requirements. Ideally, it is built on an existing quality management system.

Chapter Four

Findings, Results, Analysis, and Discussion

4. Findings, Results, Analysis and Discussion

4.1 Overview of Industrial Wastewater Generation

With the extremely low water usage in Nablus and the type of industries that predominate, careful attention must be paid to the effluent wastewater characteristics. Toxic and harmful chemicals used in industrial processing must be carefully quantified and their characteristics must be identified, and must be eliminated or reduced at their source to minimize pollution. High salinity can potentially restrict many resource options including irrigation reuse and groundwater recharge. Salinity issues may dictate separate treatment and disposal for high salinity streams. This concern may ease with higher wastewater generation rates that are anticipated when water becomes more available.

As may be seen, the stone cutting, metal and workshops and food processing industries all potentially have a significant impact on sewerage collection and proposed conventional treatment plant but not all to the same degree. The stone cutting could exert a heavy influence on recharge options, TSS load and sediment in the collection system if not controlled. But if appropriate on-site effluent management is applied, all these concerns become minor and more water will be available for reuse **(Morris and Abu Orf, 1998)**.

There are cases that need special attention; these would include heavy metals and corrosion issues for metal workshops wastestreams and solids control for stone-cutting. About 30 % of licesed industrial businesses in Al-Bireh city were classified as potentially heavy polluters. Among theses were stone - cutting factories, car maintenance, slaughter - house, diary, pharmaceutical factories, electroplating establishments, and Palestinian Aluminum Company. Harmful effects of industrial effluents discharged from their industrial sites might have negative impact on sewerage networks, operational staff, treatment process, pumping stations, and agriculture **(Al-Bireh Municipality, 1999)**.

4.2 Main Findings

As a summary the main findings of the study can be listed as:

1. Effluent is not controlled and the wastewater flow freely without compliance to standards. No information background or data-base concerning effluent discharge characteristics or control exists are available.

2. The monitoring and enforcement performed by the Environmental Quality Authority (EQA), together with the Ministry of Industry (MoI) is not efficient. The environmental inspection list performed by the EQA inspector did not have a sampling program, or regular time of inspection. The inspection performed when an environmental problem arises. And most of the times, people complaints lead to closure of the industrial facility. The inspection form is attached in the appendices.

3. According to factory owners, partial or full treatment of industrial effluent to comply with formal standards, is costly and funding must be employed to implement part of this task.

4. The industrial establishment and institutional groups have shortages in waste management experts.

5. 23 of the surveyed facilities, the managers, who are the owners, do not comply with the standards and regulations, for the following reasons:

a. Do not want to change their industrial process.

b. The financial aspects are of great concern.

c. The prevailing political conditions in Palestine.

d. Land ownership is of great difficulty, some of the factories do not have available space for partial treatment.

4.2.1 Constraints for Environmental Compliance

The constraints that opposes the compliance to environmental regulations can be summarized as follows:

1. Political conditions prevailing in Palestine. This results in the weakness and inefficient legal institution, insufficient monitoring and enforcement to the polluters. The introduction of new actors and technologies further means that necessary institutions and legal provisions need to be made, in order that new options can be efficiently implemented.

2. Financial and economical conditions. The change of industrial process, management, type of production, type of raw material, internal

management system or efficient use of water may vary in it's cost, but any kind of change is an economic burden on the industrial facility' owners.

3. Water is a limited resource. So the efficient use of water per unit production is recommended. This aspect will be further discussed in the Cleaner Production section.

4. Land ownership; land is expensive and limited; also space is not available for many industrial establishments. The prevailing political, residential and economical conditions makes it very difficult for the industrial factories owners to provide land space needed for change in the process or pretreatment.

5. People in the industrial establishments did not want to change their practices. From social point of view, the change itself needs efforts to convince people of what are the coming threats to the environment. Public awareness is considered important instrument for influencing the industry. Such awareness can be strengthened if the public can be directly involved in activities. The activities can include information and training, networking.

6. Most of the industrial enterprises are of small to medium scale, and most of them do not have internal formal management system, and this is important aspect in this study as discussed in the following chapters.

4.2.2 Formal Management Findings

Only ten out of existing industrial facilities in Nablus had internal formal management system. Three of them had product quality and management quality system, and formally registered in ISO 9000. None of the existing industrial enterprises had environmental management system. The following describes the dominating features of the existing industrial enterprises in Nablus:

1. The Palestinian Local Government did not purchase the management quality, which is the prerequisite of the integrated environmental management system.

2. The Palestinian market is not protected against poor quality products, or against environmental noncompliance product suppliers.

3. There are no industrial enterprises that are formally certificated to ISO 14000. The certification to ISO 14000 can entail significant costs. Moreover, the costs of bringing international auditors are typically quite high.

4. Most of SMEs do not have formal management structure.

5. Out of 30 surveyed factories; only two factories have technical trained personnel in environmental management. Most of the existing factories lack technical training personnel in the field of environmental management.

6. Most of existing factories are subject to severe short-term pressures on cash flow. And this is a great issue when implementing long-term management system.

4.3 Industrial Categories

Three major industrial groups exist in the Nablus district. The first group is building materials, mainly the stone-cutting industry; the second is the food processing which includes: Vegetable oil processing, olive oil mills, sweets, tahinah, slaughter and meat processing. Finally tanning, textile, chemicals, detergents, cosmetics, metal plating and miscellaneous is the third group.

Quarries, food processing industries and other industries are located as clusters. One cluster is located in the middle of the industrial zone in Deir Sharaf and Beit-Iba. The others are located at the eastern industrial zone, and some in the residential areas in Amman and Al-Quds Streets. On-site visits of industries were made according to a recent survey conducted by the Ministry of Industry. The survey included the licensed operating factory in the Nablus district. The following table summarizes the number of industries belonging to each main industrial sector.

The interviews with the representatives of the Ministry of Industry- Nablus office elaborated a list of industries within the Nablus area. This list included a total number of 30 industries.

Table 2 and Table 3 summarize the number of industries that belongs to the three main categories; C denotes construction materials, F for the food processing industries, and M stands for metal, chemical, tanning and miscellaneous industries. The subscripts are as shown in the table. Example, Mt1 denotes tanning industry, site number 1.

Table 2: Main industries in the Deir Sharaf and Beit Iba area*

Category	Industrial Sector	No. of Industries***
M	Leather and Shoe Factories (Ms)	1
	Tanning and leather factories (Mt)	2
	Textiles (Mtex)	3
	Metal factories (Mm)	5
	Aluminum factory (Mal)	1
	Machinery and Workshops (Mw)	4
	Paper Mill Factory (Mc)	1
	Paints factory (Mp)	2
	Mineral Oil Processing (Mo)	2
	Percent of total	13.3
C	Stone Cutting facilities and Quarries	48
	Block and Tile floor factories and ready mix concrete	17
	Percent of total	43.3
F	Tahina factory (Ft)	4
	Yogurt Factory (Fd)	2
	Olive mills** (Fo)	35
	Vegetable Oil (Fv)	1
	Meat factories (Fm)	5
	Sweets (Fs)	16
	Percent of total	42.7
	Total	150

* Source: Ministry of Industry, 2002

** Source: Ministry of Agriculture,2002

*** The registered number includes all stone-cutting industries that do have or not having operation licenses.

Table 3. Main industries in the eastern Industrial Area*

No.	Industrial Sector	No. of Industries***
M	Leather and Shoe Factories (Ms)	6
	Textiles (Mtex)	1
	Tanning factories (Mt)	2
	Plastics factories (Mpl)	8
	Machinery and Workshops (Mw)	30
	Paper Mill Factory (Mc)	1
	Paints factory and mineral oil processing (Mp)	3
	Chemicals, and detergents (Mch)	23
	Percent of total	42
C	Stone Cutting facilities and Quarries (Cs)	39
	Block and Tile floor factories and ready mix concrete (Ct)	10
	Percent of total	27.5
F	Tahinah factory (Ft)	2
	Diary and yogurt Factory (Fd)	1
	Olive mills** (Fo)	14
	Vegetable Oil (Fv)	1
	Meat and food processing factories	20
	Animal food (Af)	5
	Sweets (Fs)	12
	Municipal slaughter (Fsl)	1
	Food percent	31.5
	Total	179

* Source: Ministry of Industry, 2002

** Source: Ministry of Agriculture,2002

*** The registered number includes all industries that do or do not have operation licenses.

The main results obtined during the industrial site visits including the number of employees, production quantity, water consumed and disposed of, and the main effluent characteristics are presented in Table 4.

Table 4: Summary of specific on-site visits.

No	Category	Employees	Production (per month)	Water Use (m^3/month)	Effluent Characters	Disposal Practiced
1	M t1	27	12500 (hide)	650	BOD, sulfides, Zr, Zn, pH swings, Cr^{+6}	To Wadi Sajour
2	Ms1*	250-550[II]	62500 (pairs)	100	Dyes, polymers, chemicals	Municipal sewers
3	Ms2	12	Not specified	30	Residues are reused	Municipal sewers
4	Cs1	10	2200m2	200	High TSS, slurry	Wadi Al-Zeimar
5	Mc1 Carton -Evlon	Not specified	1750 ton 12000m2	3	Not specified	Not specified
6	Ct1	16	5250 (m2) of bricks and pipes	200	High TSS, slurry	Wadi al-Zeimar
7	Ct2*	18	295 tons	500	High TSS, slurry	Wadi Al-Zeimar
8	Fv1*	50	1095 tons**	88000	Styric acids, H2SO4, other chemicals	Wadi Al-Zeimar
9	Fv2	17	270	500	Acids, degumming	Wadi Al-Sajour
10	Mtex1	14	312000 unit	750-1000	NaOH, Chlorines, sulfide, stones, shampoo	Municipal sewers
11	Fo1 ***	8	48 tons (per season)	250	BOD, high organics, TSS	Wadi Al-Zeimar
12	Fo2*	6	28 tons (per season)	100	BOD, high organics, TSS	Wadi Al-Sajour
13	Mc2	7	Not specified	63	CaCO3	Wadi Al-Sajour
14	Fv3	9	Not specified	50	Bleaches, acids	Wadi Al-Sajour
15	Fv4*	83-400 ‡‡	3000	170000	Styric acids, H2SO4, other chemicals	Municipal sewers
16	Mp1	42	325	400	Salts, pigments, CaCO3 chemicals	Wadi Al-Zeimar
17	Ms3	6	500unit PVC 5 ton plastics	5	Small quantities of dyes, SO4, additives	Municipal sewers
18	Fd1	33	470 tons	2400	Milk and fats residues	Municipal sewers

Continue Table 4...

No.	Category	Employees	Production (per month)	Water Use (m^3/month)	Effluent Characteristics	Disposal Practiced
19	Ft1	6	400 tons	220	BOD, significant amount of organics	To Wadi Al-Zeimar
20	Ft2	10	88 tons	200	BOD, significant amount of organics	Municipal sewers
21	Cs1	30	585 m^2	250	High TSS, BOD, slurry, pH swings	Wadi Al-Zeimar
22	Cs2	25	500 m^2	200	High TSS, slurry, BOD, pH swings	Wadi Al-Zeimar
23‡	Mal1*	75	Not available	130	Effluent is pretreated and reproduced	Wadi Al-Zeimar
24	Fsl	70	54000 sheep 9500 cows	1090	High BOD_5, organics, fats.	Wadi Al-Sajour
25	Cs3	8	1560 m^2	400	High TSS, slurry, BOD, pH swings	Wadi Al-Zeimar
26	Ft3	4	33 tons	140	BOD, significant amount of organics	To Wadi Al-Zeimar
27	Cs4	30	3000	Not specified	High TSS, slurry, BOD, pH swings	To Wadi Al-Zeimar
28	Ft3	3	300	240	High chloride	To Wadi Al-Zeimar
29	Fo2	5	Not specified	1100	BOD, high organics, TSS	Old town, to wadi
30	Ct2	10	2600m3 ready –mix concrete	1000	High TSS, slurry	Zeimar

* the company has a formal registration to ISO 9000 which is a management of product quality.

** Full automatic olive mill.

*** Semi – automatic olive mill.

‡ Self-declaration of adopting ISO 14001.

‡‡ The small number denotes the present employees, and the greater number denotes the number of employees before the year 1994.

4.4 Industrial Wastwater Characteristics

Out of 329 industrial facilities, 30 site-visits were conducted. Interviews were made with the governmental representatives and concerned parties. Each site was selected due to its suspected significant impacts on wastewater infrastructure, and the surrounding environment. The following observations were noticed:

Construction Materials

The stone-cutting, brick and tiles, and ready-mix concrete constitute the construction industry. This industry represents 36.6 % of the total industries in the Nablus district. The water used in stone-cutting and tile industries is sedimented in concrete tanks, with storage capacity of 3-4 m^3, and reused. These tanks are emptied regularly to Wadi Al-Zeimar and Wadi Al-Sajour.

Liquid industrial effluent flows to collection sewage system or waterways without any treatment. Considerable amounts of TSS and slurry effluent from stone-cutting wastewater pollute the soil. TSS content in the recycled wastewater (from the sedimentation tanks) was within the range of 5000 – 12000 mg/liter, **(Abdi, 1997).** A substantial flow and suspended solids load from the stone-cutting facilities will cause sewer plug and complexity of the proposed WWTP in Nablus' area. The water consumption was estimated to be 500 liters per 1 m^2 of stone for the surveyed facilities. Considerable amounts of fresh water was spilled and wasted was noticed in three factories producing bricks and tiles industries. Flow meters and water storage tanks need to be installed and maintained. The water flows continuously for cooling the cutting saws, even when the worker is resting. The sedimentation tanks for water recycling are shallow, thus considerable amount of water evaporation was noticed.

Metal Plating and Chemical Industry

The metal plating and chemical industry includes one aluminium factory, five tanneries, car-washing, two shoe-making factories, and four tanneries. Spillage of mineral oil and toxic solutions cause sever soil pollution. Leather Tanning industry produces highly toxic metals such as Cr^{+6} and sulfides in the wastewater effluent.

(i) Tanning industry sector was selected due to the considerable amounts of chemicals, toxics, and organic that characterizing its effluents. Two of the existing 4 licensed factories were surveyed, and the fifth one is not operating since 15 years. One of the surveyed factories is located in the eastern part of the Nablus city. The effluent is disposed offto the Wadi Al-Sajour. The other factory is located in the western part.

(ii) Electroplating industry

The chemicals used in electroplating industry are toxic, non-degradable, and uses high amounts of acids.

Aluminum factory had recently installed a recycling plant for chromium reuse. The tested wastewater samples were within the formal parameter, the sampling report is obtained by conducting EQA office in Nablus in 2001, and shown in **appendix 2**. The samples obtained for the sludge included high amounts of toxics and harmful chemicals. The toxic effluent sludge was kept in the yards.

Food Processing Industry

(i) Diary Industry

This industry is characterized by high water consumption. 5 – 7 m^3 of fresh water needed to produce 1 ton of milk, as stated by the manager of the factory. Thermal pollution is a problem from processed diary industry. BOD_5, COD and SS are water pollution indices. These indices are highest from industries dealing with processed foodstuffs. The manager reported thermal pollution and high pH swings from diary processing.

(ii) Olive Oil Pressing Industry

As conducted from the Ministry of Agriculture, (2002), there are 49 olive mills in Nablus district, 19 of them are full automatic, and the other 30 are semi-automatic. The total olive production is thirty six thousand (36000) tons, 20% of which are olive oil. The oil is characterized high peroxide, and high acidity.

The olive yield for full-automatic and semi-automatic processes are in the same range; (180 kg per ton olive (full-automatic) and 160 kg per ton olive (semi-automatic). The water consumed by the full-automatic oil extraction was estimated to be more than 3 times the water consumed by the semi-automatic. And this results in higher amount of wasatewater generated by full-automatic. The amount of water consumed by full-automatic olive mill was estimated to be 700 liters per ton olive pulp, while it is only 200 liters per ton olive pulp for semi-automatic. The average water consumption rate is 17 m^3/d per mill, or 850 m^3/d. The BOD was estimated to 100000 mg/liter. Comparing this value to 60 mg/l – capita per day, the value around 1670 PE. One type of the effluent wastewater produced from olive washing, the other type is of organic character called "Zibar" **(PWA, 1999).**

(iii) Nablus Slaughter House

The municipal slaughter of Nablus has an average capacity of 150 sheep per day, and 27 cows per day during the normal political conditions (before the year 2000), and 25 sheep per day and 7 cows per day at present conditions (2003). The sheep or the cow comprise the slaughter process, de-blooding, de-skinning, removal of head, feet and offals. The non-eatable offals are thrown to the municipal dump site. The effluent is chartacterized by organic compounds; fat, blood, dirt and residues of offals. The water consumption was in the range 40 – 42 m^3 per day.

Two samples were tested in the Water and Environment Studies Institute at An-Najah University. The amounts of COD, TSS, and BOD_5 for fresh concentrated sample and a diluted sample were presented in Table 5:

Table 5. The effluent parameters of the wastewater from the slaughter house.

Sample discription	Parameter (mg/l)		
	BOD_5	COD	TSS
(i) Fresh sample	950	108000	3870
(ii) Diluted sample	725	25600	502.5

* The slaughter was working only at 12.5 % of it's full capacity when the two water sample was taken from the effluent.

The word fresh denotes the sample taken immediately from the wastewater drained after slaughtering process. The word diluted stands for the sample taken at the effluent pipe to the wadi in the eastern part of Nablus city. The test was performed according to the Standard Methods for Examination of Water and Wastewater.

(iv) Tahina factories

It is an important group in food industry sector, the effluent is characterized by considerable amounts of kitchen salt. The salt (NaCl) concentration in the production wastewater of 700 mg/liter, this comes up to a chloride concentration of 425 mg Cl/liter.

4.5 Industrial Wastewater Generation in Nablus

The following sections provide detailed descriptions and findings relative to the major industrial groups evaluated for their potential impact on the wastewater Palestinian management system.

4.5.1 Stone Cutting Industry

4.5.1.1 Overview

Stone cutting industry is considered a major industry in Palestine. Moreover it is one of the heaviest water consumers. The size distribution of these facilities (large, medium or small) was not indicated in all existing documents or information sources. The difference between large, medium and small facilities is based upon the amount of stone product and the number of employees. Regardless of the facility size, the stone cutting process is the same.

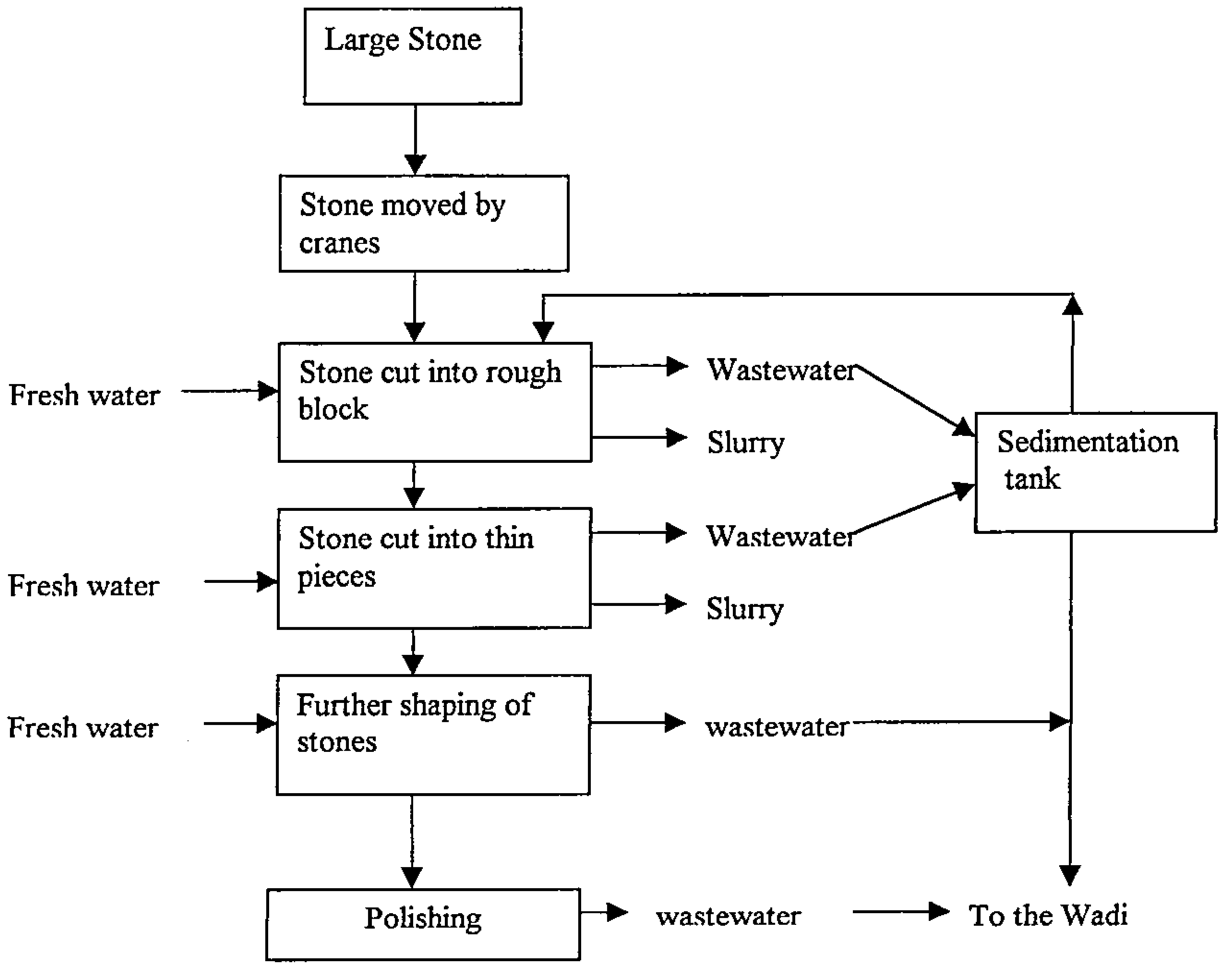
Morris and Abu Orf (1998) estimated the water consumption in Hebron city 5-10 m^3/facility-day. Thus the total slurry effluent discharged 550 – 1200 m^3/day. In Nablus, the number is expected to be higher since the stone cutting facilities do not use polymer, which is a good settling agent if properly chosen **(Morris and Abu Orf, 1998).** The water consumption gained from the 5 surveyed facilities is scattered between 4 – 11 m3/facility per day, to produce 6 m3 stone/facility-day. The Deir Sharaf and Beit Iba quarries cluster is located in the middle of a major industrial zone. Stones are used primarily for building construction, and the West Bank buildings are characterized by their stone covered appearance. Quarries produce gravel aggregates used extensively in the construction of roads, whether asphalted or not.

There is no agreement on the number of such facilities in the West Bank. Abu-Hijleh (1997) stated that there are about 400 facilities, while the Union of Stone and Marble in Palestine **(Abdi, 1997)** stated that the number is much higher (about 1000 facilities). In Nablus the stone cutting industry is also considered among the largest water consumers. From the available documents conducted in the current research, there are 48 stone cutting facilities cited in the western side, and 39 in the eastern side of the boundaries of the Nablus District, this represents 35.6% of the total number of industries.

4.5.1.2 Stone Processing

Each stone cutting facility has a raw material stockyard of large stones. In the first step, a stone is moved by cranes into the facility and is cut into a rough cubic shaped stone block (1-2 m^3). The second step saws the large stone block into thin pieces according to the desired size. Further shaping into the dimensions desired is performed using saws and shearing machines. The final step involves polishing the surfaces of these stones according to the quality desired using special polishing machines or manual finishing tools, **(Morris and Abu Orf, 1998). Chart 1** illustrates the stone – cutting process.

Chart 1. Stone – cutting process.



4.5.1.3 Water Usage and Recycle

Water is used in all three steps of production. Water is primarily used as a cooling, lubricating, and cleaning agent. The same water is recycled into concrete tank and directed through nozzles above the block are spraying continuously downward onto the active cutting surface. The two advantages of using water over the use of mineral oils, are the relatively low cost and avoiding staining or changing stone color. The water collects and carries the stone dust generated during the sawing and polishing processes. Water is drained and collected in a main swamp or collection tank.

According to the site-visits for 10 stone-cutting facilities, and information gathered, the following are recognized:

(i) Constraints to increase stone production mainly due to high water and electricity price. If water was made more available, more water will be used and less recycled for two reasons:

1. Clearer water (less TSS) will produce better stone edge.

2. Clearer water (less TSS) will increase the lifetime of the cutting saws.

(ii) The collected water, laden with stone dust and particulate, is stored in the collection tank, without using a settling aid. The solids are allowed to settle in this tank and the water is reused again in smoothing process and cooling equipment.

(iii) No settling agent is used in water collection tank in Nablus stone-cutting facilities. Polymer is widely used as a settling agent in Stone-cutting facilities in Hebron District **(Morris and Abu Orf, 1998).**

(iv) The efficient use of the polymer will increase the use of recycled water through the decrease of TSS content.

4.5.1.4 Waste Slurry

The settled slurry is the primary wastewater discharged from stone cutting facilities.

The two main methods for slurry disposal currently are:

1. Discharge to existing sewers serving the plants
2. Hauled by tank truck to neighboring wadies.

The slurry waste generation is estimated at 11.3 m^3/day for each facility **(Abu-Hijleh, 1997).** For the 87 facility in the Nablus district, the total daily generation is 980 m^3/day or 306,700 m^3/year. Population equivalent is an important issue when considering the environmental impact of polluted water. Based on the current average water usage in Nablus an average consumption of approximately 70 liter/capita-day, the flow has a hydraulic population equivalent of about 14000 people. This number represents about 10 % of the total population of Nablus city.

4.5.1.5 Slurry Characteristics

Two studies were reviewed containing information on the slurry discharged from other stone cutting industries. One was conducted by Abu-Hijleh (1997), and the other addressed the stone cutting industry in the northern West Bank **(Abdi, 1997)**.

4.5.1.5.1 Chemical Characteristics

In 1997, Abdi applied a study on 10 grab samples from 10 facilities in northern West Bank and yielded the following characteristics:

1. Most of the slurry is $CaCO_3$ and $MgCO_3$ with high alkalinity. The carbonate and calcium carbonate concentrations where calculated from the equilibrium relationships after measuring the pH and the Ca^{+2} and the bicarbonate concentration **(Abdi, 1997)**.

2. TSS content in the recycled wastewater for samples taken from channels beneath the cutting saws was within the range of 5,000 –12,000 mg/l **(Abdi, 1997)**.

3. The pH of this slurry measured for 4 different facilities in Ramallah District was estimated 8.9 –11 **(USAID and Maan, 1995)**.

4. The BOD, COD, TKN concentration are expected to be negligible in these inorganic slurries, because no organic compounds and no polymer addition are performed on the waste slurry.

4.5.1.5.2 Physical Characteristics

The physical characteristics can be summarized as follow:

1. Abu – Hijleh (1997) reported that the permeability coefficient was about 2.8 m/sec using the falling head test.

2. Column settling tests conducted at An-Najah National University on slurry without polymer addition found that, "particle settling followed zone-settling characteristics, and that 90% removal of the TSS was achieved after 80 minutes **(Abdi, 1997)**. The use of polymer was recommended for better solids removal and water recovery.

3. Mechanical dewatering would appear to recover about 65% of the slurry water **(Abu Hijleh, 1997)**.

4.5.1.6 Potential Impact of Slurry Disposal

Impacts upon the overall environment if the slurry is randomly discharged to wadies and open agricultural areas without appropriate control **(Abu Hijleh, 1997)**:

1. The low permeability of the slurry may decrease air movement to plant roots and decrease the water infiltration rate of the soil which in turn can decrease the recharge of the aquifer from rain water. Hydraulic conductivity rates for the slurry is reportedly very slow at permeability coefficients of approximately 2.8 m/sec **(Abu-Hijleh, 1997).**

2. Excessive Ca^{2+} can potentially hinder the uptake of ions by plants. The slurry could produce high soil pH values lethal to vegetation and hinder the nutrient uptake and fixation may also be hindered by high pH.

3. The increase in the pH can decrease the bio-availability of trace metals to vegetation.

4.5.1.7 Pollution Prevention and Control

Many technical viable options exist for reducing impacts from stone-cutting industry. Theses options are considered one component of an overall management plan for cost effective impact minimization.

1. Polymer is recommended as a settling agent, but efficient use of polymer is connected to the choice of polymer type and dosage. This will make efficient use of water recycling and reuse by accelerating settling process and TSS removal.
2. Other managerial instruments will be presented in the next chapters.

4.5.1.8 Ready Mix Concrete and Tile Industry

As noticed from field visits, ready mix concrete facility and tile operation have relatively small environmental impacts in total, but with problems similar to the stone- cutting industry concerning sewer maintenance and solids handling perspective. Water used and the types of reuse and wastewater discharged for production in the tile industries are similar to that described for the stone cutting industry. It is believed that the water usage and thus the daily slurry disposal for this industrial sector as a whole are very small and hence not consequential.

On site settling pond for the facilities visited handles wastewater generated by the flushing of return ready-mix concrete trucks. The TSS are settled down the pond, and the water is pump out to be reused or discharges onto an open field where it travels only a few feet before all the water is either infiltrated or evaporated. This water should pose no significant impact on the groundwater.

4.5.2 Food Processing

4.5.2.1 Olive Oil, Sesame Oil and Vegetable Oil

The vegetable oil processing industry involves the extraction and processing of oils and fats from vegetable sources. The oils and fats are extracted from a variety of vegetables, seeds and nuts.

4.5.2.1.1 Overview

According to the Ministry of Agriculture and the Olive Oil Council (2000), there are 49 olive mills in the Nablus district, either semi automatic or fully automatic. There are 19 fully automatic olive mills, and 30 olive mills are semi-automatic **(Ministry of Agriculture, 2002).** The overall all olive production is estimated 36 thousand tons in the Nablus district, around 7200 tons of olive oil or 20% of olive grains **(Olive Oil Council, 2000)**. Most of the generated wastes are discarded on vacant lands or roadsides. The preparation of raw materials for olive oil includes washing, mechanical pressing. The extraction processes are generally mechanical pressings for seeds and nuts. The liquid oil is skimmed; after pressing, the oil is filtered, the crude oil is separated and filtered. Crude oil refining includes degumming, neutralization, bleaching, deodorization, and further refining.

The olives are washed, pressed and the resulting oil-water mixture is centrifuged to separate the oil. Solid residues are collected and used as animal fodder based on the data collected from field visits. The remaining residue are sold to the soap factories. The liquid discharged to the sewer contains 83% water, 15% oil and organic compounds and the remainder represents mineral compounds. Two types of oil extraction processes are applied **(PWA, 1999):**

a. The semi-automatic oil extraction process based on vertical hydraulic presses.

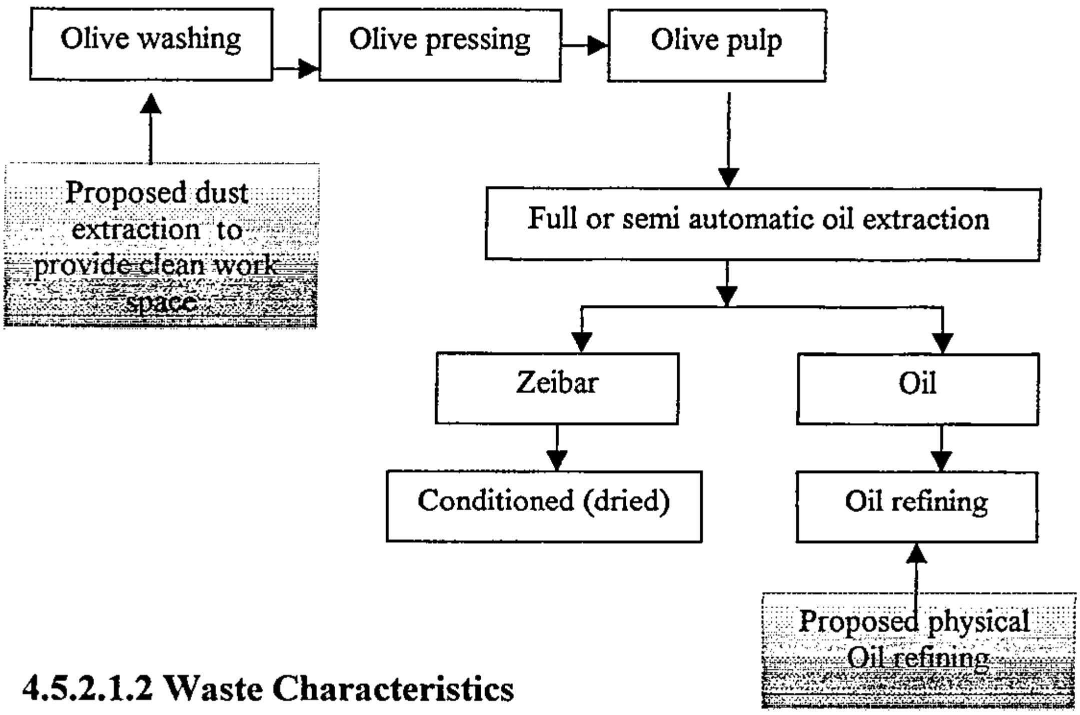
b. The full-automatic oil extraction process based on horizontal 3-phase decanters.

The basic difference between the two above mentioned types of olive oil production is the oil extraction itself, the amount of water use, the water content in the olive production cake.

In semi-automatic, a liquid mixture of oil and zibar treated to separate the olive oil from zibar by means of hydraulic process, resulting in a solid cake with 25% to 30% water content.

In full automatic oil extraction process, 3-phase decanters for the separation of olive oil, zibar and olive cake, water content in the olive cake around 50 % **(PWA, 1999).** The olive oil processing is presentented in **Chart 2.**

Chart 2: Olive oil processing



4.5.2.1.2 Waste Characteristics

In order to estimate the potential impact of food processing wastes on the wastewater management system, out of 119 food facilities, 11 major food processing facilities were visited. These included major vegetable oil processing plants, olive oil plants. The remaining factories are in fact trading factories.

Waste and spoiled foods along with other residues such as olive pressing, tahinah, vegetable oil processing, etc. are often discharged to sewer or wadies. For olive oil production, the seasonal consumption is about 870 cubic meters of wastewater is generated per day of 49 olive mills, 18 m^3 wastewater per mill. The wastewater is characterized by high organic content, resulting in BOD_5 of 40 g/liter, and COD of 120 g/liter. This organic load is 100 times stronger than municipal wastewater. The wastewater effluent also generates TSS of 15 g/liter, Cl 1200 mg/liter, Nitrogen (total) 300 mg/liter, and SO_4^{-2} content of 350 mg/liter **(PWA, 1999).**

Tahinah production steps are soaking, pealing sesame, then drying and grinding. The washwater contains dirt and salt of raw sesame corn. In addition grease and oils from machinery, cooking oils and cleaning solutions can further complicate municipal wastewater treatment processes. The seasonal nature of wastes typically adds very high BOD_5, COD and TSS loads to the sewer. In general, the final liquid residues resulting from well treated (conventional treatment in the municipal under construction plant at Deir Sharaf), agricultural or food processing wastewater typically will have little impact on agricultural reuse or groundwater recharge.

4.5.2.1.3 Pollution Prevention Control

Good pollution prevention practices and management system should focus on the following issues:

1. Optimize the use of water and cleansing chemicals. Use cleaners extracted from natural source instead of chlore and chemical soup.
2. Use citric acid instead of phosphoric acid, where feasible, in degumming operations.

3. Recover solvent vapors to minimize losses.

4. Where appropriate, give preference to physical refining instead of chemical refining of crude oil, as active clay has a lower environmental impact than the chemicals in general.

4.5.2.2 Food, Fruit and Vegetable Processing

4.5.2.2.1 Overview

Processing (canning, drying, freezing, and preparation of juices, jams and jellies) increases the shelf life of fruits and vegetables. Processing steps include preparation of the raw material (cleaning, trimming and peeling), followed by cooking, canning or freezing. Plant operation is often seasonal.

4.5.2.2.2 Waste Characteristics

The fruit and vegetable industry typically generates large volumes of effluents and solid waste. The effluents contain high organic loads, cleansing and blanching agents, salt and suspended solids such as solid particles. They may contain pesticide residues washed from the raw materials. The main solid wastes are organic materials, including discarded fruits and vegetables.

4.5.2.2.3 Pollution Prevention and Control

The large amount of wastewater effluent results from wash-water and water used for cleaning floors and machines. Proper water management should be adopted, where feasible through achieving a target level of water consumption per unit production.

4.5.2.3 The Municipal Slaughter House

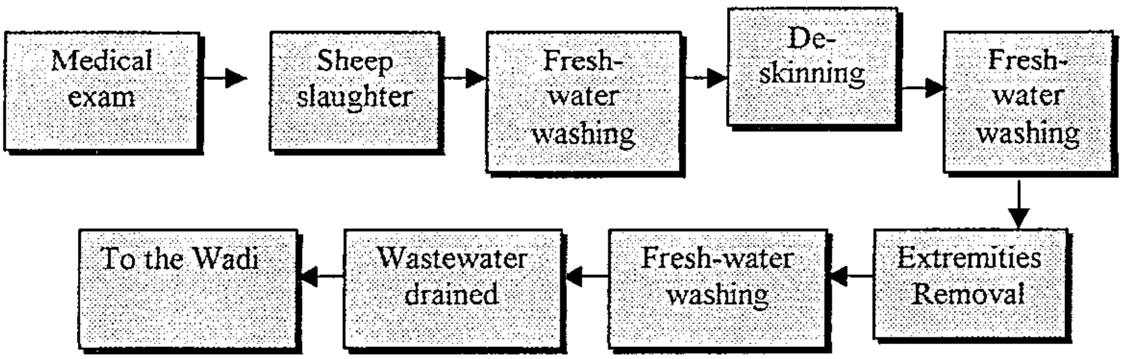
The BOD_5 for the municipal slaughter house was estimated over 250 g/liter for the blood coming out of the slaughter, and the least amount was estimated 100 g/liter **(PWA, 1999).** The amount of BOD_5 was measured 108 g/liter by the water and Environment Studies institute, see Table 5.

The water use was estimated to be 125 liters per one sheep. The following were noticed:

1. High-suspended solids, organics, blood and fats characterize the effluent, all flowing free to Wadi Al-Sajour, see the photos in the appendices.
2. The non-eatable offal removed from the slaughtered animals is dumped to the municipal dumpsite.
3. The workers in the slaughter house frequently wash the floor by using fresh water.
4. The manager stated that they started to use friendly environmental detergents (from natural source), for cleaning the slaughter house imported from Jordan. They are practicing this technique since three years. These detergents react with the biological contents in the wastewater, thus reducing the BOD_5 in the effluent.

Chart 3 illustrates the slaughtering process. First the animal under-goes a medical examination, then slaughtered, de-blooded, un-skinned, the feet, the head and the offal are removed, the eatable offal are sold to the market, the non-eatable are disposed off to the municipal dump site.

Chart 3: Schematic diagram for the slaughtering process in the slaughter house.



4.5.2.3.1 Wastewater Characteristics

The slaughter house does not have any treament facility except for a coarse screen (more than 2 centimeters openings), the fats, blood, solids, and suspended solis flows into channels, and to Wadi Al-Sajour after then, (see the photos in the appendix). The BOD_5 in the blood was estimated 100 g/liter as stated by the slaughter director.

4.5.2.3.2 Pollution Prevention and Control

The non-eatable offals and blood could be easily separated and drained off to be sold in the markets as animal fooder. Proper screening facility and sedimentation tanks could be installed to remove settelable solids. Fat traps are recommended to remove fat and grease from effluent. The slaughter director declared that the agent used for cleaning the floor is made of natural source, imported from Jordan, and is used since three years. This cleaning agent is more safe than chlore, and it an environmental friend.

More details for wastes and water effluent control will be presented in the next chapter.

4.5.3 Tanning, Metal Plating Chemicals, Shoe, and Miscellaneous

Nine miscellaneous facilities covering a broad range of industrial categories proved significant impact on the environment, were visited. Examples are:

1. Tanning industry. Out of five tanneries, Two tannery facilities were conducted, the remaining three are closed.
2. Electroplating; one Aluminum factory.
3. Chemicals, detergents, plastics, Paper, related products and cleaning agents. 6 facilities, one chemical, 3 shoe making, one paint, one carton.

4.5.3.1 Tanning Industry

4.5.3.1.1 Overview

Tanning is the process of converting animal skins into a useful, lasting product, leather. Hides are preserved by drying and salting, so that raw hides and skins will reach leather tanneries in an acceptable condition. The use of environmentally persistent toxics for preservation of raw hides should be avoided. The basic process consists of removing flesh and hair (usually) from the skin, trimming to size and thickness and impregnating the skin with a permanently bactericidal material. At this point the skin has been converted to leather. Additional steps usually include shaving the leather to a uniform thickness, oiling to provide pliability and flexibility characteristics, dying to the desired color and other surface preparations specified by the end user. A wide range of processes and chemicals, including chrome salts, is used in the tanning and finishing processes.

The tanning process consumes major quantities of water, typically 100 liter of water per kg hide **(Thorstensen, 1998)**, and generates significant pollution loads to the environment, primarily in the wastewaters; somewhat as solid wastes, and frequently as objectionable odors.

There are five tanneries in Nablus district; one of them is not operating since 15 years. Three of these are in the western side of Nablus, and the other two in the eastern side, all are discharging their wastes into the wadies.

These tanneries are considered to be small, each employing 10-25 workers and processing about 500 hides per day. Each tannery uses 11-20m^3 of water per day, or 22-40 liter/hide.

4.5.3.1.2 Tanning Process

Tanning and finishing process generally consists of:

1. Soaking and washing to remove salt, using germicide, Na_2CO_3, restore the moisture content of hides, and remove dirt and manure. Fresh hides do not need soaking and desalting, thus less water consumption is achieved.

2. Fleshing to remove fatty tissue from the hides. The water used for this soaking-washing process is drained to the municipal sewers and contains high TDS or salinity, high TSS, moderate to high BOD concentrations along with some fat grease.

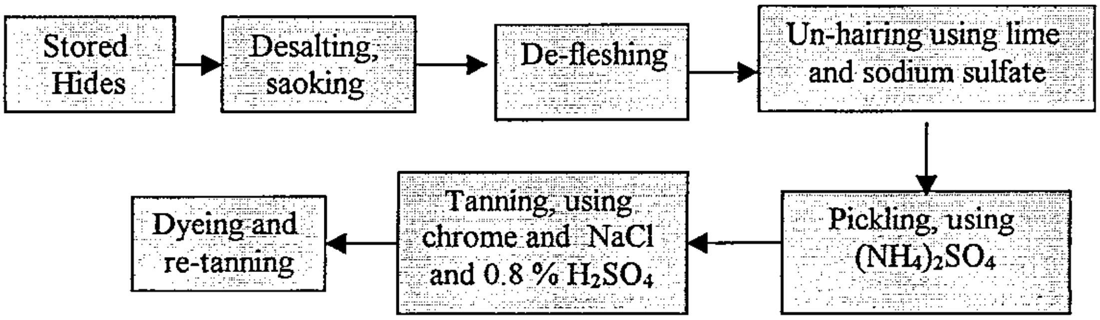
3. Un-hairing to remove hair or wool by using lime and sodium sulfate and enzymes. The pH of the solution is around 11 **(Morris and Abu Orf, 1998).**

4. Rinse using fresh water, pickling to delime the skins using $(NH_4)_2SO_4$, chemicals are added to adjust pH up to 8. Then the hides are conditioned to receive the tanning agents.

5. Tanning to stabilize the hide material using a solution of 8 % NaCl and 0.8 % H_2SO_4 added to 3 m^3 of fresh water. Next about 8 kg of chromium sulfate are added to the drum per 1000 kg of hides **(Morris and Abu Orf, 1998).** The excess water with very low pH and high chrome is discharged to the valley. Re-tanning, dyeing and fat liquoring to impart special properties to the leather increase penetration and impart color.

The following schematic diagram summarizes tanning process, and indicates where the savings and less polluting process.

Chart 4: The present tanning process diagram.



The pollution control is introduced in the following section, and summarized in the next section.

4.5.3.1.3 Waste Characteristics

Based on the chemicals employed in the tanning process, the composition of the tannery effluent is very complex in nature. According to UNEP (1991), the amount of chemicals and tanning materials vary depending on tanning recipes and fashions changes and colors **(UNEP, 1991).** Table 6 illustrates the composition of raw tannery effluent.

The potential environmental impacts of tanning are significant. Composite untreated wastewater has significant amounts of physical and biological loads stronger than domestic wastewaters **(Al-Sous, 2000).** The TSS, BOD_5 and TKN loads can be handled by conventional biological treatment processes if appropriate allowances are made.

High toxic compounds (such as hexa-chromium, trivalent chromium and sulfides) characterize the discharge of tanning. However of special concern are the high sulfide (S^{-2}) and high chrome loads along with the sulfate (SO_4^{-2}) generated from the ammonium and chrome salts and the sulfuric acid used in the tanning process **(Al-Sous, 2000).** The sulfates are very likely to be reduced to sulfides in the main trunk sewer leading to the wastewater treatment plant under low flow conditions, especially during warm weather. Hydrogen sulfide (H_2S) will be potentially generated enters the gas phase and cause crown corrosion where pipe coal tar epoxy coatings are incomplete or have been compromised by erosion. These sulfides also will cause excessive corrosion in the head works of the proposed treatment facility.

The high pH of tannery wastewater will also cause extensive corrosion problems unless neutralized in sewers. Chrome is of special concern, because it may bio-accumulate in residual wastewater treatment plant sludge, and hence presents final sludge disposal problems **(Thorstensen, 1998)**,. Decaying organic material produces strong odors. Hydrogen sulfide is released during dehairing, and ammonia is released in deliming. Large quantities of sludge are generated. Typical tannery effluent characteristics are shown in Table 6.

Table 6: Typical tannery effluent characteristics (UNEP, 1991).

Parameter	Value*
pH	9
Total solids	10000
Total suspended solids	2500
BOD_5	900
COD	2500
Sulfide	160
Total Nitrogen	120
Ammonium Nitogen	70
Cr^{+3}	70
Cl^{-1}	2580
Sulfate SO_4^{-2}	2000

* All the units in mg/liter except pH value.

4.5.3.1.4 Pollution Prevention and Control

Nazer (2002) has developed a method of unhairing – liming of hides in the tanning industry. The results obtained in her study revealed that the effluent of the dehairing process could be reused 4 times without visible effects on the quality of the final product of leathers. The modified method proposed reduced the costs of dehairing – unliming process and reduced the environmental impact of the pollutants generated from the process **(Nazer, 2002).**

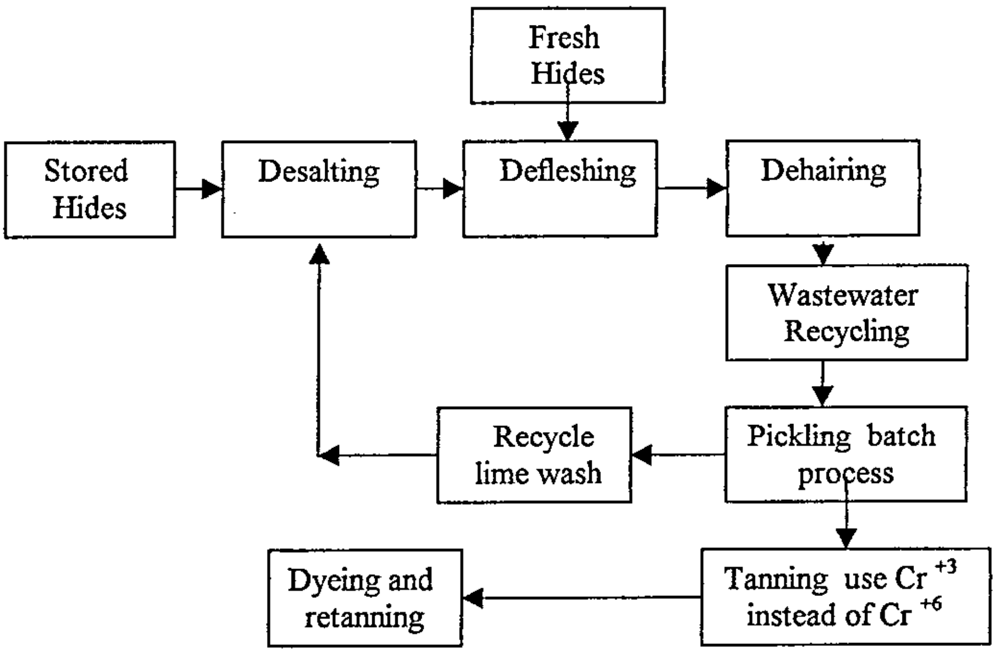
Other processes for pollution prevention can be summarized as follow:

1. Change in process; process fresh hides, substitute toxic materials when feasible, use batch process for soaking instead of continuous.

2. Recycle wash water.
3. Segregate wastestreams by screening and sedimentation after dehairing process.

Chart 5 presents the proposed management practice to reduce pollution in the wastewater effluent. More detailed pollution management and control practices are presented in the next chapters.

Chart 5: Proposed tanning process diagram.



4.5.3.2 Metal Plating Industry

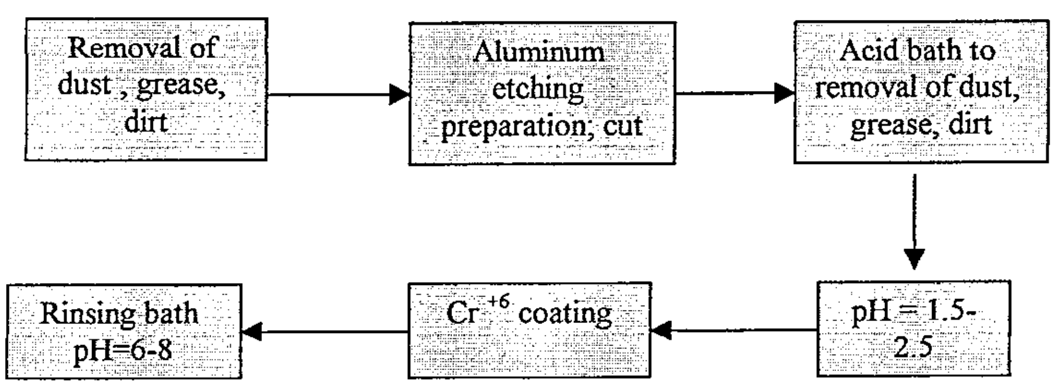
4.5.3.2.1 Overview

Metal finishing is performed on manufactured parts after they have been shaped, formed, forged, drilled, turned wrought, cast, etc. Common metal finishes include paint, lacquer, ceramic coatings, and electroplating. Plating and surface treatment processes are typically batch operations, in which metal objects are dipped into and then removed from baths containing various reagents to achieve the desired surface condition. The processes involve moving the object being coated through a series of baths designed to produce the desired end product. These processes can be manual or highly automated operations, depending on the level of sophistication and modernization of the facility and the application.

4.5.3.2.2 Batch Processes

Metal surface treatment and plating operations have three basic steps; first; surface cleaning or preparation, which involves the use of solvents, alkaline cleaners, acid cleaners, abrasive materials, and water. Second; surface modification, which involves some change in surface properties, such as application of a metal layer or hardening. Finally, rinsing or other work-piece finishing operations to produce the final product. The aluminum factory is of special concern since it is located in the catchment area of the proposed WWTP in the western part, and the production water (130 m^3/day) discharges to the sewer system of the Nablus city. The only arrangement that was informed by this industry was about the bath of anodizing plant and the pretreatment plant for the powder painting is presented in **Chart 6.**

Chart 6: Aluminum plating using chrome powder; (clean process).



The chromium and the acid solutions are not removed from the bath (internal recycling).

4.5.3.2.3 Waste Characteristics

Any or all of the substances used in electroplating, such as acidic solutions, toxic metals, solvents and cyanides can be found in the wastewater, either from rinsing of the product or the spillage and dumping of the process baths **(Cheng *et al.*, 1995).** The solvents and vapors from hot plating baths result in elevated levels of volatile organic compounds (VOCs) and, in some cases, volatile metal compounds. The wastewater stream is usually high in heavy metals, including cadmium, chrome, lead, copper, zinc, nickel, cyanides, oil and grease.

Furthermore, hydrocarbons and sulfates are also included in the wastewater. Sulfate in the wastewater of anodic oxidation treatment plants causes the most problem. With field proven precipitation of lime sulfate values depending on the total ion load of the wastewater of 2000 up to 8000 mg/liter are expected **(Beitelsman and Hijjawi, 1999).**

4.5.3.2.4 Pollution Control

Aluminum, chrome, nickel, copper, cobalt and tin are considered worldwide as dangerous substances and must be removed from with the best available state of the art techniques. Dangerous substances are supposed to be poisonous, long-life, and capable of changing DNA characteristics **(Beitelsman and Hijjawi, 1999).**

More details concerning the characteristics and pollution management and control will be presented in the following chapters.

4.5.3.3 Chemicals, Detergents, Pulp, Paper and Miscellaneous

Due to the size or the type of water use, the processes used were judged to have little impact on the wastewater management system. However there were disturbing practices observed that could lead to threats to the groundwater resource, and human health and safety. In the surveyed locations, like car-washing, jeans express, it was noted that they disposed of spent cutting oils, solvents, or other potentially hazardous materials in a casual fashion. Typically this pcatice considerably harms the soil beneath or adjacent to their production area. The factory owners disposed the grease and contaminant-laden material to the adjacent fields, or to the municipal sewerage system or to an on-site infiltration or cesspit. These disposal techniques pose a direct threat to the groundwater that underlies the entire region. This did not appear to be malicious or irresponsible dumping, but rather a harmful practice due to ignorance. This points directly to one of the basic needs for public and industrial educational programs.

Chapter Five

Management Concept

5. Management Concept

5.1 Management Concept Formulation

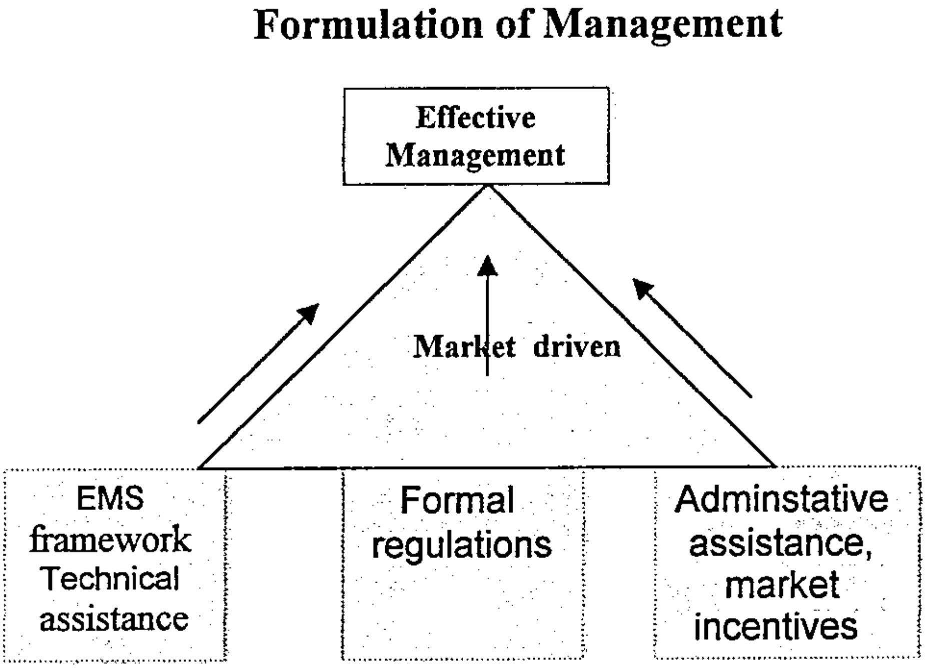
Palestine shares the world's growing concerns about waste minimization and pollution prevention. Many of the processes and products associated with modern lifestyles have deleterious effects on the environment. For example, they may release pollutants into the atmosphere or into water or soil. Or, if managed improperly they may produce excessive waste, which not only causes pollution but also necessitates expensive waste treatment and disposal strategies **(EPA1, 1997).**

This sets out to promote and stimulate sustainable development and environmentally sound practices in Palestine. It emphasizes prevention; reduction and minimization of harm to the environment, including that caused by waste and pollution.

To achieve these goals a strategic framework and management concept have been developed for the industrial wastewater management requirements of the Palestinian community, taking Nablus district as a case study. To be effective, the strategy requires support from industry, authority and local government and the community. It identified the need for significant changes to industrial effluent management practices in Palestine. This management concept should ensure the commitment to the Palestinian Environmental Strategy, Palestinian Environmental Law, together with the management practices under the International Standard

Organization ISO 14001. Compliance to formal regulations, technical assistance, and the industrial incentives form the base of a pyramid to reach the integrated environmental management **(EPA2, 1997)**. This can be expressed in terms of the pyramid **(Chart 7).**

Chart 7: Integrated management approach.



Initially, efforts are directed towards environmental policy and management system. Programmatic approach towards achieving regulatory compliance, together with the industrial incentives and institutional administrative assistance form the base of the pyramid. This is the foundation stone for the enterprise success in the marketplace, as the business becomes more competitive and customer-driven, and the expectations of the regulators are met **(EPA4, 2000).**

5.2 The Palestinian Environmental Strategy

The Palestinian Environmental Strategy (PES) and the Palestinian Environmental Law (PEnL) are the legal regime of the environmental compliance of the industrial enterprises. The Palestinian Ministry of Environmental Affairs (MEnA) known today as the Environmental Quality Authority, had always sought to promote the sustainable environmental development for the Palestinian society. The MEnA (1999), in co-operation with the Netherlands Development Agency (NEDA) had developed the Palestinian Environmental Strategy (PES). The objective of this PES is to identify, analyze and control environmental problems and their causes in Palestine, define environmental objectives to introduce a series of prioritized measures that will lead to reaching these objectives.

PES indicated that lack of efficient industrial wastewater control and management is linked to the depletion of water resources and deterioration of water quality in Palestine. The PES stated the major types of wastewater generated by industrial categories, and the associated environmental and health impacts **(MEnA, 1999).**

The PES had set-forth measures to control the out-coming threats to the environment from industrial processing. The measures include setting industrial wastewater standards **(appendix 1)**. This will include pre-treatment requirements, and standards for discharge into sewer system or Wadies, as well as full-treatment requirement for direct discharge. Also setting up monitoring and enforcement systems that support these measures.

The Palestinian Environmental Law had set-forth prohibitions to prevent environmental pollution; also pollution charges and punishments against polluters were enacted. But no charge records were documented. Also no regular inspections are performed, no laboratory records to wastewater effluent discharges exists.

5.3 Environmental Management Systems

Several mechanisms are now emerging as effective ways to improve environmental compliance in countries that lack the necessary institutional capabilities for formal regulations **(World Bank Group, 1998)**. These include Environmental Management System, Cleaner Production, Pollution Inventories and Information on Enterprise Performance. These mechanisms are shown in Table 7, and will be further discussed in the following sections.

Table 7: Mechanisms for improving and developing environmental compliance

Mechanisms	Requirements	Impact
1. Environmental Management Systems	International Trade and market pressures; commitment from management	Impacts of industrial 'facilities are managed by a process of continuous environmental management improvements that are regularly monitored, measured and reported.
2. Cleaner Production Techniques	(a) For government; regulations and real natural resource pricing.	Improvements in industrial processes and management
	(b) For industry; commitment from management	Reduce in the volume of pollution generated, increase production efficiencies, and cut overall operating costs.
3. Pollution Inventories and information on enterprise performance	Industry monitoring of pollution loads, and government monitoring and dissemination of data on pollution load	Collection and dissemination of environmental information can result in open discussion and improvement for firms with poor performance.

Environmental Management systems (EMSs) such as ISO 14000 series are seen as mechanisms for achieving improvements in environmental performance. EMSs are the logical complements to cleaner production techniques.

The best-known common framework of EMS is the International Organization for Standardization (ISO) 14000 series. These series of standards are designed to produce globally accepted systems for an enterprise' environmental performance **(EPA2, 1997).**

The ISO 14001 describes a system that includes an environmental policy, targets and objectives, programs for implementation, monitoring and measurement, and corrective action. An organization's environmental policy must reflect management's commitment to compliance with applicable laws, pollution prevention, and continual improvement. The policy then forms the basis for establishing objectives and targets. Companies carry out a program to achieve those objectives and targets through operational controls, organizational structures, and accountability.

5.3.1 The Benefits of an EMS

The broad benefits that can be reaped from adoption of such environmental management systems, according to World Bank Group are:

1. The direct benefits to an industrial enterprise of implementing an EMS usually come from savings through cleaner production and waste minimization approaches. An order of magnitude estimate is that 50% of the pollution generated in a typical "uncontrolled" plant can be prevented, with minimal investment, by adopting simple and cheap process improvement **(World Bank Group, 1998)**.
2. The control of industrial pollution and improve the performance of many polluters. This can be gained through production efficiencies and management improvements; these measures are grouped under cleaner production and eco-efficiency.
3. The potential benefits of eco-efficiency are unequivocal: good

operational practices can achieve considerable improvements in environmental performance at low cost and get the maximum benefits in the hardware.

4. In the context of increasing free trade, is the concern that environmental performance may become an important commercial factor, either as positive attributes or as potential trade barrier, this will help to emerge in competitive with the international markets **(Miles *et al.*, 1999).**
5. A good EMS allows an enterprise to understand and track its environmental performance. It provides a framework for implementing improvements that may be desirable for financial or regulatory requirements. Ideally, it is built on an existing quality management system.
6. The application of EMSs and cleaner production techniques can reveal cost-saving opportunities in industrial restructuring.

5.3.2 Obstacles in Implementing EMS in Palestine

A common feature of the industrial facilities in Palestine is that most of the industrial enterprises are small and medium size (SMS) **(USAID and Maan, 1995).** The use of EMS in SMEs enterprises is difficult because:

1. According to the site visits and interviews with the stakeholders, the industrial management quality, which is the prerequisite of the integrated environmental management system, was not purchased by the Palestinian Local Government. The Palestinian market is not protected

against poor quality products, or against environmental noncompliance product suppliers.

2. In Palestine, negotiated agreements between governmental affairs and industry do not exist. The negotiated agreements between the government and industry, as partnership, offer a way to take concrete steps towards pollution prevention steps while the details of regulations are still evolving.
3. The difficulties of regulating the large numbers of small enterprises and the potential efficiency improvements that are believed to exist.
4. Most of SMEs do not have formal management structure.
5. Most of SMEs lack technical training personnel.
6. SMEs are subject to severe short-term pressures on cash flow.
7. The certification to EMS with the requirements of ISO 14001 can entail significant costs. For firms concerned about having certification that carries real credibility, the costs of bringing international auditors are typically quite high.
8. Targeted training in management and quality control can improve overall performance and can provide a basis for more specific EMS.
9. Many firms can reap significant benefits from introducing quality management concepts, even where they are not aiming at formal certification. Government should encourage any step in this direction **(Miles *et al.*, 1999).**

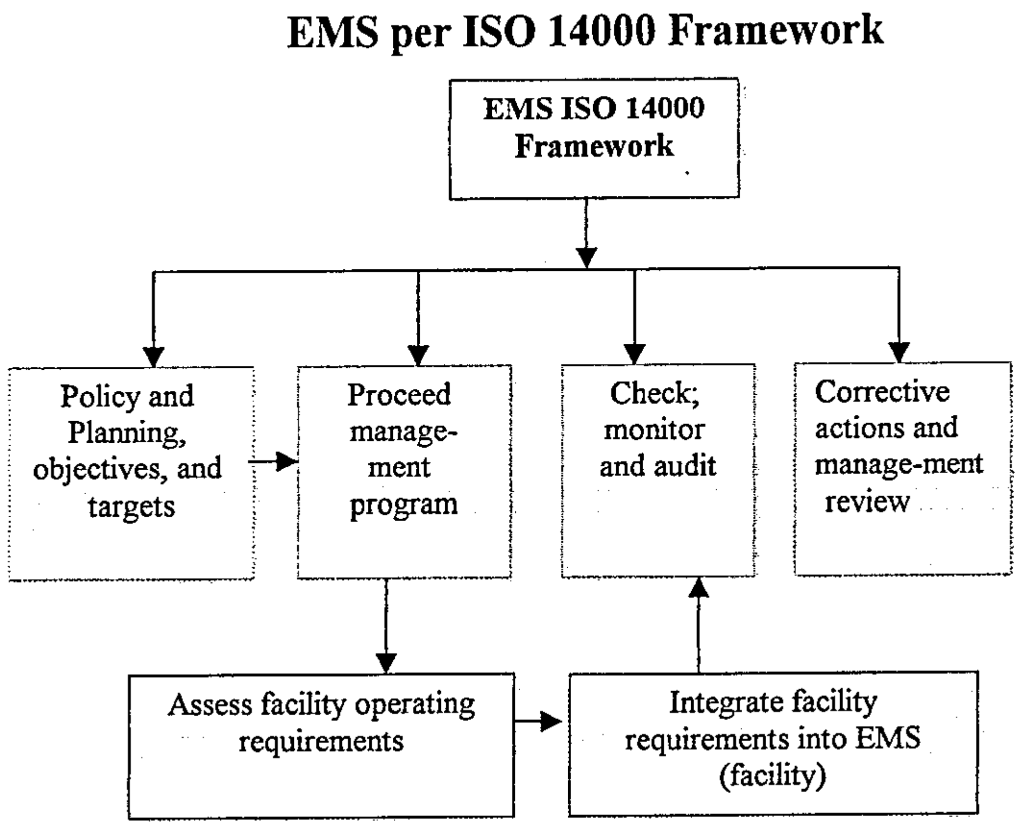
5.3.3 The EMS Elements

The Environmental Management System (EMS) contains the following elements:

1. An environmental policy support by top management.
2. Identification of environmental aspects, significant impacts and legal requirements.
3. Environmental goals, objectives, and the targets that support the policy.
4. Environmental management program.
5. Definition of roles, responsibilities and authorities.
6. Training and awareness procedures.
7. Process for communication of the EMS to all interested parties.
8. Document and operational control procedures.
9. A program for auditing and corrective action.

An EMS per ISO 14000 is a systematic format for controlling the impact of an enterprise's activities and products on the environment. Under the guiding principle of "continuous improvement", the standard requires an environmental policy that is based on a comprehensive analysis of significant environmental aspects, and a commitment to pollution prevention. The following elements cascade from the policy planning (objective and targets), implementation and control, checking and corrective action, and management review. This can be summarized in the following schematic diagram.

Chart 8: Systematic format integrating the elements of EMS.



To begin, a company's current system will need to be compared with the ISO 14000 requirements to identify gaps (i.e. areas requiring improvement), assess facility-operating requirement. Then integrate the facility requirements into the environmental Management System. Typically, gabs are found in training, company procedures, and corrective actins together with the management review process.

5.3.3.1 Environmental Policy Supported by Top Management

The development and implementation of strategic plans provides a framework within which environmental management can be optimized in terms of net environmental benefits. It defines the appropriate level of treatment to minimize the financial burden.

Pollution prevention is not something that any single industrial enterprise' manager can do alone. It requires cooperation and effort by many people in the enterprise. Before starting a program, you need to be sure the company president supports the concept. This is the principle of operation that should be kept in mind.

To begin, you will need a written policy signed by the company president stating the company's commitment to pollution prevention. Secondly, responsibility will need to be assigned and action plans developed. A good way to begin a program is to form a company team within the industrial enterprise, conduct a waste reduction opportunity, and identify the assessment. Following the assessment, action plans can be developed to implement the most significant waste reduction opportunities identified by the team **(EPA24, 2000).**

A well structured gap analysis on the direction toward sustainable development and where EMS per ISO 14000 series, or self-declaration of EMS will likely direct the manager. The following significant aspects

1. The EMS should reinforce intergovernmental environmental standards in sustainable industrial development.
2. The process within the EMS per ISO 14000 performance represent the perspectives of the major environmental stakeholders.
3. The economic consequences of EMS (self-regulating) or formal register in ISO 14000.
4. Can EMS be integrated into public law and policy or it can't.
5. The corrective action if ISO 14000 does not guarantee the the environmental performance.

5.3.3.2 Identification of Environmental and Legal Aspects

It is clear that the EMS is not a substitute for a statutory framework. The first step in implementing an environmental system is to examine the legal requirements, then review the company's existing environmental systems if any, as well as quality systems, which could easily be expanded to include environmental elements. Based on the results of the gap analysis, the business' priorities for improving existing systems and developing new systems can be determined.

5.3.3.3 Environmental Goals, Objectives, and Targets

For effective implementation, an organization should develop the capabilities and support mechanisms necessary to achieve its environmental policy, objectives and targets.

Objectives can include commitments to:

1. Reduce waste and the depletion of resources; i.e. reduce water consumption per unit production.
2. Reduce or eliminate the release of pollutants into the environment. I.e. eliminate heavy metals, toxics, and trace metals from the industrial wastewater effluent through product processing before discharge to the environment.
3. Minimize the environmental impact of new developments.
4. Promote environmental awareness among employees and the community.

Progress towards an objective can generally be measured using environmental performance indicators, which reflect an industrial enterprise ambitions and context. Practical examples of these objectives:

(i) Quantity of raw material used.

(ii) Quantity of emissions such as hexavalent chrome.

(iii) Wastewater produced per quantity of finished product.

(iv) Efficiency of material used.

Policy, target and action plan can be defined as:

- **Policy**: To conserve natural resources.
- **Objective**: To minimize the use of water, for example in tanning industry, wherever technologically and commercially viable.

- **Target**: To target the reduction of water consumption to certain percent of the present levels within a pre-defined period of time. Such a target would in turn have to be translated into a number of action plans, including for example:
- **Action Plan**: Install equipment to recycle rinse water for process; such as salt elimination, for reuse in another process, which does not require water of the same high quality **(Freeman, 1995).** Other example use batch washing of hides instead of continuous washing.

5.3.3.4 Environmental Management Program

An environmental system will include methods of evaluating environmental impacts and systems for responding to emergencies.

The industrial organization must have a plan, or management program, to help meeting each stated objective and target. The program must include defined responsibilities and timing. For example, a business could have an objective to reduce its water use per unit production, supported by a specific target to reduce water consumption by a specific percent over the previous year or years. The program for achieving this target could include detailed plans for improving operating efficiencies in the plant, using batch processes instead of continuous washing, use a pressurized nozzle to concentrate water, and replacing a piece of old equipment by more efficient one. In this way, the program supports the objectives and targets, which support the overall policy, creating a framework for improving the environmental system.

5.3.3.5 Definition of Roles, Responsibilities, and Authorities

The head policy for an industrial enterprise, the objectives, targets, and the action plan for waste minimization, are defined. The head manager of the factory should assign the team responsible for the management task. He or she should name the person who is responsible, the auditor, and the workers whom are employed to apply the action plan within the EMS for the factory.

5.3.3.6 Training and Awareness Procedures

The successful implementation of an industrial wastewater management plan is dependent upon the skill and experience of the operating and management staff as well as the management framework in which they work **(EPA2, 1997).**

Both technical and managerial training is required in order to build on the skills of staff and ensure that the industrial wastewater management runs smoothly and efficiently.

5.3.3.7 Process for Communication of EMS

The results of an enterprise' self-auditing and monitoring of environmental compliance should be kept in acceptable format. This data should be updated and available to all management employees working in the factory. Also this data should be reported to the responsible environmental authorities and relevant parties, as required.

5.3.3.8 Document Control

Document control is a good example. Many companies have poor control of critical documents. A system is required to ensure that important management-related documents are up-to-date and available where they are needed. This same system can be used to ensure that environmental documents are available and current. Internal auditing system is another example of documented procedure control to ISO 14001 compliant systems. Each organization should choose an auditing system that will work most effectively within its own unique environment. This will be discussed in the following section.

5.3.3.9 Auditing and Corrective Action

Audits and inspections are tools to help the facility manager locate potential problems before they arise. The usefulness of the internal audit tool is directly related to how consistent the methodology and the record keeping are. The whole purpose of the Audits and Inspections is to provide a common, user-specific, roles-complaint base that directs audits and collates results so that areas for action are clear and valid by keeping track of inspections, checklists, and violations within a facility **(EPA2, 1997).**

The basis of any compliance program is the ability to identify and correct areas of non-compliance **(EPA2, 1997).** When inspections are performed, the results are record and any of the violations within the system is tracked. Determining specific areas that need to be evaluated and ensuring the inspections are done consistently, has always been a barrier to a good audit and inspections. The time of the inspection, the date of the inspection, and the name of the person performing the inspection log each inspection. The system inspectors should track any violation during an inspection. Corrective action is taken in a timely manner. Current results are linked to past results so that progress or problems over time are evident.

The findings, conclusions, and recommendations reached as a result of audits and reviews of the Environmental Management System should be documented. The necessary corrective and preventive actions identified Management should ensure that these corrective and preventive actions have been implemented and that there is systematic follow up to ensure effectiveness.

5.3.4 The Role of Palestinian Stakeholders

Although ISO 14000 is a set of voluntary standards that individual companies may or may not choose to adopt, government can have a role in providing information on the sectors and markets where ISO certification is a significant issue and assessing industrial sector organizations to develop appropriate responses. Also the government can help to establish a certificate framework to asses companies to adopt ISO14000 based on strengthening Palestinian Organization Standards and encouraging competitive private sector provision of auditing and certification services **(EPA3, 2000).**

Palestinian Government should see Environmental Management System (EMS) and ISO 14000 approaches as a part of a broad environmental strategy that includes regulatory systems, appropriate financial incentives, and encouraged industrial performance. Such encouragement can be effective where there is cooperation at the government level between the relevant departments, including Ministry of Industry and Trade, as well as the Environmental Affairs.

5.4 Pollution Inventories and Enterprise Performance

5.4.1 Overview

Pollution inventories can accelerate environmental compliance by providing information base for understanding pollution problems, actions, and identifying opportunities for cleaner production.

On the factory level, pollution inventories are a comprehensive current accounting of specific pollution discharges. On the government level, it should be the database of regularly updated, reliable information quantifying industrial releases of specific pollutants **(Freeman, 1995).**

Firms can use pollution inventories to pressure their suppliers to make changes. Pollution inventories are also useful tools for setting firm's internal environmental management system.

The challenge lies in determining which tool or combination of tools, can be more effective in Palestine situation.

5.4.2 Obstacles in Palestine

It is difficult to implement the Pollution Inventory mechanism in a developing country like Palestine for the following reasons:

1. The Pollution Release Inventories is very recent in industrialized countries, and the results of using this management system in the developing countries are still unfolding.
2. Pollution Inventory Mechanism is feasible for the government. Application of this environmental mechanism requires the Palestinian Governmental Affairs to develop a continuous monitoring and sampling program of industrial wastewater.
3. The industrial enterprise must, voluntary and mandatory, report periodically on what was released, the quantity involved, and to which environmental media. And this is not applicable in Palestine because of the cost and the mentality of the factory owners.
4. This mechanism is more applicable in industrialized countries, and focuses on chemical substances and effluents. Most of the pollution burden in industrial wastewater, in developing countries like Palestine,

is conventional; it is characterized by high BOD, COD, TSS, TDS, turbid, and odorous.

Therefore, this mechanism was not included in the development management plan.

5.5 Cleaner Production Techniques

5.5.1 Industrial Efficiency and Environmental Impact

The Cleaner Production (CP) is a conceptual approach aiming at reducing industrial environmental impact through a better use of natural resources, techniques, and proper management of process and activities **(Siebel, 1999).** Seibel reported that industrial efficiency (IE) could be improved by applying the CP approach according to

$$IE = \frac{\text{Product generated}}{\text{Raw material used + waste production}}$$

Obviously, this approach has the advantage that less raw material used to generate the same product (economic efficiency improvement).

Cleaner Production (CP) minimizes the use of resources and reduces the wastes discharged to the environment. The WBG (1998), World Bank Group reported that in many cases, the adoption of CP improvements can reduce or even eliminate the need for end-of-pipe investments and can therefore provide both financial and economic net benefits, see examples in the next section. As a rough guide, 20–30% reductions in pollution can often be achieved with no capital investment required, and a further 20% or more reduction can be obtained with investments that have a payback time of only months **(WBG, 1998).**

CP is also attractive because of concerns about the lack of effectiveness of end-of-pipe solutions: there are numerous examples of poor operation and maintenance of treatment plants, with resulting failure of the system to achieve its objectives.

Reported figures for the textile industry in one South American country indicate that 38% of the plants have treatment systems installed, but more than half of these were not operating properly, reducing the effective share of plants with treatment to about 17% **(WBG, 1998)**.

Cleaner Production (CP) and related approaches will be increasingly important in environmental management in the future. However, changes will require effort and will be gradual. CP should therefore be seen as part of an overall approach, not as a "costless" alternative to a comprehensive set of environmental polices and regulations.

The introduction of CP is an ongoing process: as resource prices and disposal costs continue to rise, new opportunities arise for pollution prevention and reductions in treatment costs. For this reason, CP can be linked closely with Environmental Management Systems.

5.5.2 Proposed Framework of Governmental Departments

A number of key characteristics of the government framework required for the promotion of CP have been identified **(EPA3, 2000)**:

• A broad macroeconomic context that sets real resource prices, encourages investment in new technology, and supports an orientation toward export markets, thus providing strong incentives.

• A predictable and flexible regulatory regime under which predictability will encourage investment in pollution management and flexibility will allow enterprises to adopt the most cost-effective solutions.

• A credible enforcement system to provide backbone for the regulations.

• Targeted measures to assist enterprises in adopting cleaner production.

In Table 8, examples of possible roles of environmental affairs for cleaner production are presented.

Table 8: Possible Roles and Responsibilities for Cleaner Production

Responsible Agency	Agency Proposed Activation	Influencing Future Investment towards cleaner production
1. Palestinian EQA; (MEnA in the past)	Establish environmental objectives	Establish clear framework of long-term objectives and environmental requirements
2. Ministry of Industry and Trade	Mobilize sectors and identify necessary structures.	Identify and promote appropriate technology; support improvement of environment.
3. Trade Unions and work-force union	Assist in identification of issues and opportunities: upgrade work-force skills.	Promote continued training of work force in necessary skills.
4. Academic Institutions	Provide advice; conduct research on local problems	Develop technical and management skills to drive local initiatives in clean technology.
5. NGO's	Transmit local community viewpoints and priorities; assist in monitoring progress; reach firms and groups that are outside the structured industry associations.	Mobilize public support to improvements in new techniques.

Chapter Six

Technical and Administrative Implementation

6. Technical and Administrative Implementation

Management proposed action plans, the difficulties, all assumptions made to achieve the goals as well as the indicators that the goals are achieved, are summarized in Table 9. A detailed discussion on these items is presented in the next sections. The following issues must be taken into consideration, because the movement toward a formal global environmental management system will dramatically affect them:

1. The existing industrial facilities in Nablus, as well as the Palestinian industrial sector is dominated mainly by small to medium enterprises (SMEs). Consequently, they did not have the internal resources, facility operating requirements, for ISO 14000 adoption. The certification for ISO 14000 for large multinational companies may simply involve the paying of a registrar for objective, third party certification **(EPA2, 1997).**
2. SMEs control less management capital, and labor resources in total and enjoy substantially fewer discretionary resources that may be reallocated in environmental management.
3. A great motivate for SMEs is that in developing countries, factories are concerned neither with the environmental advantage nor economic opportunity that ISO certification may or may not bring, but with the economic disadvantage from not getting involved in global market **(Tanner, 2001).**

4. Factories that are producing high technology products or serve high technology industry tend to adopt ISO 14000 and other innovative environmental improvement mechanisms to satisfy customer and international market.
5. In most case, SME's are managed by the owner/founder, and have less formal management and planning. Also SMEs manage only one site, so objectivity would be an issue. Outside, objective auditors may be useful to mediate compliance and reputation problems.
6. Factories that are registered in ISO 9000 will be more likely to adopt ISO 14000. The ISO 9000 program establishes ways for suppliers to demonstrate that their processes include adequate quality control steps, while ISO14000 series identify how companies can meet appropriate environmental standards and document such performance. The ISO 14000 series was transplanted from the ISO 9000 series of standards of quality management, where a company standardizes a process, not a product's performance. The multiplier effect of the supplier condition created a wave of ISO 9000 certifications and a huge market for certification consultants. This fear of market pressure is being the motive for the ISO 14000 certification **(Wardojo A., 1998).**

From economic point-of-view, the economic benefit can be gained from the lowering penalties, avoid environmental accidents, fewer audits and workplace disruptions, easier permits than others who are not adopting EMS.

Table 9: Proposed management proposed plans, actions, assumptions to achieve the objective and goals and the indicators of achieved goals.

Goals and Objectives	Main Issues	Possible Roles for the Concerned Parties			Indicators
		Government	Industrial enterprises Owners	NGO's, Trade Unions, acadimec Institutions	
1.Environmental Compliance to PES and Policy	1. Contamination in effluent ww and waterways 2. Political instability holds back environmental planning. Lack of enforcement. 3. Shortage of environmental engineering skills. 4.Cost burden for government (inspection) and factories.	1. Continous evaluation and modification to the existing standards. 2. Field inpection and fines adjusments. 3. Polluter pays policy	1. Management team to execute 2. Self monitoring and pollution control. 3. Document control; work-shop disruption 4. Additional costs, time spent in analysis and modification. 5. Training personnel.	1. Research efforts devoted to train environ-mental managers.	1. Pollution loads reduction in wastewater discharge 2. Costs reduction for non-compliance. 3. Number increase in well trained and skilled personnel 4. Water quality improvement
2. Adoption of EMS and CPT	Foreign grants are available. Local investment in building up environmental infrastructure	1. Government provides consulting survices. 2. Free or low cost training. 3. Market resources and pricing.	1. Pollution Prevention according to cost, life cycle analysis, risk and effort. 2. Improve process quality (i.e. spillage). 3. Substitute toxic materials (use of Cr +3 instead of Cr+6).	1. Raising the consumer awareness. 2.Employee training. 3. Encourage foreign investments in environ-mental structure 4. Research motivation and technology innovation	1. Effective use of raw materials 2. Effective use of water demand per unit product 3. Drive down the cost due to enhanced efficiency 4. Less process failure in wastewater pretreatment units
3. Introduction to ISO 14000 Certification	1. Factories registered ISO 9000 will tend to apply to 14000. 2. High tech products idustry tend to register. 3. Foreign trade pressure is forcing motivative.	1. Identify appropriate technology towards CP 2. Provision of local registration party (3rd)	1. Willingness to adopt innovative products and market. 2. Accept rational risks.	1. Training and awareness of both quality and environ-mental management standards	1. Registration to certificate ISO 14000. 2. Enhance environmental performance, image and reputation.

6.1 Role of Governmental Organizations

It will be politically important to involve key players from the Palestinian Environmental Authority, (at present Environmental Quality Authority EQA), the Plestinian Ministry of Industry, the Palestinian Water Authority (PWA), and Nablus Municipality. From the side of industries, cooperation from groups like the Trade Union and others should be sought. Citizen groups and NGO's should be considered.

The legal provisions and standards stated in the Palestinian Environmental Law for the control of industrial pollution adequate. But the enforcement and monitoring is insufficient. Amendments are proposed to the administrative processes. These amendments are related to discharge permits, responsibility of polluters, and the fines. The most important articles concerning pollution prevention are:

a. Article (5): the pollutant discharging into surface or groundwater or environment is considered as an offence.

b. Article number (30): it is prohibited for anyone to discharge industrial wastewater with parameters exceeding those stated from the Palestinian Standard Institution.

c. Article (47): the Ministry of Environment should determine the industrial activity that needs approval to gain a license.

d. Article (48): establishing an industrial facility needs a permit.

e. Article (52): the inspectors of the Ministry of Environment has the right to inspect any industrial firm to ensure environmental compliance.

f. Article (54): the owner of each industrial establishment should perform self-monitoring.

g. Penalties; any person who is guilty of an offence in terms of the above articles, shall be liable and subject to the penalties stated in articles (68), (69), and (72).

h. The proposed amendments to the role of environmental authority in relation to water pollution control are to achieve the following principles:

6.1.1 The Polluter Pays Principle

The proposed amendments to the Environmental Quality Authority (EQA) in relation to the wastewater pollution control are to achieve the following principles and are in line with polluter pays principle **(Mtetwa, 1997):**

a. The discharge of any industrial effluent should be controlled through the issue of permit.

b. The permit will specify the monitoring and reporting requirements of the discharger.

c. There should be an administrative charge for thje issue of the permits.

d. An appeal will not suspend the implementation of an administrative decision.

e. Polluter may be required to remedy the effects of the pollution.

f. Additional levies (charge value) will be charged according to the quality of the effluent. The more poor the quality of the effluent, the higher the levy is.

g. The levies gained in for poor effluent quality will be used for environmental restoration and researches.

h. Fines should be related to the type of pollutant discharged, and the fine should also reflect the average profits made by the offender in the process of pollution.

i. Local authorities have delegated powers to control pollution.

6.1.2 The Roles and Responsibilities

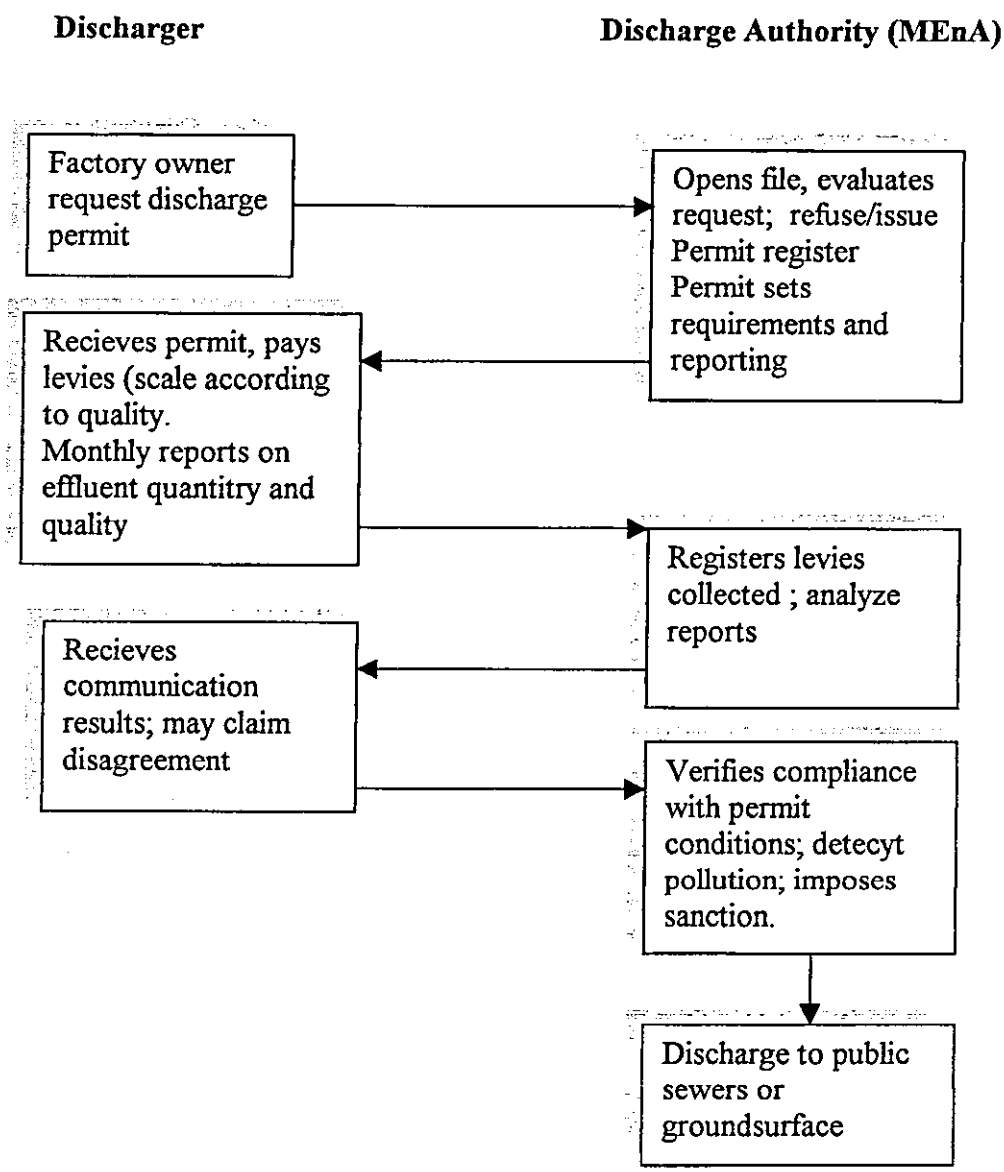
It is recommended to make it a legal requirement for anyone discharging industrial effluent to public sewerage or freely onto ground surface, to keep a record of the quality. The wastewater should be analyzed either by a qualified person within the discharging establishment or a governmental approved laboratory.

The new system will emphasize the responsibility of the polluter rather than the responsibility of government. Therefore, adequate industrial monitoring should be an integral part of any industrial management plan. The latter will ensure achieving improvements of both environmental and economical efficiencies. **Chart 9** illustrates the components of an appropriate industrialized management plan.

Industrial management plan as follows:

1. Improvement of economical and environmental efficiencies.
2. Monitoring of composition and flow of raw materials input.
3. Energy input.
4. Composition and flow of product output.
5. Output of liquid, solid, gaseous waste materials and heat release.
6. Monitoring of labor conditions, health, safety conditions, and other non-technical aspects.

Chart 9: Appropriate industrialized management plan.



The principles in Chart 9 are:

1. All industrial establishments or factory owners' wishes to discharge industrial effluent to public sewerage or freely onto ground surface should have a permit issued by pollution control department within the Environmental Quality Authority (EQA).
2. The EQA department opens file, and evaluates the discharger request. Then the department may refuse or issue permit. There is an administration charge, called levy, for the permit but a scale of charges will be established which increases with the decrease in effluent discharge quality. Thus penalizing polluters and encouraging improvement in effluent quality.
3. The industrial establishments or factory owners have to submit periodic reports on the quality of effluent. Thus removing the burden of inspection from the EQA (MEnA in the past), and placing it on the discharge establishment.
4. The local environmental office in every district in Palestine checks the accuracy of the reports, conducts random tests and imposes penalties for non-compliance where necessary.
5. The discharger receives the results from EQA (MEnA in the past) department or branch, and may claim disagreement.

The advantages of such an approach are that it will:

1. Reduce the need for the prosecution;

2. Create the incentive for effective wastewater treatment;

3. Allow for a progressive improvement in standards.

6.1.3 Field Inspection

Audits and inspection are tools to help Environmental authority to verify the regulatory performance of the industrial establishment. The monthly routine inspection, the environmental accidents, the self-monitoring and sampling reports of an establishment, and citizen complaints together form the whole inspection constituents **(Chart 10)**.

The inspector performs the field inspection as follows:

a. Monitor discharge quantity and quality of an establishment; check the factory self-monitoring and sampling report, and compare it to the issued permit.

b. Check the charge pollution payment (levy status).

c. Review the sampling discharge report to ensure compliance.

d. If there is non-regulatory compliance, the check three simultaneous steps:

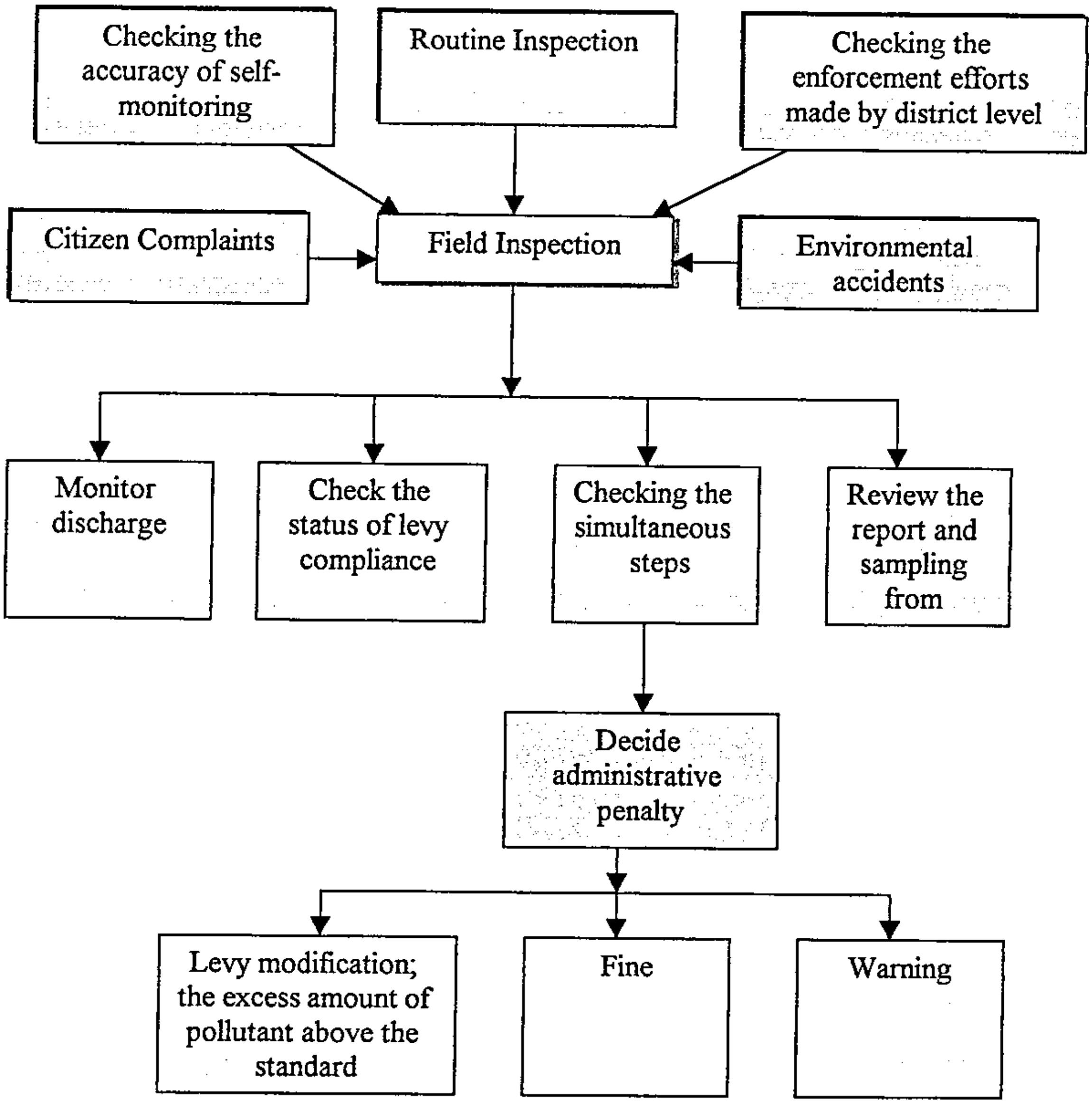
(i) Give warning and abatement deadline.

(ii) Decide fine according to the offence done by the polluter.

(iii) Modify the levy; that is the amount of excess quantity of the polluting parameter.

The following chart illustrates the aforementioned inspection procedures.

Chart 10: Field Inspection Procedure (Cropper and Oates, 1992), and (Mtetwa, 1997).



6.1.4 The New Model of Government – Market - Community

Besides the establishment of the legal framework and regulatory standards, the proposed new role of the government is to provide information about the market. It is to identify and promote appropriate technology; support environmental improvement. Also provide information on the production markets where cleaner production and ISO 14001 certification is a significant issue.

The good government assistance can help to inform the factory owner by introducing good technical advice through technical agency. This agency can help the polluters to reduce the cost of non-compliance by suggesting different technologies in which the discharger can abate his pollution at reasonable cost, and then dispense with a lot of this cost.

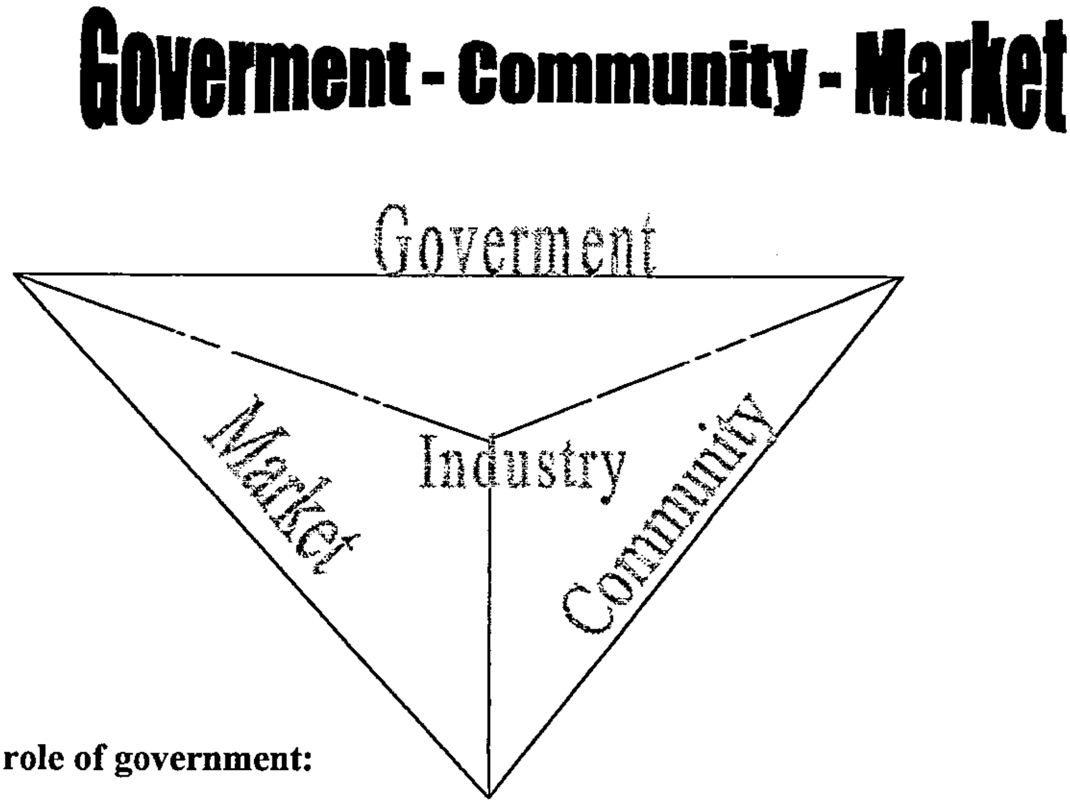
On the other side, the government should provide third party technical assistance, working together with the Non-Governmental Organizations, should inform public about the toxic releases of industries, and efficiency of the industrial effluent management and cleaner production. An informed public can achieve much through informal pressure, and progressive firms are finding that open discussions with their communities can reduce mistrust.

The International Standards Organization through publication of ISO 14001 has exerted another powerful market influence; it's most recent business performance standard. For the first time, this ISO standard includes explicit norms for environmental management. Hundreds of developing-country firms have already made the changes necessary to qualify for ISO 14001 certification **(Drobney, 1997).**

Once the roles of communities and markets are introduced, we have a much more robust model for explaining variations in polluters' behavior. Even where formal regulation is weak or absent, pressure applied through these new channels can significantly increase a plant's expected penalties for polluting. Polluters will react by reducing emissions, just as if government inspectors were enforcing regulatory standards.

This new model is captured by the regulatory triangle in **Chart 11**. Regulators still play an important part in controlling pollution, but their role is no longer confined to establishing and enforcing standards or charges. Instead, regulators gain leverage through programs designed to provide concrete information to communities and markets.

Chart 11: The new model of Government – Community – Market.



The role of government:

1. Regulations
2. Monitor compliance to the standards
3. Provide information to community and markets

The effect on industrial markets:

Even when the formal regulations are weak, the polluter will react by reducing the effluent emmisions, by the pressure of community channels and government.

6.1.5 Monitoring and Reporting

Dischargers are required to implement best management practices in order to prevent the discharge of a concentrated form of any of the toxic and organic pollutants. Individual permit limits for specific industrial discharges may be established for the toxic and organic pollutants on a case-by-case basis.

6.2 Factory Owner

Often with no capital investment, a company pollution prevention team can identify options that will yield significant dollar savings, improve manufacturing efficiency and reduce wastes. The only investment required is time **(Freeman, 1995)** .

Waste reduction techniques could be classified to three levels in terms of cost-based evaluation, effort and risk. The first level is the lowest cost, risk and effort; the second is characterized by medium level of cost, risk and effort. The third level requires major changes and major capital investment. These are described as follows:

(i) First level, includes minor change in process and equipment and work habits, and can be implemented with minimum cost. Examples are training, segregation of wastestreams, installing meters, recycling scrap materials.

(ii) The second level needs planning, research and evaluation. Examples are chemical and material substitution and low cost recovery.

(iv) The third level requires major changes in the operations, significant capital investment and higher risk. Major changes to or replacement of process or equipment are performed. Extensive planning, research and evaluation are necessary. Implementing should be only after easier options are completed and only if payback justifies the effort and investment. Examples are process automation and alternative technology **(Crushnie, 1994).**

The following table summarizes examples of clean production or waste reduction techniques in accordance with the predefined levels, see Table 10. Each of these technologies will be dealt with in the following sections, the proposed pollution prevention control for the different industrial sectors in Nablus; the focus will be on levels (1) and (2).

Table 10: Cleaner production techniques in accordance with cost, risk and effort levels (WBG, 1998).

Cleaner Production Technique	Action Plans and Practices	Cost, Risk and Effort (level)
1. Good operating practices	a. Company pollution prevention policy	Level (1)
	b. Employee training	Level (1)
	c. Material and inventory control	Level (1)
	d. Preventive maintenance and spill control	Level (1)
	e. Effluent wastewater Stream segregation	Level (1), Level (2)
2. Material substitution and process modification	a. Alternatives to toxic metals	Level (1), Level (3)
	b. Optimize use of water and cleaning chemicals, i.e. recirculation of cooling water.	Level (2)
	c. Addition control	Level (2)
3. Rinse water reduction	a. Reuse of washwater, i.e. Use batch washing instead of continuous,	Level (1)
	b. Spray and nozzle rinsing	Level (2), Level (1)
	c. Manual rinse water flow control	Level (1)
	d. Drain boards	Level (1)
4. Drag-out reduction	a. Reduce total solids through primary sedimentation	
	b. Chemical recovery and waste recycling, using	
	(I) Reverse osmosis, or	Level (3)
	(ii) Ion exchange, or	Level (2)
	(iii) Oil skimmer	Level (2)
5. Pollution control (end-of-pipe)	Wastewater treatment	Level (3)

The following sections will introduce waste reduction tools; these will include new technologies, materials and practices that often developed with the support of grants (partially or fully), technology transfer, or information exchange.

6.2.1 Stone Cutting Industry

There are many technical viable options within the management practices in the context of reducing impacts from stone-cutting industry. These options are considered one component of an overall management plan for cost effective impact minimization.

1. Policy; The most important target in the strategic objective is to preserve water since it is scarce, through the reduction of water consumption, and to prevent pollution to environment.

2. Target Objective;

(i) Minimize wastewater effluent by minimizing water content in the slurry effluent.

(ii) Also prevent random disposal of slurry through defining feasible options to use dewatered slurry.

(iii) Target the TSS concentration in the effluent at the site.

3. Action Plan; The following management practices are proposed to improve environmental performance:

6.2.1.1 Pollution Prevention and Control

The following management practices are proposed to achieve the targeted goals:

1. Develop and apply efficient monitoring procedures to prevent random disposal of the slurry to non-dedicated approved sites.
2. Perform water audit to determine where and how to use the water in the facility.
3. Replace or retrofit indoor plumbing fixtures with low water flow devices and models.
4. Utilize high pressure, low volume and spray nozzles, flow restrictors on valves on valves where high volume is not necessary and automatic shut off valves on equipments to optimize water use efficiency.
5. The addition of Polymers will help to settle the slurry in the wastewater. Polymer is recommended as a settling agent, but efficient use of polymer is connected to the choice of polymer type and dosage. Use of polymers for sludge dewatering on regular bases; accurate dose, proper mixing, etc. This will make efficient use of water recycling and reuse by accelerating settling process and TSS removal.
6. Develop and apply efficient monitoring procedures to prevent random disposal of the slurry to non-dedicated approved sites.
7. Polymer usage and wastewater evaporation in a settling pond.

8. Evaluate the feasible of different options for the beneficial use of dewatered slurry. These options include:

- Production of light bricks used for partitions and walkways.
- Use as a soil amendment.
- Use as a component of plastering material.
- Use as a component material for wall painting.
- Use as a component material for landfill liners.

9. On-site drying of stone-cutting slurries at the facility producing the wastestream is practiced in many stone processing factories around the world. The slurry is placed in open drying pits and allowed to drain and evaporate.

6.2.2 Vegetable Oil Industry

Implementing good management practices and cleaner production will need the following definitions and practices:

1. **Policy;** reduce water consumption, and the waste content in the effluent water.
2. **Targeted Objective;** need to reduce the use of harmful chemicals in de-gumming, reduce chloride and salts in the effluent.
3. **Action Plan**; Immediate management practices are proposed to imply the pollution prevention control is introduced in the following section. Then the remaining organics and chemicals will be discharged to the

proposed municipal WasteWater Treatment Plant (WWTP) in Dir-Sharaf and the Eastern Zone in the Nablus district.

6.2.2.1 Pollution Prevention Control

Good pollution prevention practices in the vegetable oil industry should focus on the following:

1. Optimize the use of water and cleansing chemicals in olive oil extraction.
2. Use citric acid instead of phosphoric acid, where feasible, in degumming operations **(WBG, 1998).**
3. Collect waste product for use in by-products such as animal feed (in olive oil processing) to minimize losses.
4. Where appropriate, give preference to physical refining instead of chemical refining of crude oil, as active clay has a lower environmental impact than the chemicals in general.
5. In the extraction of sesam oil, it is recommended to install sedimentation tank with a drainage basin for the settled sludge, to reduce the high content of TSS, salts, organics and chloride, before discharging to public sewers or to the, under-construction, municipal wastewater treatment plant.

6.2.3 Food, Fruit and Vegetable Processing

1. **Policy;** In the first stage in implementing pollution reduction technology, it proposed to apply the management practices proposed in

section 6.2.3.1. The effluent is recommended to be treated in the proposed municipal Waste Water Treatment Plant (WWTP). The reduction of water consumption is the most important strategy in the management framework. The large amount of wastewater effluent results from wash-water and water used for cleaning floors and machines. Also TSS and organics in the effluent water are to be reduced.

2. **Targeted objectives;**

(i) a target level of water consumption, i.e. 25-30% reduction in wastewater effluent volume to achieve water consumption per unit production if dry cleaning of fruit is adopted **(WBG, 1998).**

(ii) Procure clean raw materials to reduce water consumption.

3. **Action Plan;** the following management for pollution prevention control are recommended:

6.2.3.1 Pollution Prevention and Control

Good water management should be adopted, where feasible through achieving a target level of water consumption per unit production.

1. Procure clean raw fruit and vegetable, thus reducing the concentration of dirt and organics in the effluent.
2. Use dry methods for cleaning such as air jets to clean raw fruits or vegetables.
3. Use countercurrent systems where washing is necessary.
4. Minimize the use of water for cleaning floors and machines.

5. Remove solid wastes without the use of water. I.e. train the workers to pick up the solid wastes that are dropped during processing, camera can be used to monitor the processing to target the wastes, let the workers see themselves while they are practicing the dry clean process. These solids can be sold to the market as animal food.

6.2.3.2 Monitoring and Reporting

Monitoring of the final effluent for the parameters listed in **appendix 6** should be carried out once in a month.

To estimate the water usage in various production processes, the waste-water from unit operations should be monitored during each product season.

Monitoring data should be analyzed and reviewed at regular intervals and compared with the operating standards so that necessary corrective actions can be taken. The records should be reported to the responsible authorities as required.

6.2.4 Tanning, Metal Plating, Chemicals, Shoe, and Miscellaneous

6.2.4.1 Tanning Industry

1. Policy; includes the following constituents:

(i) Reduce the large amount of wastewater effluent results from water processed during manufacturing.

(ii) Reduce the high organic concentration content in the effluent water.

(iii) Eliminate or reduce the sulfates and toxic metals such as the hexavalent chrome is introduced in the wastewater effluent and toxic to employees involved in the factory.

2. Targeted Objectives; implementation of cleaner production and pollution prevention measures can yield both economic and environmental benefits.

(i) Reduce chrome and sulfide levels and salts, i.e. by processing fresh skins wherever feasible, dilute the sulfide solution.

(ii) Reduce the use of water consumed per unit production.

(iii) Reduce organics, such as BOD, COD, Nitrogen, in the effluent water.

(iv) Reduce energy use; i.e. recover energy from drying process to heat process water.

3. Action Plan

Immediate procedures such as the following management practices should be adopted, but the next stage, when funds are available; treatment of tanning wastewater is always required.

6.2.4.2 Treatment Technologies

The following treatment concept is proposed:

(i) Streamline segregation should be applied. Soaking liquor (which has high salinity), sulfide rich lime liquor and chrome wastewater should be segregated **(WBG, 1998).**

(ii) Preliminary screening of wastewater is required because of large quantities of solids.

(iii) Hair recovery reduces BOD in the effluent wastewater.

(iv) Physical-chemical precipitates metals, this removes large portion of BOD and COD.

(v) Biological treatment is usually required to reduce the remaining organic loads to acceptable levels.

6.2.4.3 Pollution Prevention and Control

Recommendations for reducing wastewater, organic, chemical and toxic effluents include the following:

1. Process fresh hides or skins to reduce the quantities of salt in wastewater, where feasible.
2. When salted skins are used as raw materials, pre-treat the skins with salt elimination methods.
3. Use sulfide and lime as 20-50% solution to reduce sulfide levels in the wastewater.
4. Split the limed hides to reduce the amount of chrome needed for tanning.
5. Use only trivalent chrome when required for tanning.

6. Inject tanning solution in the skin using high-pressure nozzles; recover chrome from chrome-containing wastewater (i.e. through precipitation).

7. Examine alternatives to chrome in tanning, such as titanium, aluminum, iron, zirconium and vegetable tanning agents.

8. Use non-organic solvents for dyeing and finishing.

9. Use photocell-assisted paint-spraying techniques to avoid overspraying.

10. Recover hair by hair-saving methods to reduce pollution loads. For example, avoid dissolving hair in chemicals by making a proper choice of chemicals and using screens to remove hair from wastewater.

Application of cleaner production principles as a tool for pollution load minmization from the tanning industry was investigated by Nazer (2002). Four times recycling of the effluent from dehairing process have achieved more than 40 % in wastewater production. Also about 2 fold savings in the net financial benefits were achieved, when the effluent was recycled four times compared to one **(Nazer, 2002).**

Through good management, water can be reduced by 30-50% of raw material **(WBG, 1998)**. Recommendations for reducing water consumption include the following:

1. Monitor and control process water can achieve water consumption up to 50 % **(Danish Technological Institute, 1992).**
2. Use batch washing instead of continuous washing.
3. Use drums instead of pits for immersion of hides.
5. Reuse wastewater for washing. For example by recycling lime wash water to the soaking stage.
6. Effluent recycling of the dehairing – liming process.

6.2.4.4 Monitoring and Reporting

Frequent sampling is required during the start up and upset conditions. Once a record of consistent performance has been established, sampling and measurements of Parameters listed in **appendix 6**, should be monthly conducted.

6.2.5 Metal Plating Industry

Wastewater from metal plating is characterized by all substances used in metal plating, such as acidic solutions, toxic metals and cyanides, can be found in effluent, either via rinsing of the product or from spillage of process baths.

The pollution reduction policy, objectives and action plans are:

1. **Policy**; first stage is the immediate prevention of pollution from toxic metals, acidic solution, and reduce water use. The second stage using treatment technology.

2. **Targeted objectives;** reduce the effluent of Cr^{+6}, minimize water consumption in rinsing system, minimize drag-out and wastage.

3. **Action Plan;** change in process, improvements on traditional practices should be implemented where possible.

6.2.5.1 Pollution Prevention and Control

The following management practices are proposed in the context of pollution prevention or reduction:

6.2.5.1.1 Change in Process

Change in production process can be achieved by the following:

1. Use trivalent chrome instead of hexavalent chrome; acceptance of the change in finish needs to be promoted.

2. Give preference to water-based surface cleaning agents, where feasible, instead of organic cleaning agents, some of them are considered toxic.

3. Regenerate acids and other process ingredient whenever feasible.

6.2.5.1.2 Reduction in Drag-out

Drag-out can be processed by the following:

1. Minimize drag-out through effective draining of bath solutions from the plated part.
2. Maintain the density, viscosity, and temperature of the baths to minimize drag-out.
3. Place recovery tanks before the rinse tanks, the recovery tank provides for static rinsing with high drag-out recovery.

6.2.5.1.3 Minimize Water Consumption in Rinsing Systems

Rinsing water can be minimized through the following:

1. Agitate of rinse water or work pieces to increase rinsing efficiency.
2. Multiple countercurrent rinses.

6.2.5.2 Treatment Technology

1. Waste-stream segregation is essential because of the dangerous reactions that can occur. Strong acid and caustic reactions can generate boiling and splashing of corrosive liquids; acids can react with cyanides and generate lethal hydrogen cyanide gas.
2. Recycle rinse water.
3. Clean racks between baths to minimize contamination.
4. The generation of sludge should be minimized. Sludge must be dewatered and stabilized and should be disposed of in an approved, secure landfill. Leachate from stabilized sludge should not contain toxics at higher than those indicated for liquid, as shown in **appendix 6.**

6.2.5.3 Monitoring and Reporting

Equipment to continuously monitor pH should be installed to provide an indication of overall treatment reliability. Sampling of metals should be performed monthly.

Monitoring data should be analyzed and reviewed at regular intervals and compared with the operating standards so that necessary corrective actions can be taken. The records should be reported to the responsible authorities as required.

Chapter Seven

Conclusions and Recommendations

7. Conclusions and Recommendations

7.1 Conclusions

The finding of the technical visits and interviews as well as the results of the questionnaires revealed that additional data on industrial discharges are needed. More information should concentrate on monitoring and sampling programs as well industrial management plans for the existing industrial enterprises.

Managerial and technical options were introduced to prevent or minimize the impacts from the industrial wastewater effluent upon the environment. Among these tools; the EMS, the CP, strong government support, and effective reinforcement tools were adopted in the case of Palestine. The adoption of EMS and CP are encouraged by government through resource pricing and market incentives control. But in the first place, process of production, effluent disposal, and quantity of water consumed per unit production, and effluent characteristics must be carefully known and understood. The major conclusions drawn from the study are as follows:

- The industrial wastewater pollutants in Nablus district contain conventional pollution parameters. Nitrogen, BOD, COD, TSS, pH and turbidity. These pollutants are inherent with the three major industrial sectors; first sector includes building and construction material, the second is the food processing, the third group is the tanneries, textiles and chemicals.

- The industrial facilities are distributed in the clusters in the eastern side of Nablus, the western side, and the rest are situated in the center of the residential and commercial areas. The important industrial wastewater polluters in Nablus:

(i) One slaughter house (42 m^3/d effluent wastewater).

(ii) Stone – cutting industry. The daily effluent water generation is 980 m^3/day, this represents more than 10 % of the total population of Nablus city according to the amount of water consumed.

(iii) One aluminum factory (130 m^3/d, 75 employees).

(iv) Tahinah factories (consumption range 12-39 m^3/d; total of about 50 m^3/d wastewater, 40% salt and chloride production).

(v) Olive oil processing mills (850 m^3/d or 50000 m^3/season, BOD_5 was estimated 100 g/liter, or 1700 PE).

(vi) 4 Textile facilities (120 m^3/d wastewater).

(vii) 5 Tanning industry (toxic and non-degradable metals in the effluent).

- Heavy metals are significant in the third industrial sector; metal plating, textiles, and tannery industry. To control the effluent pollution , the monitoring must focus on effluent stream segregation using managerial and technical environmental tools.
- According to metal plating industry, it is recommended to rinse plates before mixing with other process effluent and substitution of toxic metals with more environmentally friendly metals.

- Textile industries are recommended to provide equalizing basins at present stage, because the amount of effluent is small, but the pollution load is high compared to domestic wastewater. Also, it is recommended to change the process and the seizing agent. Poly Vinyl Alcohol (PVA) is recommended instead of traditional sizing agent. Poly Vinyl Alcohol (PVA) size was recoverable and gave excellent sizing and weaving performance on reuse **(Grove and Hart, 1983).**
- The results obtained in this research thus suggest that significant reductions in industrial wastewater pollution can be obtained by focusing effort and resources on environmental management system and pollution prevention or minimization before environmental crises arise.
- It is difficult, but could be achieved, to apply Environmental Management System (EMS) as the formal series of ISO 14001, because most of the industrial enterprises in Palestine are small and medium size, and do not have formal interior management systems and environmental management experts.
- The funding is a very important aspect to help in the application of ISO 14001 for the industrial enterprises, also the monitoring program of the environmental affairs in Palestine.
- The pollution control policy, taking into consideration the economic situation, the industrial wastewater effluent will partially be pre-treated in the industrial enterprise, until the effluent pollution parameters is

reached at acceptable level compared to the domestic effluent standard. Then the effluent is treated in the proposed municipal treatment plants in the Nablus District.

- The current review of the legislation, the effective monitoring and enforcement will improve industrial performance, because in any event, the best law is no better than the weakest enforcement.
- In developing countries, factories are concerned not so much with the environmental advantage and economic opportunity that ISO certification may or may not bring, but with the economic disadvantage from not getting involved.

7.2 Recommendations

Based on the results obtained from this research study, the followings recommendations can be made:

- Enforcement of the Palestinian Environmental law should be implemented in phases especially in those existing industrial enterprises. Gradual implementation should entail incentives for the implementation for the pollution prevention program by these enterprises.
- Encouragement of the research institutions to conduct further research programs with regard to cleaner production technologies to minimize pollution loads from existing and new planned industrial sites.

- Establishment of sub-committees on the national level to provide technical support as far as pollution prevention, monitoring, environmental management, health risk minimization and industrial impact are concerned.
- An industrial cadastra should be established to the whole Nablus city to develop by law aiming at industrial pollution management. The location of industrial facilities in the western side of Nablus city are shown in the **appendix 7.**

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List of Interviews

No.	The Interviewed Party	Date of Visit
1	Ministry of Industry, Nablus office	Many visits, the last was in 18/1/2003
2	Ministry of Environmental Affairs (MEnA), EQA at present	Many visits, the last was in 18/01/2003
3	Palestinian Standard Institute (PSI)	20/03/2002
4	Chamber of Commerce	11/02/2002, 15/01/2002
5	Ministry of Agriculture, Nablus office	13/08/2002 and many others
6	Ministry of Health, Environmental Health Department	19/03/2002
7	Olive Oil Council	15/08/2002
8	Nablus Municipality	30/01/2003 and many others

Appendices

Appendix 1 Parameters of the industrial effluent standards according to PSI, 1999

Appendix 2 Inspection form used by Environmental Quality Authority EQA.

Appendix 3 Questionnaire used for on site – investigation of the wastewater effluent from industrial facilities.

Appendix 4 Sample questionnaire used for on site – investigation of the wastewater effluent from industrial facilities.

Appendix 5 Waste effluent characteristics from the aluminium factory in Nablus (EQA, 2001).

Appendix 6 Proposed effluent parameters for certain industries.

Appendix 7 Location of industrial facilities in the western part of Nablus city, adapted from Nablus Municipality (1999).

Appendix 1

Standard parameters of the wastewater effluent according to EQA and PSI

Parameter	Value (mg/l)	Parameter	Value (mg/l)
Cadmium	0.01-0.02	**TSS**	50
Chromium	.05-0.1	**Oil Content**	15
Cyanides	0.1	**Phenol**	.002
Lead	0.1	**Ammonia Nitrogen**	5-12
Mercury	0.001	**Chloride**	500
Nickel	0.2	**Fluoride**	15
Zinc	0.05	**Iron**	1
Selenium	0.02	**Copper**	2
COD	150	**pH (Between)**	6.5-9.0
Dissolved Oxygen	1	**BOD**	20
TDS	3000	**Fecal Coliforms**	1000

Appendix 2

Inspection form used by Authority of Environmetal Quality (AEQ, 2002, Arabic).

وزارة شؤون البيئة
الإدارة العامة للعمليات
المحافظات الشمالية

نموذج كشف بيئي أولي

رقم الملف

اسم المشروع

نوع المشروع:

اسم صاحب المشروع أو مديره:

العنوان:

المحافظة	البلدة	الموقع
حوض	قطعة	
تلفون	فاكس	

تاريخ التأسيس:

تاريخ التشغيل:

الموقع:

الطبوغرافية

استخدامات الأراضي

الغطاء النباتي

البيئة الطبيعية

المشروع في منطقة صناعية:
حدد موقع اقرب منطقة صناعية للمشروع

وصف المشروع:

الإنشاء والتصميم

العملية الإنتاجية

البنية التحتية

المساحة

عدد العمال والفنيين:

التراخيص والموافقات التي حصل عليها المشروع وتاريخ انتهاء التراخيص:

هل حصل المشروع على موافقة بيئية (   ) ومن قبل من ---------------------

المواد الداخلة في الإنتاج و مصدرها

١.
٢.
٣.
٤.
٥.

المواد المصنعة وأماكن تسويقها

١)
٢)
٣)
٤)
٥)

هل يوجد شكاوى للمواطنين حول المشروع مع ذكر الأسباب

الوضع التنظيمي للمشروع

بعد المشروع عن المناطق السكنية
مرور وسائل نقل المشروع عبر المناطق السكنية أو المناطق الحساسة

بعد المشروع عن أقرب شارع تنظيمي وسعته

حجم حركة المواصلات

كيفية التخلص من:
- **النفايات الصلبة**

- **النفايات الخطرة**

- **النفايات السائلة**

آثار بيئية محتملة

١.
٢.
٣.
٤.
٥.

إجراءات بيئية متبعة داخل المشروع:

معلومات بيئية أخرى هامة:

المكلف بالكشف:

الهدف من الكشف:

ملاحظات وتوصيات من قام بالكشف

التاريخ

الاسم:

توقيع:

Appendix 3

Questionnaire used for on site – investigation of the wastewater effluent from industrial facilities.

Questionnaire used for on-site visit of industry

1. General Information

1.1 Industry:

1.2 Branch:

1.3 Name of Company/owner:

1.4 Address:

1.5 Employees:

Administrative ....Workers....... .

1.6 Working Hours........Shifts........ .Working Days........

2. Production.........................

....

3. Batch Process

3.1 ....

3.2 ....

3.3 ....

3.4 ....

3.5 ....

3.6 ....

4. Raw Materials ....

....

5. Water Usage

5.1 Source

Municipality................

Private Wells................

Others................

5.2 Quantity Used ....

5.3 Is the Quantity Used seasonal? ....

5.4 Quantity Discharged ....

5.5 Wastewater Discharge Point ....

Is the wastewater discharge controlled and How?

....

6. Future Plans

....

7. General Comments

....

Appendix 4

Sample questionnaire used for on-site visit of industry

Sample questionnaire used for on-site visit of industry

1. Beny Zeid for Tannery

1. General Information

1.1 Industry: Tanning Industry

1.2 Branch: Tanning Industry

1.3 Name of Company/owner: Beny Zeid for Tannery

1.4 Address: Salphete - Nablus

1.5 Employees:

Administrative = 2 , Workers = 23

1.6 Working Hours: 8 hr's **Shifts: 1, Working Days:** 6 days

2. Production: 150,000 hide per year to convert it to clothes.

3. Batch Process

3.1 Salt – wash – soak

3.2 dehairing

3.3 Rinse

3.4 Bate, Chromium addition

3.5 Shave and wash

3.6 Add dyes, oils and formic acids.

4. Raw Materials ....

No.	Material	Quantity(ton/year)
1.	Acoustic Soda	4.5
2.	$CaCO^3$	300
3.	Dyes	3.6
4.	Chromium	30
5.	As	15
6.	Paints	15

5. Water Usage

5.1 Source

Municipality: 275-400 m^3/month or 12-14 m^3/day

5.2 Quantity Used 275-400 m^3/month or 12-14 m^3/day

5.3 Is the Quantity Used seasonal? Slight increase after Ramadan and during summer.

5.4 Quantity Discharged 275-400 m^3/month or 12-14 m^3/day

5.5 Wastewater Discharge Point To Wadi Al-Sajour

Is the wastewater discharge controlled and How?

No discharge control

6. Future Plans

No future plans.

7. General Comments

The quantity of water consumed is not accurate. The water use for

Tanner haul solid waste to municipality dump.

Sample questionnaire used for on-site visit of industry

2. Malhesco Company

1. General Information

1.1 Industry: Shoe Manufacturing – large scale

1.2 Branch: Shoe manufacturing

1.3 Name of Company/owner: Malhesco company

1.4 Address: Wadi Al-Tuffah

1.5 Employees:

Administratives + maintenance technicians = 70 , Workers = 180

1.6 Working Hours: 8 hr's **Shifts:** 1, **Working Days:** 6 days

2. Production: 750000 pairs of footwear per year, sandals, men' dress shoes and athletic shoes.

3. Production Machines

3.1 Shoe making machines

3.2 Splitting

3.3 Air-compressors

3.4 Sewing Machines

3.5 Painting

3.6 Add plastic dyes, wax

3.7 Varnish and release agents

4. Raw Materials

No.	Material	Quantity(ton/year)
1.	Plastic PVC	200
2.	Politan	300
3.	Plastic Dyes	3
4.	Release, vernish agents	100
5.	Leather and textiles	30meter length/year

5. Water Usage

5.1 Source

Municipality: 1200m^3/year or 4 m^3/day

5.2 Quantity Used 1200m^3/year or 4 m^3/day

5.3 Is the Quantity Used seasonal? Slight increase before Ramadan and school start time.

5.4 Quantity Discharged 4m^3/day.

5.5 Wastewater Discharge Point To the municipal sewer.

Is the wastewater discharge controlled and How?

No discharge control

6. Future Plans

....

7. General Comments

a. Shoe factory use dye, wax, chrome and other undesirable materials that are sewered.

b. Solid waste are picked up by municipality.

c. The Company has accredit to ISO 9000 and ISO 9002 since 1997 funded by foreign donor.

Appendix 5 Waste effluent characteristics from the aluminum factory in Nablus, EQA, 2000.

Table 5.1: Mixed sludge characteristics after one – month drying

Parameter	mg/kg	%
Cr total	140.00	1.1800
Cr^{+6}	0.0400	0.0003
Co	0.0000	0.0000
Ni	6.6800	0.0600
Zn	2.0300	0.0200
Al	2930.0000	24.6100
As	<0.0500	<0.0004

Table 5.2: Wastewater characteristics from the effluent

Parameter	Mg/liter
Ca	50.800
Cr total	0.003
Cr^{+6}	0.000
Co	0.071
Ni	Not available
Zn	0.176
Al	1.540

Appendix 6. Concentrate standard proposed for specific types of factories.

1. Vegetable oil processing, (EPA, 1993).

Components	Value (not exceeding)
BOD	50 mg/l
TSS	100 mg/l
pH	Between 6-9.5
TSS	50 mg/l
COD	250 mg/l
Total nitrogen	10 mg/l
Temperature increase	≤3 °

2. Textile and Garment factory, (EPA, 1993).

Components	Value (not exceeding)
BOD_5	40 mg/l
Phenols	1 mg/l
TSS	40 mg/l
pH	Between 6-9.5

3. Target loads per unit of production for tanning, (WBG, 1998)

Components	Value (not exceeding)
BOD_5	50 mg/l
TSS	50 mg/l
PH	Between 6-9
Sulfide	1.0 mg/l
Chrome (total)	0.5 mg/l
Chrome $^{+6}$	0.1 mg/l
NH_4-N	10 mg/liter
Phosphorus	2 mg/l

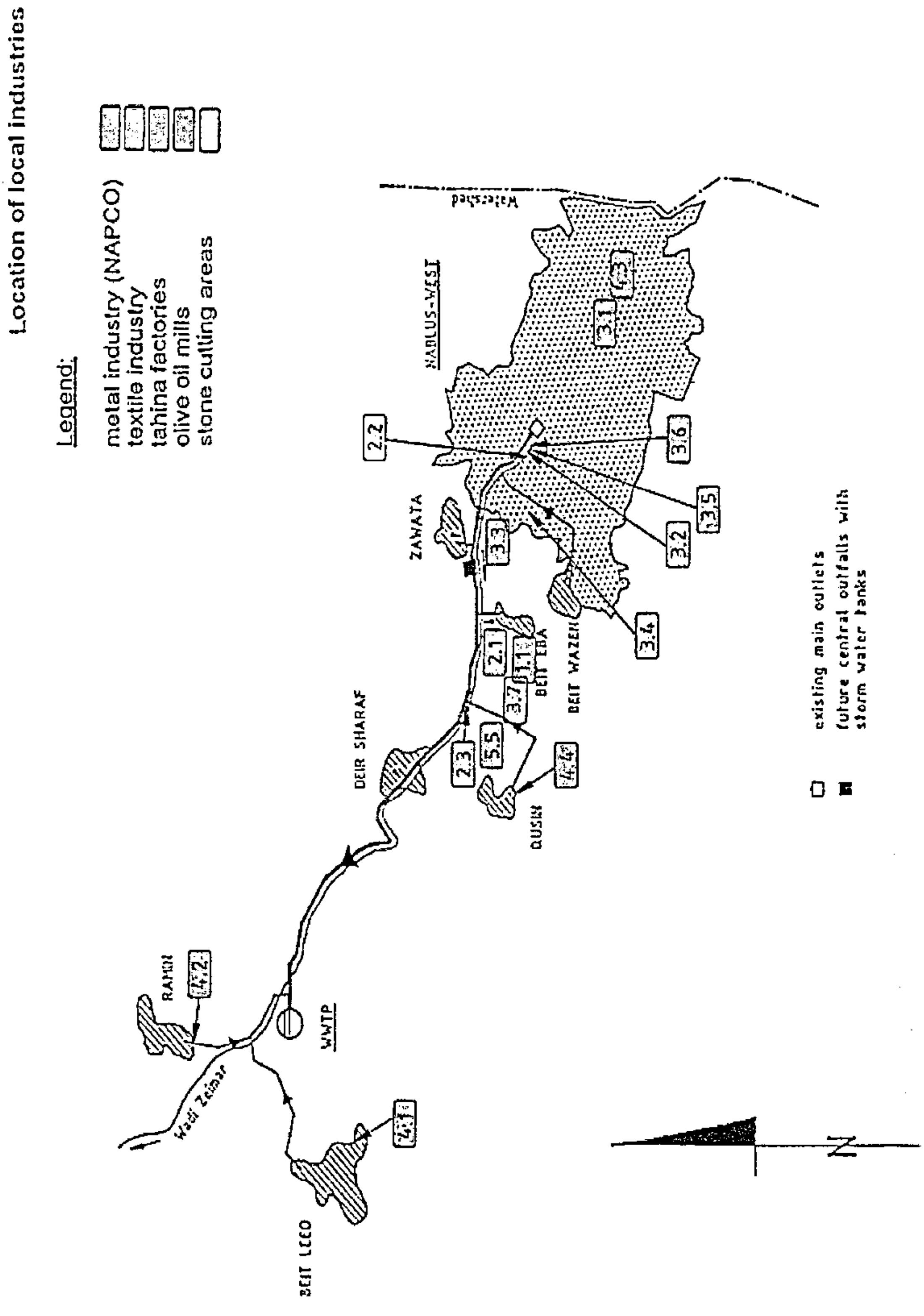
Factories with inorganic substances:

4. Metal Plating:

Parameter	**Value (not exceeding)**
TSS	25 mg/l
Cyanide	0.2 mg/l
Chrome $^{+6}$	0.1 mg/l
Total Chrome	0.5 mg/l
Arsenic	0.1 mg/l
Copper	1.0 mg/l
Zinc	5.0 mg/l
Total Metals	10.0 mg/l
Oil and Grease	30 mg/l
BOD	50 mg/l
PH	Between 7-9.5
Sulfate	400-2000 *

* 400 mg/l stands for the discharge into public sewers, 2000 mg/liter stands for the discharge to the wadi, **(Beitelsman and Hijjawee, 1999).**

Appendix 7 Location of industrial facilities in the western part of Nablus city, adapted from Nablus Municipality (1999).



Photograph documentation

Sample photograghs from the surveyed factories

Diary Factory

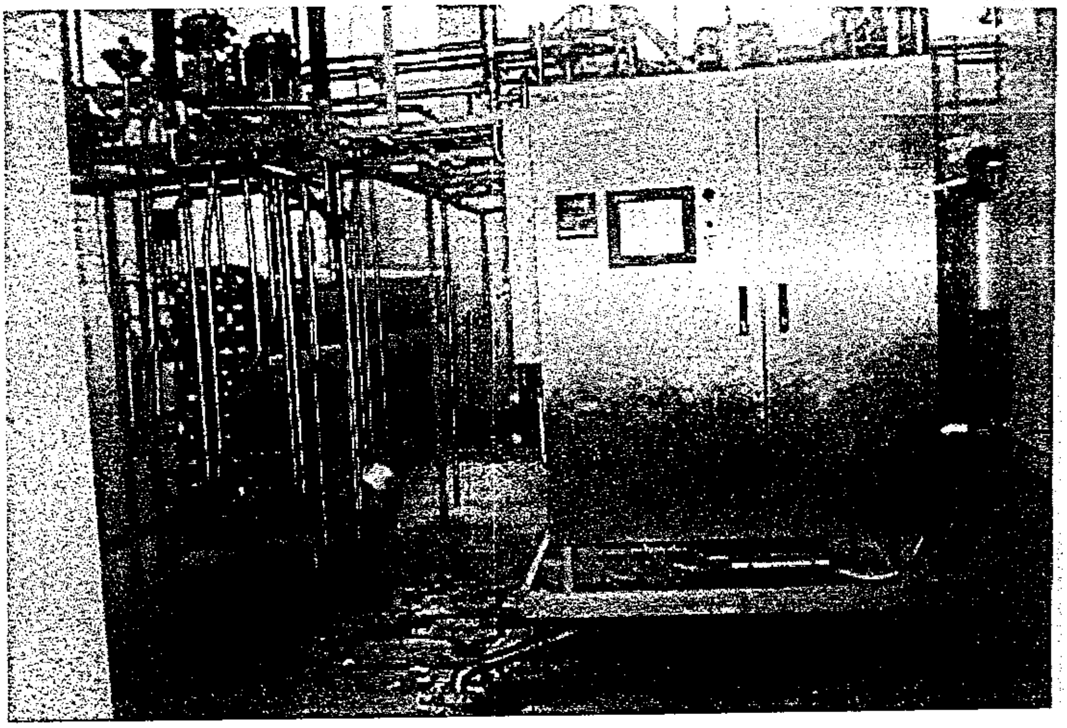


Photo (1): Fresh boiling water flowing on the factory ground

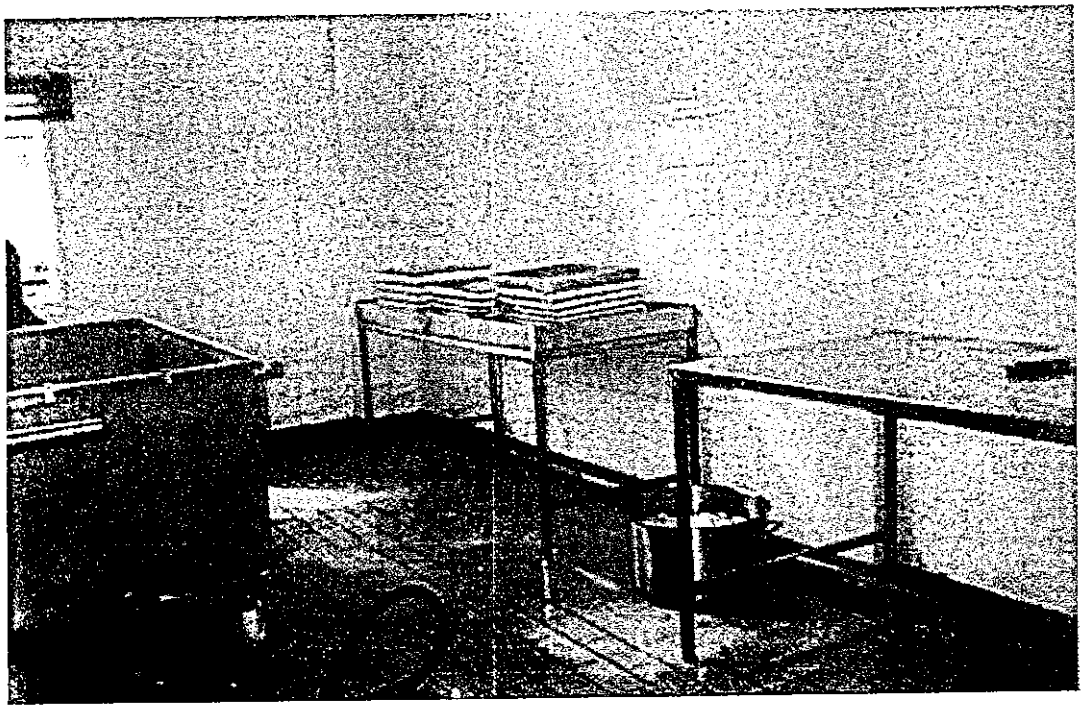


Photo (2): Cheese processing in the diary factory

Photo (3): Final production process in a diary factory

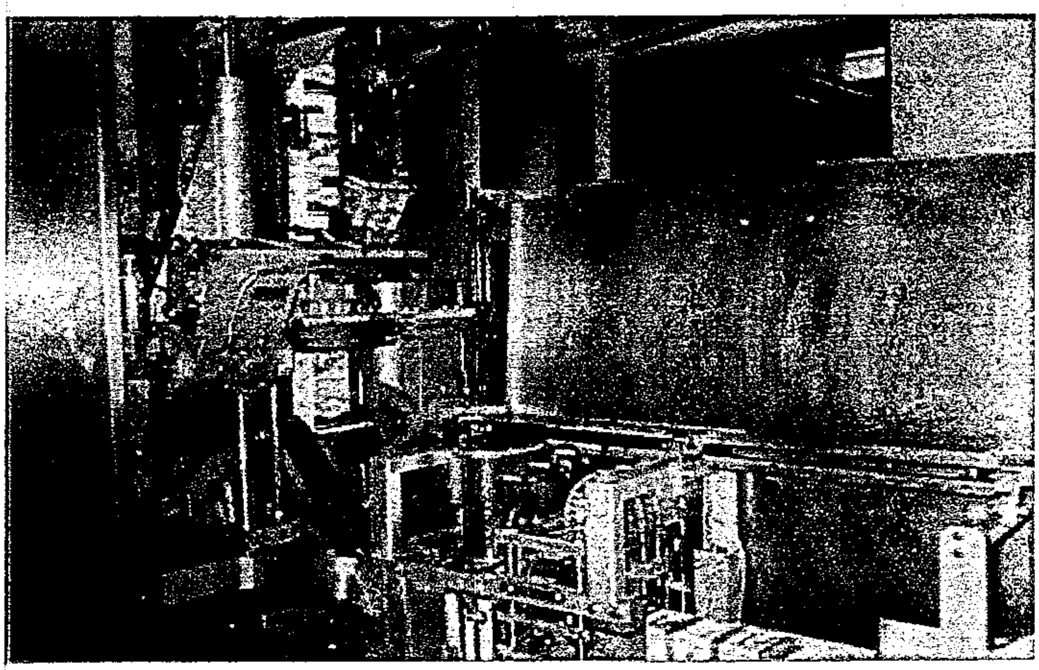


Photo (4): Vegetable Oil processing machines and sedimentation tank

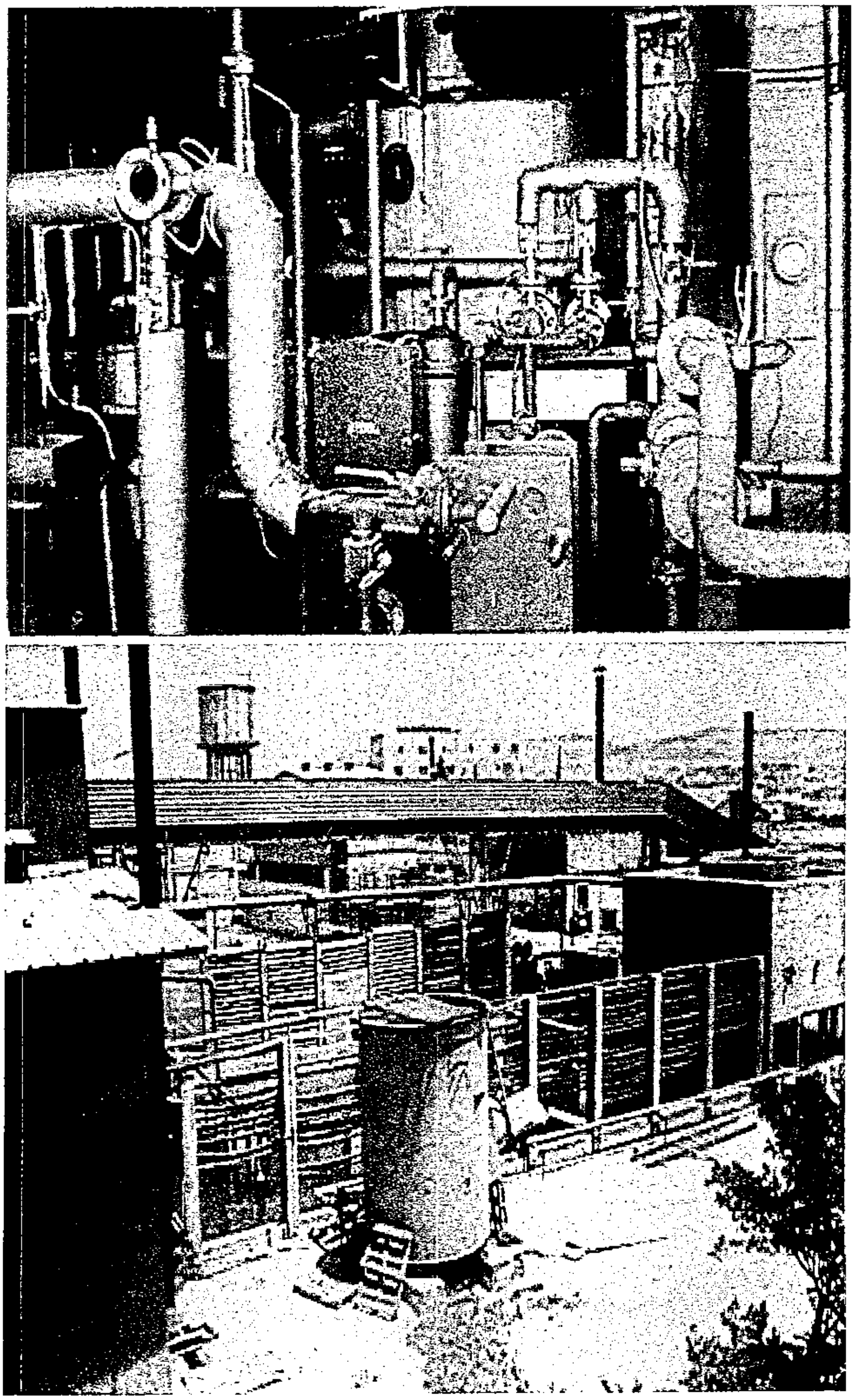
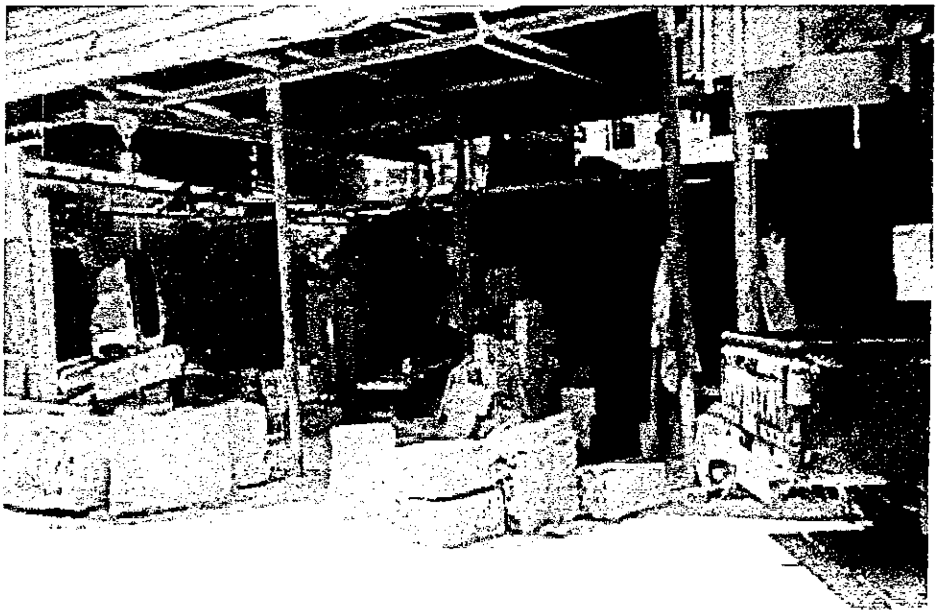


Photo (5): Slurry disposal onto the ground surface



The Municipal Slaughter house

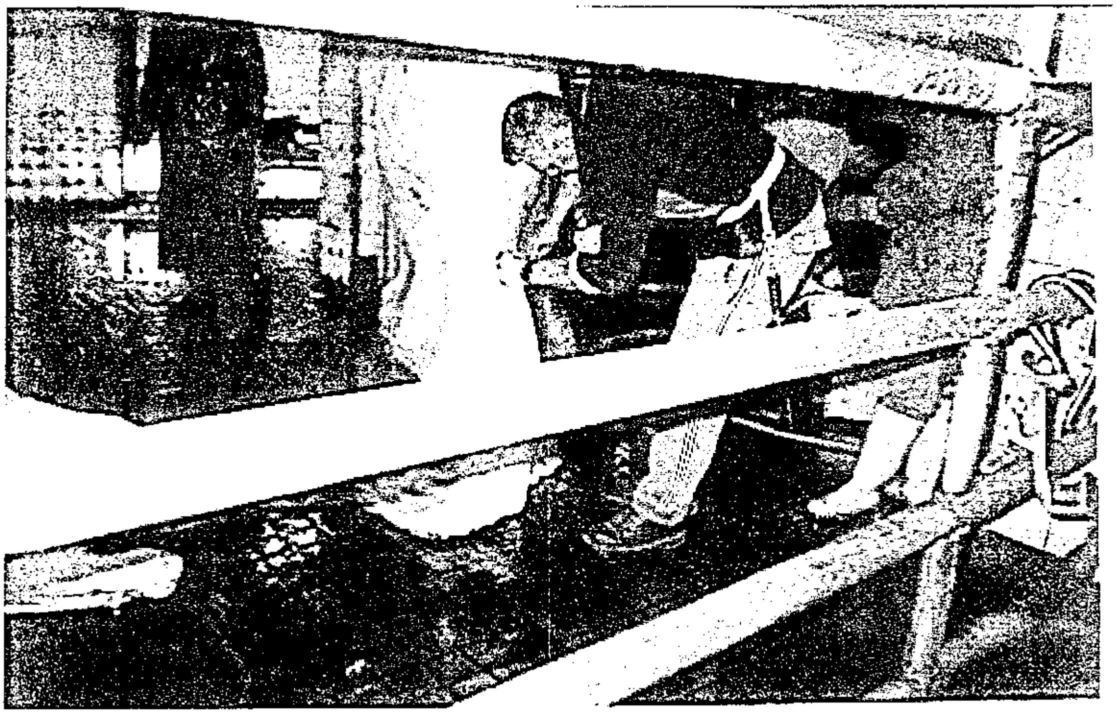


Photo (6): De-skinning of the cow

Photo (7): The blood from slaughtering goes through drain channels to the sewerage collection

Photo (8): Cow capturing machine in the slaughter house

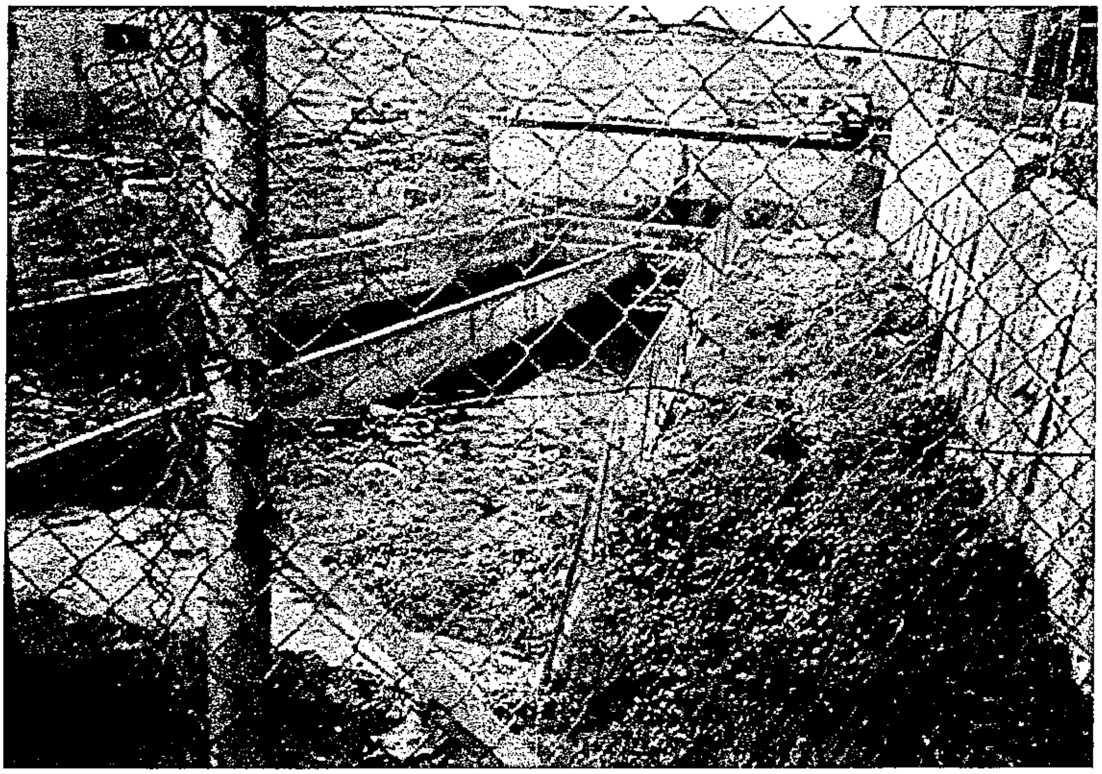


Photo (9): Concrete sedimentation tank in the slaughter house

ملخص

ان معظـــم التجمعات السكنية في المناطق الفلسطينية تتمركز على سفوح الجبال التي تشكل أساسا مناطق تغذية المياه الجوفية. وهذا يؤدي الى جريان المياه الصناعية الملوثة على سطح الأرض ونفاذها الى الأحواض المائية الجوفـــية عـــبر الأودية المحيطة. ان المحافظة على جودة المياه الجوفية والبيئة المحيطة، وذلك من خلال منع وتخفيف درجة التلوث في المياه الصناعية، يعتبر من أهم الأمور المتعلقة بالحفاظ على المياه والبيئة.

كمـــا أن دخول القطـاع الصناعي الفلسطيني معترك التنافس من الناحية البيئية مهم أيضا. حيث أن مفهوم التجارة العالمي قد بدأ يأخذ شكلا جديدا لا يتعلق فقط بمقياس جودة المنتج بل يتعداه الى جودة الادارة البيئية، Cleaner Production and ISO 14000، وأصبح ذلك متطلبا اجباريا في مواثيق التبادل التجاري في كثير مـــن دول العالم وخاصة في أميركا ومجموعة دول الاتحاد الأوروبي. وفي فلسطين ينقصنا الكثير للوصول الى درجـــة مقـــبولة فـــي تطبيق القوانين البيئية. ومن أجل ذلك، تم جمع المعلومات المتعلقة بعدد المصانع، أماكن تواجدها، كمية وكفية استخدام المياه والمواد الخام والمواد المنتجة. كذلك تم جمع المعلومات حول كيفية التخلص مـــن النفايات السائلة والصلبة، التعرف على طريقة الانتاج، تقييم الآلات الموجودة، النظم الادارية المتبعة داخل المصانع، و كذلك دراسة الامكانيات الادارية والبشرية.

ومـــن أهـــم النتائج المتعلقة بالتلوث البيئي بالنسبة للمياه الصناعية، ليس فقط من ناحية الكمية، وانما نوعية هذه المياه. فعلى سبيل المثال، ان كمية المياه المستخدمة في مناشير الحجر تعادل 980 م^3/يوم، وهذا يعادل 10% مـــن عدد سكان نابلس من حيث كمية استخدام المياه. كما أن هذه الدراسة كشفت أن معظم القطاعات الصناعية لا يوجـــد لديها أنظمة بيئية أو حتى أنظمة ادارية، سواء في استخدام المواد الخام، أو من خلال عملية التصنيع، أو الانـــتاج أو الأفراد؛ فمعظم المصانع صغيرة الى متوسطة الحجم، وعليه فان السيولة والقروض طويلة الأمد تعتـــبر مشكلة كبيرة بل وعائق أمام تطوير الأنظمة البيئية وتغيير طريقة الانتاج، كما أن المستوى التكنولوجي بسيط مقارنة بالصناعات العالمية.

وقـــد تم اقتراح طرق لتحسين الانتاج من الناحية البيئية، بالاضافة الى الجودة وتقليل تكلفة الانتاج. تقديم طرق إنـــتاج تســـتخدم فـــيها تكنولوجـــيا نظيفة Clean Production Technology, مساهمة الحكومة من خلال المساهمة في دعم المصـــانع بالخبراء، تشـجيع تبني أنظمة ادارة بيئية EMS ، تجنيد جزء من أموال الدول المانحة لتحســـين الجودة البيئية في المصانع وبخاصة المصانع الصغيرة و المتوسطة، تعديل القوانين البيئية والغرامات

بمـــا يتناســـب مـــع الحالـــة والظرف البيئي المحيط، وتقديم المعلومات للصناعة والناس، دعم سوق المنتجات الخضراء.

وقد أوصت الرسالة بعمل مزيد من الدراسات لأساليب الانتاج في المصانع الفلسطينية، وطرق التخلص من المياه الصناعية ومكوناتها، ولا سيما برنامج فحص منتظم للمياه الخارجة من المصانع، وتبني أنظمة الادارة البيئية الجيدة، وتكنولوجيا المنتجات النظيفة، وذلك من أجل وضع الأساس لتوثيق الحفاظ على البيئة.