Reduction of Pollution and Enhancement of Productivity in Industries through Attitude Change and Cleaner Production: Perception and Reality in Nepal

A THESIS

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DOCTOR OF PHILOSOPHY in Applied Science (Environment)

By

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"Reduction of Pollution and Enhancement of Productivity in Industries through Attitude Change and Cleaner Production: Perception and Reality in Nepal"

LETTER OF RECOMMENDATION

(CERTIFICATE TO ACCOMPANY THE THESIS)

It is certified that the

(i) Thesis entitled "**Reduction of Pollution and Enhancement of Productivity in Industries through Attitude Change and Cleaner Production: Perception and Reality in Nepal"** submitted by **Mr.Durga Bahadur Karanjit** is an original piece of research work carried out by the candidate under my supervision.

(ii) Literary presentation is satisfactory and the thesis is in a form suitable for publication.

(iii) Work evinces the capacity of the candidate for critical examination and independent judgement.

_____

Dr. Ramesh Man Singh
Supervisor

Date: 4 October 2012

DECLARTION

CERTIFICATE BY SCHOLAR

This is to certify that the thesis titled "**Reduction of Pollution and Enhancement of Productivity in Industries through Attitude Change and Cleaner Production: Perception and Reality in Nepal"** and submitted by **Mr. Durga Bahadur Karanjit**, under the supervision of Dr. Ramesh Man Singh, Enrollment No. 1150100060 for award of PhD Degree of the University carried out during the period of March 2010 to September 2012 embodies my original work and has not formed the basis for the award of any degree, diploma associateship, fellowship, titles in this or any other University or other similar Institution of higher learning.

Signature in full:

Name in block letters: DURGA BAHADUR KARANJIT

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Date: 30 September 2012

DEDICATION

This PhD thesis work is dedicated to the victims of pollution from the industries

ACKNOWLEDGEMENTS

Cleaner Production should be taken as one of our important tools to integrate conventional industrial production activities with the ecological demand for a better society and for environmental friendly production patterns. This thesis is based on author's fifteen-year professional journey in a search of the most important foundation for Cleaner Production based upon professional experience both as its promotional activist in the Department of Cottage and Small Industries, Ministry of Industry, Nepal and as a freelance consultant on Cleaner Production (CP) Program for a wide spectrum of industries. The long and professional experience in the sector is well integrated within the framework of the Ph.D Program of Singhania University.

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Durga Bahadur Karanjit, Degree Candidate

ABSTRACT

This research study deals with the reduction of the pollution generated from the operation of industries. Adverse impact of industrial activities on the natural environment has created critical ecological concerns. Now, industries research organizations and government agencies are considering the alternates of the command and control technique in environmental pollution control activities. End of the pipe treatment for pollution is no more effective and sustainable. Basically, adverse impact on environment due to pollution from the industries can be reduced by applying two approaches viz hardware and software approaches. Although industries have many options to reduce the environmental impact of their activities through technology change, modern equipment, product design, waste disposal using end of pipe treatment, it all required high investment and additional expenses which add the production cost leading to being uncompetitive in the market. It is always effective to reduce the pollution by controlling the waste generation at the source itself rather than to treat it after it was generated. The research was conducted focusing on the software approaches such as good housekeeping, better production management, regular training and creating awareness among the working people.

Qualitative Methodology is adopted for data collection and research design with focus on its philosophical premise, which encompasses ontological, epistemological, and methodological assumptions. The concept of Cleaner Production was adopted and implemented in the study.

The outcomes of the research study are based on long years of my experience in industrial environmental management. During the research study period, several sessions of in-depth interaction, observations and interviews with all level of the research participants were conducted. Number of awareness programs and trainings on attitude change within the premises of the concept of Cleaner Production was also conducted for research participants. The comparison in improvement before and after the program was done and improvement in the reduction of the waste leading to reduction of pollution was monitored.

The study revealed that attitude of the working people is the prime requisite for reduction of pollution from the industries. Thus the pollution from the operation of industries can be reduced by Changing the Attitude of the working people. The attitude of the working people can be changed through regular awareness program and training on Cleaner Production along with motivational scheme. The study asserted that the success in reduction of the pollution by changing the attitude of the working people will be for long term and it is sustainable. As Pollution Reduction is due to waste minimization at the source itself, it gave not only better natural environment and safety to working people through reduction of pollution but also enhancement of overall productivity and more benefit to industries through resource saving. The study also revealed that the reduction of pollution discharged by the industries cannot be achieved for long term sustainability only through Command and Control Approach.

Key Words: Pollution, Attitude, Cleaner Production

Degree Candidate
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LIST OF ABBREVIATION AND ACCRONYMS

APO	Asian Productivity Organization
BOD	Bio-chemical Oxygen Demand
cm^2	Centimeter square
^0C	Degree Celsius
COD	Chemical Oxygen Demand
CP	Cleaner Production
Cu. m., m^3	Cubic Meter/Meter cube
CO_2	Carbon Dioxide
DANIDA	Danish International Development Assistance
DCSI	Department of Cottage and Small Industries
DOI	Department of Industries
DDC	District Development Committee
ESPS	Environment Sector ProgramSupport
FINIDA	Finish International Development Assistance
GDP	Gross Domestic Product
GHG	Green House Gas
GN	Government of Nepal
gm.	Gram
g/Nm^3	Gram per Normal Meter Cube
GP	Green Productivity
IPCM	Industrial Pollution Control Management
Kg.	Kilogram
lit, l.	Liter
Ltd.	Limited
LPG	Liquefied Petroleum Gas
m	Meter
m^2	Meter square
mg	Milligram

mg/L,mg/l	Milligram per Liter
mm	Millimeter
m^3, M^3	Cubic meter
Max	Maximum
MoI	Ministry of Industry
MOEST	Ministry of Environment, Science and Technology
MOF	Ministry of Finance
MT	Metric Tone
NRs	Nepalese Rupees
No, no.	Number
OHS	Occupational Health and Safety
Pvt. Ltd	Private Limited
PDCA	Plan-Do-Check- Act
PP, P2	Pollution Prevention
S.N., Ser No.	Serial Number
SEAM-Nepal	Strengthening of Environmental Administration and Management at Local Level in Nepal
SO_2	Sulfur Dioxide
TDS	Total Dissolved Solid
TSP	Total Suspended Solid Particles
TSS	Total Suspended Solid
UNEP	United Nation Environment Program
UNIDO	United Nation Industrial Development Organization
USEPA	United States Environment Protection Agency
VDC	Village Development Committee
WM	Waste Minimization

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TERMINOLOGIES USED IN THIS STUDY

Environment	The interaction and inter-relationship among the components of natural, cultural and social systems, economic and human activities and their components.
Pollution	The emission generated from the activities of the industry that significantly degrade, damage the environment and harm human health on the beneficial or useful purpose of the environment, by changing the environment, directly or indirectly.
Waste	Unwanted products such as liquid, solid, gas, slurry, smoke, dust, radiated element or substance or similar other materials generated from the operation of industries and disposed in a manner to degrade the environment and human health. The waste may be in the form of all kinds of raw materials, water, energy and human labour used by the industries.
Industry	The manufacturing establishments producing goods and services
Cleaner Production	The continuous application of an integrated preventive environmental strategy applied to processes, products and services to increase overall efficiency and reduce risks to humans and the environment. It is also called waste minimization and Pollution Prevention Concept
Research Participants	Workers, Operators, Managers and Directors of the industries under study
Attitude	Attitude is defined as an opinion or way of thinking and behaviour reflecting (Betty, 1987). However, the term in this research work **,** refers to Working behaviours of the working people of the industries toward the production of the products and generating waste leading to pollution and unsafe work

PROLOGUE

I completed my Master Degree in Chemical Engineering from Moscow Institute of Fine Chemical Technology in 1978 and Master in Business Administration from Tribhuvan University, Nepal in 1985. Since 1978 till date, I have been associated with industries, industrial workers and entrepreneurs. In 1997, I got training on Cleaner Production through IPCM project implemented by Ministry of Industry under UNIDO support and had also participated as a team leader in the intervention program of Cleaner Production in a textile industry of Kathmandu. We generated many options on productivity enhancement of the industry and at the same time, on the reduction of pollution emitted from the industry. I was so much satisfied with the result of this intervention program.

At that time, Cleaner Production Concept had just been introduced in Nepal as a tool for overall productivity enhancements along with pollution reduction from the industries. At that time I was Technical Director in Department of Cottage and Small Industries and was chief of Industrial Promotion Division. I started to introduce Cleaner Production Concept along with 5S and Kaizen (Japanese Good Housekeeping and small improvement Concept) to various industries through training program to them. I developed training models and topics suitable for small scale industries. Within a small period of time Cleaner Production became so popular among the industries that every industry preferred having training on Cleaner Production. I started to promote Cleaner Production concept among the small scale industries of Nepal.

In 2001, I took an unpaid leave from the government job and joined Environment Sector Program Support (ESPS) Project implemented by Ministry of Industry under DANIDA support as a Cleaner Production Consultant. My first assignment was implementation of Cleaner Production in nine woolen yarn dyeing industries. I did not feel any difficulty to start the assignment. I worked together with one Danish Expert. His expertise in the field of textile technology and my

expertise in implementation of Cleaner Production complimented each other very well in accomplishing our assignment successfully.

Normally we provide integrated technical services and support to industries. It includes not only Cleaner Production Concept, but it also covers Energy Efficiency and Occupational Health and Safety matters. Generally the whole integrated program is conducted by a team of consultants of various fields like Energy, Occupational Health & Safety and Sector Specialist. We normally formed a team of 3-4 persons among the staff of the particular industries. Within this period we provided phase wise trainings to all team members of all participating industries, awareness program in individual industry, and audit of Cleaner Production including Energy and Occupational Health and Safety. Brainstorming program, group and individual discussion and interaction among the team members were normally conducted. The duration of one assignment program was normally 5 month. So, at the end of the program a number of options for improvement were generated, analyzed and only technically, financially and environmentally feasible options were advised to be implemented. From this program all participating industries could save a lot, both economically and environmentally. They were very much satisfied from this program. Undoubtedly, I got self satisfaction too.

Till now I am associated with these industries. Directly or indirectly I have been providing technical and managerial suggestions to these industries. Pollution reduction potential was even up to 58% and chemical saving up to 83%. Immediately after completing the assignment in woolen yarn dyeing industries, my next assignment was in Balaju Industrial District. Total 23 industries had participated in this program with two phases. Most of the industries in this assignment were small and medium sized and chemical based industries. They were mainly plastic and rubber processing and metal re-rolling industries. They did not generate waste water but they produced a lot of solid waste. So my assignment was to reduce the waste at the source during designing, and formulation and sizing. They got success in reduction of solid waste generation up to 25%. It means that they save d the materials up to 25 %.

My third assignment was very challenging. I worked with 15 woman entrepreneurs. All of them had cottage scale industries and mainly handi craft production starting from glass bead jewellery to pashmina shawls. Being cottage scale industries, it was very difficult to identify the area of improvement and to generate saving options. The quality of work and its saving depends on the working approach and working attitude of the workers. I provided three trainings in group and awareness program individually in respective industry. The training program was conducted with actual experiment of Material Balance (following Steps of Cleaner Production Concept), which helped them to understand why and how the waste is generated and what we have to do for reduction of such waste. The awareness program in their respective industry helped in great extent to reduce the waste and save money. The saving of raw materials was in an average 11%.

It was so fruitful that they all got some benefit from this program. The program gave them practical experience and they were convinced that they could reduce the waste and save a considerable amount of money as well. They appreciated the program. I worked with them for 5 months. I visited their work place and observed their work and working practices and discussed with management, operators and workers about waste minimization. In-house awareness program on attitude of working practice helped in great extent in reduction of pollution.

Even today when I meet them, they remember the program and the work done. I got a lot of impression and new experience from this programme.

In addition to the above mentioned assignments, I got a very fruitful working experience after completing the assigned work with Enviroplast Nepal Pvt. Ltd located in Chitwan. The industry made second grade granule from used waste plastic. It helped to keep the environment clean on one side and to raise the economy of the country by utilizing waste resources of the country on the other side. The industry uses a lot of water for cleaning the waste plastic containing oil and grease and even some food waste. During processing, it also generates some waste water which is discharged without ubdergoing any treatment.

I felt at that time that I did some responsible job by creating awareness to the workers on proper utilization of resources and providing them useful suggestion for better working practices toward waste water minimization. They got success on reduction of pollution from this unit up to 40%.

After completing the program with woman entrepreneurs and Enviroplast, from January 2003 to May 2003, I had conducted similar program in 13 small scale industries of Narayanghat and Butwal area. There were mainly plastic and rubber processing, and food industries. It was my first experience working with industries outside the Kathmandu Valley under this project. We had started program with management Commitment Seminar and awareness program. The industries got the same kinds of increase in saving and reduction of pollution. After completing the program, they had requested to organize similar programfor more other industries and we conducted again similar programfor nine more industries. The resources saving were up to 10 % and reduction of solid waste was up to 55%. And 76% of all options generated were Simple Housekeeping Options, which needed only more positive attitude and better working practices and nothjing other.

Between of September 2003 to March 2004, I was involved with small scale industries of Pashmina and Hand Made Papers. Both Pashmina and handmade papers are export business. They both use a lot of chemicals and generate waste water. Similar Cleaner Production program was conducted in 11 industries. Same kinds of saving and reduction of waste water generation was achieved. At the end of the program the potential of materials saving was about 4% and reduction of waste water was 30% and Solid waste was 17%.

Similar Cleaner production assessment program was carried out in Pokhara too. The program was conducted in two phases (phase I from July 2004–December 2004 and Phase II, January 2005-May 2005). In total 20 industries from had participated in this programme. Although it was my last assignment in this project but it was the most memorable. In my almost one year stay in Pokhara, working with small and large industries of that region gave me more working experiences and deep

knowledge on Cleaner Production. My awareness program to the employees of the industries were so impressive and fruitful that it was successful in changing the attitude of the working people toward waste minimization and better working approaches. Although I developed some new awareness material after every awareness program, the materials developed during this assignment proved to be most effective and result oriented.

At the end of the program, many industries implemented no cost low cost options. The working people of the industries were very much enthusiastic to learn more about Cleaner Production. Some participants had implemented cost saving and maximum resource utilization approach even in the kitchen management. I am so happy to know about it.

Unfortunately ESPS project was terminated from July 2005 due to political changes in the country. Due to this I almost made the decision to return to my government job. However, I was so much associated with Cleaner Production activities which gave me self satisfaction that I decided to continue similar Cleaner Production Activities more effectively. Hence, I decided not to go back to the government job.

I together with some other friends registered a consultancy firm named PACE Nepal Pvt. Ltd. Then, from July 2005 we started to continue the venture of Cleaner Production, as a legacy of what we had done in the ESPS project. My first assignment from this company was to conduct an awareness program for employees of Sher Carpet Industries. We got some assignments from the Ministry of Industry and Ministry of Environment, Science and Technology on Cleaner Production. It was my first challenge in the private job. So I changed my approach and became more promotional and professional. Although we had no competitors in this field, we still had to prove our customers that we carry on our job professionally with result.

My first assignment from Ministry of Industry was on the industries of Pokhara. I selected seven industries and conducted Cleaner Production assessment

from March 2006– July 2006. Industries were selected on the basis of commitment from top management to work on positive attitude toward waste reduction leading to lesser pollution. My job, as usual, was to create awareness among the working people regarding the understanding of waste, pollution and working approach from attitudinal point of view. So, I conducted awareness program to all employees with fully participation approach. Their understanding of waste and pollution and working approach was totally different from my intention. But ultimately they confessed that I was right and they agreed to change their attitude or working approach according to my intention.

During 2006 to 2011, I conducted similar Cleaner Production intervention programs in more than 20 industries and Environmental Management System in 10 industries under Ministry of Industry and Ministry of Environment (now Ministry of Science, Technology and Envirnment). Although we conducted the programs basically in same way , each and every time I got some new knowledge and experiences from conducting such programs. It was mainly because of the people's attitude and their thinking toward pollution and waste generated in the industries, which helped me to broaden my horizon of knowledge toward waste management and pollution control activities.

On the basis of the waste streams potential, I suggested options for reduction of waste and pollution and at the same time industries get monetary benefit too from saving of the resources.

One after other I got assignments from various organizations and completed them accordingly. Our biggest client is Strengthening of Environmental Administration and Management at the Local Level in Nepal (SEAM –Nepal) Project supported by FINIDA. The overall objective of the Project is to improve the state of the environment and to enhance environmentally sustainable rural, urban and industrial development and utilization of natural resources in the project area. PACE Nepal worked with SEAM-Nepal from June 2006 – Jan 2012. I was team leader in most of the assignments.

During this five and half year period, I completed Detail Cleaner Production implementation program in 12 industries and Rapid Cleaner production Assessment with monitoring in 31 industries of various sectors of Morang, Sunsari and Dhankuta Districts. Similarly, I provided technical services regarding Pollution Control Certification together with Rapid Cleaner Production to 47 industries of various sectors and various sizes of Morang, Sunsari, and Dhankuta and Jhapa. It was a really challenging job to monitor the emission from the 15 brick industries of Sunsari district and provide them with improvement options for reduction of the emission meeting to National Emission Standard so that they all get Provisional Pollution Control Certificate.

Besides these long duration activities, I organized and conducted 4 days training program on Environmental Management System to students and teachers of Central Technology Campus of Dharan, Environmental Planning Management training to staffs of 6 District Development Committee and Municipalities/VDCs separately (Morang, Sunsari, Dhankuta, Jhapa, Panchthar, Ilam) and Occupational Health and Safety to Jute industries. Also, I have organized and conducted 1-2 days training on Cleaner Production to the staffs and members of Chambers of Commerce and Industries.

Besides these, in parallel, I have conducted one or half day awareness program on Cleaner Production to staffs and workers of various industries and members of social organizations and communities. During this period, I had conducted a number of short awareness programs to staffs of various industries including Woolen Yarn Dyeing Industries.

In the time span of 15 years, I came across so many different industries, different sectors, different technologies, and different persons and of course different working attitude. So, I accumulated all these differences in a pot of brain and started to analyze why people have different attitude towards work and environment and also thought that the working people in the manufacturing sector have great responsibility and duty in reducing the waste and pollution to environment. When I conducted

awareness program on understanding of the waste, cleaning, and working approach to working people and management, I felt very happy that they agreed with me and committed to follow my thinking and attitude.

After the awareness programme and short training on Cleaner Production, I usually do monitoring of their works. At that time I noticed that most of the people at least tried to apply changed attitude on working practice and they actually reduced the spillage and leakage and changed working practice on overall waste generation. I developed very basic awareness materials along with practical illustration understandable even to layman. I got very positive appreciation feedback from the participants; even from qualified personnel and management that the programs had changed the attitude of the working people toward waste reduction. Considering all these realities and importances for protection of environment, I decided to do some more work on this as a researcher and do my PhD on this area so that the horizon of my vision expands and I can share my experiences and successful cases with others. Some pictures on conducting the awareness and training programme are given in Annex-7

CHAPTER I

INTRODUCTION

Pollution is an undesirable change in physical, chemical or biological characteristics of our living environment which may harmfully affect human life, flora, fauna and materials. Pollution is generated from the various activities including industrial production. There are mainly two types of techniques that can be applied for reduction of such pollution. Firstly, pollution can be reduced technologically using modern machine and equipment and using high quality clean raw materials. Secondly, there are possibilities of reduction of pollution through applying positive attitude of the working people with good operating practices. Second technique will be more reliable, result oriented and less resource required. My research topic is based on the reduction of pollution through attitudinal change in the working people. This thesis is based on my many years of experience in the subject.

Background of the Study

Since many centuries, the environmental issues have been considered as one of the main top agendas in international forum. Global concern on environmental issues has escalated as human activities against environment have increased. It is as a result of the rapid population growth (Tantawai et al., 2006, p. 1). One of the most damaging influences of man on the environment is pollution. Pollution is not just pollution and it is not just the adverse impact to people. But it is waste of resources, waste of valuable time and waste of importance of whole life.

Environmental pollution is a concern of many people in Nepal, in particular and the world in general. We Nepalese people are more concerned with immediate pollution and adverse impact like garbage, polluted rivers and lakes, dusty streets, noise and smoke pollution etc rather than global perspective alike ozone depletion, global warming and so on. Industrial development in Nepal is still at an early stage and production is going down and down in every year and the contribution of manufacturing subsector to GDP is reduced to 6.5% in the fiscal year 2010/11 from

9.0% in the fiscal year 2004/05 (Economic Survey, 2011, p. 6). According to industry sources, the production has declined mainly due to political instability in the country leading to low productivity and inefficient use of resources. The industries do not take any priority or importance in the protection of environment. Inefficient use of resources generates waste in the form of pollution. Despite the low level of industrialization, problems of pollution have been emerging in Nepal in specific industrial and urban localities. At present industrial pollution problems have been identified in many industries especially tanning, paper, and textile dyeing, metal cement and brick factories. Although my thesis is based on my observation and findings in many industries since last 15 years (refer to my prologue given in page1), more focus is concentrated on woolen yarn dyeing industries located in and around the Kathmandu Valley.

Dyeing and washing units are integral part of the carpet manufacturing industries. Dyeing and washing units of carpet are one of the main sources of wastewater generation in Kathmandu valley. The valley has many sacred rivers, ponds and lakes and can boast of unique social, cultural and religious status. But due to pollution from the wastewater discharged and solid waste disposal, the sacred rivers and lakes of the Kathmandu valley have turned into an open sewerage unsuitable for undertaking any activities including religious ceremony. The rivers in Kathmandu valley particularly Bagmati river is heavily polluted and contaminated even with heavy metals, pesticides and other hazardous materials (Gautam, 2000, p. 226).

Environmental activists have demanded either removal of dyeing industries or to discharge the wastewater only after correct treatment. They consider dyeing units to be major source of river/lake pollution in the valley. Dyeing process is the most critical and important stage, both from economical and environmental point of view in the production process of the carpet. Re-dyeing is a usual practice, which adds to the quantity of wastewater generation as a result of poor process control system and non-uniform quality of yarn and dyestuff used.

From the pollution prone industries point of view, the woolen yarn dyeing industries produce a lot of wastewater and cause air pollution (ESPS, 2005, p. 1). The carpet sector is associated with dyeing and washing operations and discharges large volumes of wastewater and emits toxic gases into environment. As these industries are small scale and some even family business, they are scattered and situated mostly in residential areas within the Kathmandu valley. Hence, they are subsequently highly visible and the environmental implication of these industries has always been a concern for government and public.

My thesis focuses on the attitude of the working people. Attitude reflects the working and operating practices of the working people. Although it looks very simple that the pollution can be reduced by changing attitude of the working people, it is very complex and difficult to understand the attitude. Attitude is the way you look at things mentally. (WilMcknight, 2001).

Attitudes are judgments. Most attitudes are the result of either direct experience or observational learning from the environment. There are three ways of learning viz knowledge, skill and attitude practice. First we learn something in the form of knowledge and then make it perfect through skill development and lastly make it culture by applying and practicing this perfect skillful knowledge with positive attitude. Any work or matter, even if it is with full of skillful knowledge, it will be useless if the attitude of the person who is going to apply it, is with negative attitude. So attitude is foremost important thing that should be learnt by us to perform any work successfully. Attitude works differently. Attitude of one person may vary from others in performing any work.

The attitude toward environmental pollution is the set of perception on various issues on environmental matters. This kind of perception is developed in the mind of human being only through own experience and gaining knowledge on environment. The society with positive attitude and environment knowledge work better for the preservation of the environment (Myzatul, 2005, p. 36).

The industry produces the product. It is very good and fine that the industry produces the product that we want. But if the industry produces only the product we want, it will not be necessary to make this study. Unfortunately the industry also produces the things that we do not want. The things that we do not want are pollution of environment through waste generation, risk of accident and hazard to working people due to unsafe working condition and through emission of toxic things. The general production process of any product and service can be viewed as given in figure 1 below:

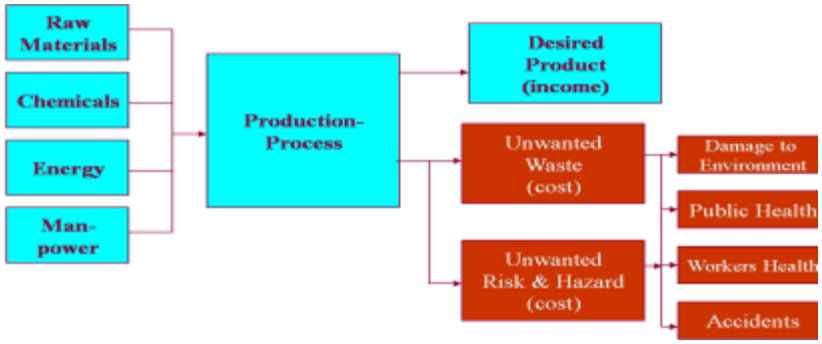


Figure 1 General Production Process

Source: ESPS publication, DANIDA Project, 2004

Cleaner Production is the concept developed by United Nation Environment Program (UNEP). Cleaner Production can be defined as the continuous application of an integrated preventive environmental strategy applied to processes, products and services to increase overall efficiency and reduce risks to humans and the environment (UNEP, 1994). So through application of Cleaner Production, the waste generation during the production process will be minimized leading to less pollution to environment and less risk of accident and hazard to working people. Since the industrialization, the safety and working condition of working people is considered as one of the main concerns of the worker's union. The research revealed that behaviour changes must have been preceded by a change in attitude towards safety for the peoples, working environment as well as the environment at large. The industries which consider the safety and better working condition of the workers and

environment can develop and improve the productivity and industries succeeded (Christel, 2001, p. 2)

Cleaner Production is the only concept that addresses the attitude as one of the most important factors to be considered in pollution controlling activities in industries. The implementation of Cleaner Production is only possible with changing attitude (Van Berkley, 1999, p. 2).The key difference between pollution control and Cleaner Production is one of timing. Pollution control is an after-the-event, 'react and treat' approach, whereas Cleaner Production reflects a proactive, 'anticipate and prevent' philosophy. Prevention is always better than cure. It is important to stress that Cleaner Production is about attitudinal as well as technological change. In many cases, the most significant Cleaner Production benefits can be gained through lateral thinking, without adopting technological solutions (UNEP, 1994).

To change the people toward positive attitude, they should be convinced so that they embrace the change. They should understand the importance of positive attitude and value for their own benefits. It is also very important to have belief in mind that they can change their attitude positively (Jodi, 2002, p. 6)

Therefore, positive attitude towards environmental pollution is important for everyone in order to help to preserve and conserve the environment.

Statement of the Problems

The former prime minister of India, Mrs.Indira Gandhi, had said in an UN environment conference in Stockholm in 1972 that Poverty is the biggest polluter. But nearly four decades since then, although poverty has declined substantially in India, but pollution has increased more than before. Probably contrary to her belief, economic activities including industrialization aimed at eradicating poverty have become bigger sources of pollution (Chandrakanta, 2009, p. 1).Same condition is happening in Nepal too. Although Industrialization is still in early stage, Nepal especially urban cities like Kathmandu are facing bigger pollution. Rivers, streets, air of cities are polluted. Economical development together with industrialization in the

country creates more polluted water in water bodies, dusty air in atmosphere and solid waste in the street.

Woolen Carpet and Pashmina industries are major foreign currency earners and are concentrated mostly in and around Kathmandu valley. According to the recent sectoral analysis, hand knotted woollen carpet and pashmina industry occupies the first in the export foreign currency earners of Nepal (Economic Survey, 2011, p. 105).This sector is providing employment to about two hundred thousand people (Abhiyan Product Directory, 2011, p. 96).The main raw material of these products is woolen yarn. Dyeing units are integral part of the carpet and pashmina manufacturing industries. Dyeing units are one of the main sources of wastewater generation in Kathmandu Valley. Nepal Government has already gazetted the enforcement of wastewater discharge standards for wool dyeing industries. It must be acknowledged that the sector generates wastewater, which has clearly contributed to poor quality of surface water in Kathmandu valley. But due to pollution from the wastewater discharged and solid waste disposal, the sacred rivers of the Kathmandu valley have turned into an open sewerage unsuitable for undertaking any religious ceremony. Environmental activists have demanded the removal of dyeing industries considering them to be major source of river pollution in the valley. The pollution from this sector is escalated due to unnecessarily high consumption of chemicals and repeating the dyeing operations due to wrong operating practices and negative attitude of workers toward operation and handling of the process. Dyeing process is the most critical and important stage, both from economical and pollution point of view in the production process of the carpet.

On the other hand, due to lack of the government policy and poor enforcement of regulations regarding the pollution from the industries, the industries are not following the present rules and regulation on the protection of the environment. Both the industries and customers think that the expenses made for pollution prevention activities are additional and unnecessary expenses, which only escalate the cost of the product.

The working people in the industries are totally not concern with the pollution caused from the industrial waste. They do not consider even the safety measures to be followed during the production.

The management does not know about Cleaner Production Concept and its implementation toward the pollution reduction. Their main concern is only to increase the production and get more profit. Yes it is true that the main aim of the business is to get profit. They are not aware of pollution caused from waste generated by the industries. They never make study why the waste is generated and how much and they never give importance to human factor and their attitude.

Significance of the Study

The health of the people is prime concern matter for mankind. Pollution is the negative aspect of the health. There are two types of environment. The first is natural environment, which is created by nature such as mountain, river, forest, land, birds and human being etc and another is manmade environment such as physical infrastructure, vehicle, and all other artificial things. Pollution is not natural phenomena. Pollution is generated from activities of manmade environment which is performed using the resources from natural environment that is decreasing day by day. So the level of pollution depends on the working approach and intention of human being. It can be controlled and it can be minimized if man wants. But men are not taking this matter seriously.

Industrial activities are generating a lot of pollution to environment and human health and risk and hazard to workers. As mentioned in the earlier, production process produce one wanted product and two unwanted things which make adverse impact to mankind in the form of pollution and in the form of risk of accident and hazard.

Cleaner Production is the concept which makes the production with minimum unwanted thing maximizing the wanted product. This is a win-win win concept. By minimizing unwanted thing, it gives maximum profit to investor, less pollution to

society and safe working condition to workers. Only man himself can make his life, society and environment where they live, enjoyable. Thus the attitude of the working people plays main role in reducing the pollution. The main thrust of this study is that changing in the attitude of the working people can reduce the pollution from the industries and provide safe working condition. And this will provide not only less pollution to environment but also it saves a lot of our valuable resources without any investment and expenses. Thus this study plays very important role to explore new approach for welfare of the mankind.

Purpose of the Study

The main purpose of this study is to reduce the industrial pollution through positive attitude of the working people. However it has following specific purposes.

a. To save our valuable resources through efficient and effective utilization of materials and resources
b. To provide safe working condition to working people through good housekeeping and proper handling of the materials.
c. To add one more concept in the academic world through which the industrial pollution can be reduced in great extent using low cost/no cost approach (Positive Attitude)

Research Questions

This study aimed to answer the following research questions:

1. What is the level of knowledge and attitude towards environmental pollution among the workers of the woolen yarn dyeing industries of Nepal?

2. What is the existing pollution and pollution load in dyeing industries?

3. How the pollution from the dyeing industries can be reduced?

4. How it will be possible to reduce the pollution load by changing the attitude of workers positively with better operating practices?

5. What are the techniques and approaches to be used for changing the attitude of the working people?

Delimitation of the Study

I am doing the study in this field since last 15 years. During this period, I have worked with many types of people with different attitude and working practices in various industries. This study is the compilation of my findings in this period in general. Different industries generate different kinds of pollution with various degree of adverse impact. So, if I try to incorporate all my finding and outcomes in one study, I will be lost in somewhere. Of course, to make my study more result oriented and practicable, I have to also use some findings and results of this period. So although the boundary of my study for this research work is up to the findings of 15 years of my work in this field, I like to focus more on the recent findings of my work in the woolen yarn dyeing industries located in and around the Kathmandu Valley.

I have associated with woolen yarn dyeing industries since last 12 years. I have worked and contributed a lot for these industries. So I have good relation with management of these industries and of course it will be easy for me to get some additional data and information about these industries, if needed.

Industries under this study are small scale industries. The people working in these industries are mostly with low education background. These working people are my target group or research participants. Although there are many methods suitable for such study, my study will be based on the various methods such as case studies, observation, in-depth interviews, focus group discussion and awareness program as an intervention using various attitudinal change techniques and approaches.

Organization of the Study

The thesis consists of Six Chapters. The Chapter First contains introduction of the study, background of the study, statement of the problems, significance of the study, purpose of the study, research questions, delimitation of the study, organization of the study. Chapter Two provides a comprehensive literature review.
Chapter Three discusses the data, models, and methodology and research procedures in detail. Chapter Four provides an overview of condition of the industries focusing woolen yarn dyeing industries before the study intervention. The main empirical findings and results are analyzed in Chapter Five and working trends and practices with theoretical link. And Chapter Six provides the Summary, Conclusion and Implication of the study along with results of improvement reducing the pollution

CHAPTER II

LITERATURE REVIEWS

This chapter mainly describes on reviewing the literatures related to Pollution Reduction and its Concept, Techniques, Methodologies and Approaches, Theories and Reports related to pollution, pollution prevention and reduction in industries. First I started from the review of documents on the introduction to Environment and Pollution and its types and sources. Then I reviewed the documents related to understanding of waste, causes of its generation. In detail I described the Concept, Techniques and Methodology of Cleaner Production and its Barrier in its implementation in industries. I described reports on dyeing industries in Nepal and situation of the pollution and its adverse impact to environment created by this industrial sector. I made reflection review of the documents related to attitude of working people toward pollution and pollution prevention. Lastly, I discussed major three theories; Environmental Ethic Theory, Motivational Theory and Attitudinal theory. These theories provided me a strong theoretical background while analyzing and interpreting findings on Reduction of Pollution through attitudinal changes applying Cleaner Production. Finally, I expressed my view on pollution reduction in the context of Nepal. In this chapter, I have presented my ideas thematically, critically and diagrammatically.

Environment and Pollution

Environment

ISO14001:2004 defines Environment as Surroundings in which an organization operates including air, water, land, natural resources, flora, fauna, humans and their interrelations.

The environment is referred to as “the physical factors of the surroundings of human beings including land, water, atmosphere, climate, sound, odour, taste, the biological factors of animals and plants and the social factor of aesthetics” *(Ponniah,*

1981, p. 4). Natural Environment means the sum of all living and non-living things that surround an organism, or group of organisms *(Ned Haluzan, 2008)*

In another words “Environment is sum total of water, air and land and their interrelationships among themselves and also with the human being, other living organisms and property". It includes all the physical and biological surrounding and their interactions. Thus environment is actually global in nature. Environment can be divided into two type viz natural and built environment. *(Ned Haluzan, 2008)*

Presence of any matter or energy in any quantity and in any location brings the changes in characteristics or the processes of any part of environment causing adverse impact to the condition, health, safety or welfare of living and non living things including human beings. Pollution is the presence of such contaminants into an environment that makes disorder, harm or discomfort to the ecosystem. The presence of such matters is considered contaminants when they exceed some tolerance limit. Pollution can be any form, quantity, magnitude such as matters (Sold, liquid, air pollution), or heat, light, energy and noise *(TNAU, 2008).*

There are two types of the cause of pollution: natural and man-made. Natural pollution occurs naturally as land slide, flood, soil erosion etc. In this case there is not any significant intervention from human beings on their occurrence. While the man-made pollution is caused by human activities, such as industrial production, construction of physical infrastructure, population, technology and techniques applied. We human beings get all resources from nature for fulfilling our requirements and this is for the sake of our comfortable living. Naturally we depend on the nature and at the same time we contact to environment. On fulfilling our requirements, our needs are increasing day by day, which intensify the contact with environment. The increase of such requirements (new technology, new products) would bring their respective side effects besides their advantages. Pollution caused from the exploitation to nature is a growing pain. Pollution is not generated automatically and it does not come suddenly from the sky. It is we that generate the pollution. It is our fault and we should take responsibility for creating the pollution.

We must be wise in managing our resources, and take positive attitude towards preventing any forms of pollution to the environment.

Mainly there are six types of pollution that has to be faced by us. They are as follows: *(TNAU, 2008)*

- Air Pollution
- Water Pollution
- Land Pollution
- Noise Pollution
- Radioactive Pollution
- Thermal Pollution

Industrial Pollution

The industrial sector is one of the high contributors to GDP. This sector plays prime role in economic development and the alleviation of poverty. But at the same time it produces a lot of waste and emission causing to pollution to environment. So if environmental considerations are not effectively integrated in the production and process start from its designing stage, adverse impact to environment can be manifold causing negative impact to economical development. Industries, in general, consume 37 per cent of the world's energy and emit 50 per cent of world's CO_2, 90 per cent of world's SO_2. Lately, however, the severity of some of the local impacts of industry and the high cost of remediation industry is becoming an increasingly sensitive issue (*State of Environment-South Asia, 2001)*

Industrial pollution was accelerated since start of industrial revolution in 1800. As the industries started use of mechanized technology for production of various products and product development, the pollution generated from this development was also increased as the demand of people increased. *(Hardik, 2012)*

Industrial pollution is one of the main causes of pollution to the environment. Because of its size and scope of development, industrial pollution is a serious problem

for the entire planet, especially in nations which are rapidly industrializing, like China and for both developed and developing countries. Because of the nature of the global environment, industrial pollution is never limited to industrial nations. The industrial pollution, being very severe adverse impact to environment; it hurts the environment in a diversified ways. Workers being directly attached with the activities of the industry in areas with uncontrolled industrial pollution are especially vulnerable *(Hardik, 2012).*

Generally, in developing countries environment is not taken in consideration during the planning of production process. So, Environmental impact of Small and Medium Industries have generally been ignored. However, the costs associated with environmental impacts are very high. Rapid industrial growth in South Asian countries causes the environmental impact more and more.

The environmental costs of rapid industrial growth in South Asia are caused in following areas:

• Contamination of water resources, including pollution of groundwater

• Unacceptable levels of air pollution, and

• Unsafe handling and disposal of toxic substances.

These costs are associated with contaminated water, air and land; adverse health impacts; and damage to local flora and fauna (*State of Environment-South Asia, 2001)*

Waste

Waste is normally generated as a by- product from the human activities. Economic development together with high living standard of the people has led to increase of waste generation both in quantity and complexity. As the countries becoming industrialized with diversified products and technologies and expansion of health care facilities, their activities have added substantial industrial hazardous waste and biomedical waste into environment with negative impact to human health.

According Encyclopedia, Waste is considered as rubbish, trash, refuse, garbage, junk, and litter unwanted or useless materials. According to the *Basel Convention, 1989, Switzerland*, waste is defined as follows:

"Wastes are materials that are not prime products (that is products produced for the market) for which the generator has no further use in terms of his/her own purposes of production, transformation or consumption, and of which he/she wants to dispose.

Wastes may be generated during the extraction of raw materials, the processing of raw materials into intermediate and final products, the consumption of final products, and other human activities.

Merriam-Webster defines *waste* as "refuse from places of human or animal habitation." *The World Book Dictionary* defines waste as "useless or worthless material; stuff to be thrown away." Unfortunately, both definitions reflect a widespread attitude that does not recognize waste as a resource.

Zero Waste America defines waste as "a resource that is not safely recycled back into the environment or the marketplace." This definition considers the waste as valuable resource, even the recycling of waste is not the problem solving, which may affect the environment and public health adversely and at the same time, any how it is loss of resource.

The word 'waste' and the act of 'wasting' are human inventions. The waste and waste generation is created by human beings. We do not get any waste in Nature. There is nothing useless in nature. Everything has some purpose. Wasting results long term harmful consequences for humans, nature and economy. So, education and awareness in the area of waste and waste management is increasingly important from a global perspective of resource management *(Lynn, 2010).*

Types of Waste can be classified as follows: *(Eionet, 2009)*

- Municipal Waste (including Household and Commercial)

- Industrial waste (including manufacturing)
- Hazardous Waste
- Construction and Demolition Waste
- Mining Waste
- Waste from Electrical and Electronic Equipment (WEEE)
- Biodegradable Municipal Waste
- Packaging Waste
- End-of-Life Vehicles (ELVs) and Tyres
- Agricultural waste

Waste Minimization

The study survey on Attitudes toward waste minimization in Finland and Czech Republic – barriers and drivers was carried out in Czech and Finish companies to know about the attitude of the working people toward waste minimization. The survey revealed that the influencing factor for waste minimization was employees' attitudes. This result seems to confirm the assumption that it is not the technology or regulations, but the human factor that is the most important thing in environmental management. The survey also revealed that the most important factor to get the benefit is to reduce the raw material and energy losses. The answer received on question asked about the barriers for waste minimization was that although lack of money and technology constraints were mentioned in both of the countries, the most significant barrier was insufficient environmental awareness and concern. However, the amount of barriers was higher with Czech companies, which corresponds with the fact that Czech Republic is still in the second stage of environmental awareness where Finland has already reached the third level *(Olgyaiová et.al, 2005)*

The study further revealed that employees can affect waste minimization with their efforts more than their management. The following are the factors to influence to waste minimization by employees:

- with their attitudes towards waste separation and environment
- by separating waste;

- by realizing the consequences of their work/actions;
- by initiative in finding improvements;
- By saving.
- Designers and developers by having environmental issues on mind when designing and developing *(Olgyaiová et.al, 2005)*

Cleaner Production

If we look back into the history of response to pollution from industries, we notice that the response has been changing over time. In the beginning, pollution was considered to be unavoidable with industrial production and thus was just *ignored*. When pollution levels in industrial centers became of great concern due to adverse impacts on health, industries were dispersed so that the resulting pollution got *diluted* and the adverse impact diminished. *Dilution is the solution to pollution* was a popular phrase. With further industrialization, dilution possibility was limited due to the limit of the carrying capacity of the environmental media and infrastructure availability. The next response was to *treat* the generated waste to keep the pollution within tolerable limits. The treatment process, which is also known as the pollution control measure, is a costly affair. It increases the cost of production per unit. It most often also transforms the pollutants from one medium to another. Raising costs of treatments together with high level of competition in the global market led to change in the response from treatment to *source reduction* or *prevention of pollution* at the source itself *(UNEP1994).* Various organizations call this approach by different names. United States Environment Protection Agency (USEPA) uses Pollution Prevention (PP or P2), United Nations Industrial Development Organization (UNIDO) names it Waste Minimization (WM), Asian Productivity Organization (APO) uses Green Productivity (GP) and United Nations Environment Program (UNEP) calls it Cleaner Production (CP) *(Karanjit, 2006).*

Cleaner Production is defined as "the continuous application of an integrated preventive environmental strategy applied to processes, products and services to

increase overall efficiency and reduce risks to humans and the environment*" (UNEP 1994).* It aims at:

• *Production processes*: conserving all input materials like Raw Materials, Energy, Labour, Water both in quantity and toxicity through minimization of waste and emission generation

• *Products*: reducing the environmental impact from the product produced from raw materials extraction to its ultimate disposal after used (whole Life Cycle);

• *Services*: incorporating environmental concerns into designing and delivering services

Cleaner Production requires changing attitudes, following environmental management System and applying better technology options *(Berkel, 1999).* The scope of understanding of Environmental Science and Engineering is spreading. Now the controlling of environmental pollution is shifted from end of pipe treatment to preventive approach for sustainability. Cleaner Production requires Positive Attitude, Knowledge and Skill for all working people to assure that preventive environmental strategies are followed starting from planning and development activities throughout society *(Martin and Rigola, 2001)* .

Although the organizations and industries have applied various Environmental Management Systems likes ISO14001, BS 7790 in their activities for better environmental performances, success has not been universial and sustainable. To get the universial success, it is not enough to have employees with high skill and abilities, but also it is very much necessary on what they care about, to which they are committed and beliefe is very important. Employees of the company are the main actor of the environmental management initiative of the company. Their support to the initiative will increase the probability of successful implementation of any management system *(Genevie`ve et all, 2005)*

According to *International Declaration on Cleaner Production, which was adopted at the fifth International High Level Seminar held in South Korea in September, 1998*, Cleaner Production (CP) was defined as follows: "We understand Cleaner Production to be the continuous application of an integrated, preventive strategy applied to processes, products and services in pursuit of economic, social, health, safety and environmental benefits."

When CP activities are defined as 'the continuous use of industrial processes and products to prevent the pollution of air, water and land, reduce waste at the source' *(UNEP, 1994),* they have at least three following basic characteristics:

i) CP is a preventative environmental management movement in the industrial sector;

ii) CP activities focus on developing not only more environmentally sound but also economically beneficial systems of production beyond governmental regulations;

iii) The CP movement requires intrinsically evolutionary and environmentally positive changes in the production processes *(Dong Won Shin, 2005, p. 4).*

Cleaner Production is thus totally focused on the continuous application of an integrated preventive strategy to industrial processes and products in order to avoid, or at least minimize, the generation of waste and emissions leading to less risk and hazard to human and environment *(Berkel, 1999)*

This preventive approach of Cleaner Production Concept gives benefits not only to society, working people but also economic benefit to industry itself. Thus Cleaner Production creates Win-Win –Win situation to all three sectors viz to industry - economic saving and ethic, to workers- safe and better working condition, and to society- better living without pollution.

The Cleaner Production can be further explained graphically figure 2 as follows:

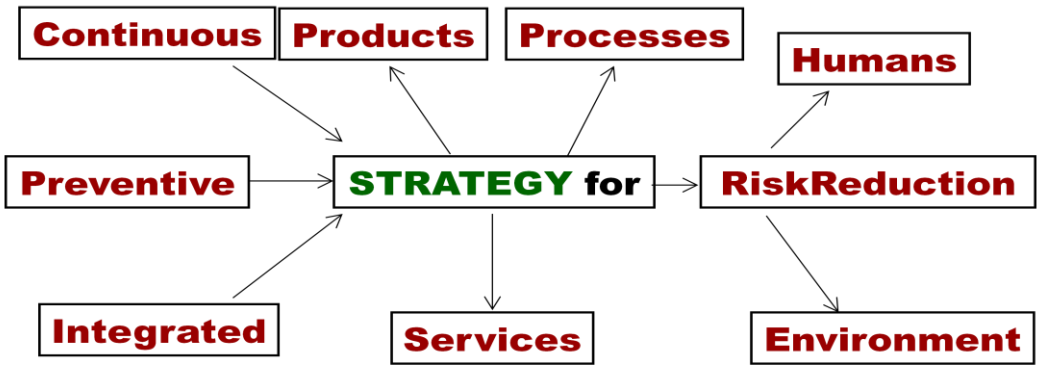


Figure 2 Graphical presentation of Cleaner Production

Adopted from: Institute of Environmental Engineering (APINI) Kaunas University of Technology, Lithuania

In short, Cleaner Production is considered as a strategic tool of business policy to improve the market competitiveness by considering the requirement of then environment leading to its sustainability. However, its application requires responsible environmental management, a change of attitude positively and application of technological knowledge correctly. This concept of integrated environmental prevention is known by several names of very similar meaning: minimization, reduction at source, pollution prevention, cleaner production, eco-efficiency etc.

Cleaner Production also can be considered as an environmental management system which follows the preventive approach by controlling the generation waste/ pollution at source itself and the incorporation of environmental criteria and requirement at the stage of its designing. Thus Cleaner Production:

- Gives the savings of input materials like raw materials, water and energy, labour cost.
- Makes reduction and/or replacement of hazardous materials.
- Reduces the generation of waste and emissions. (*Doctor Roux,n.d)*

The first United Nations Conference on Environment and Development (UNCED Earth Summit**)** was held in Rio de Janeiro in 1992 and Agenda 21 is the outcome of this Summit. It represented a turning point in the way we look at environment and development. Chapter 4 of Agenda 21 explicitly identifies unsustainable production and consumption patterns, particularly in industrialized countries,' as 'the major cause of the continued deterioration of the global environment' *(UN, 1992, para. 4.3).*

Chapter 4 of this Agenda 21 "Changing Consumption and Production Patterns" created the stage of debate on Sustainable Consumption and Cleaner Production. It provided also a thrust on the need of such policies and strategies that encourage changes in present Consumption and Production Pattern. It can be concluded that Production and Consumption are two sides of the same coin. Thus Cleaner Production and Sustainable Consumption should go hand in hand as a two sides of same coin *(UNEP, 2001, pp. 37-40)*

Pollution Prevention (Cleaner Production) is good business. While most pollution control strategies cost money, pollution prevention has saved many firms thousands of dollars in treatment and disposal costs alone. Pollution prevention requires a new attitude about pollution control. Traditional thinking places all the responsibility on a few environmental experts in charge of treatment. The new focus makes pollution prevention everyone's responsibility. Preventing pollution may be a new role for production-oriented managers and workers, but their cooperation is crucial. It will be the workers themselves who must make pollution prevention succeed in the workplace. *(CHMR, 1996)*

On conclusion, Basic Cleaner Production can be conceptualized Figure 3 as follow

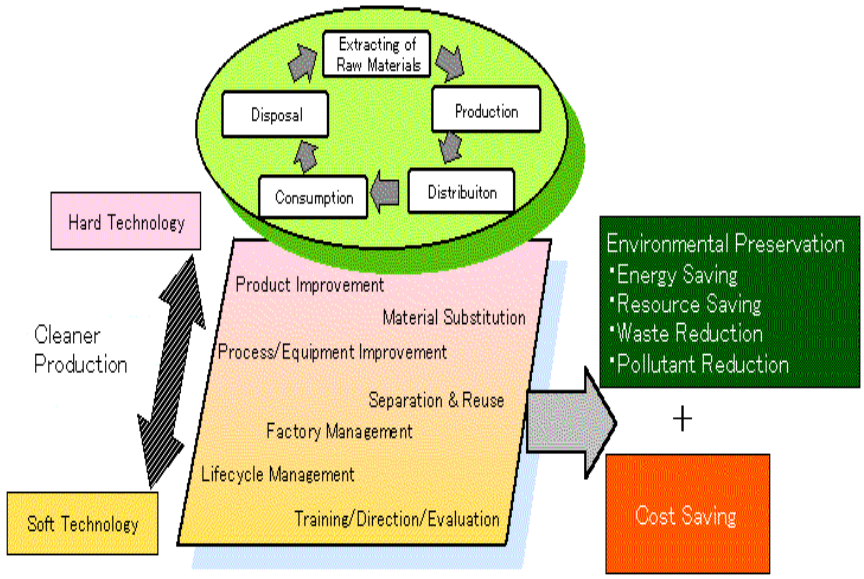


Figure 3 Conceptualization of Cleaner Production

Adopted from: Global Environment Centre Foundation, (GECF)

Cleaner Production Techniques:

The concept of Cleaner Production is applied in the industry using following five Cleaner Production techniques *(ESPS/DANIDA, 2005)*

1. Good House Keeping and Better Process Control
2. Equipment Modification and Technology Change
3. Substitution of Input Materials
4. Product Reformulation and Use of By Product
5. On-Site Reuse and Recycle.

These five techniques applied in production process can be illustrated digramatically figure 4 as follow:

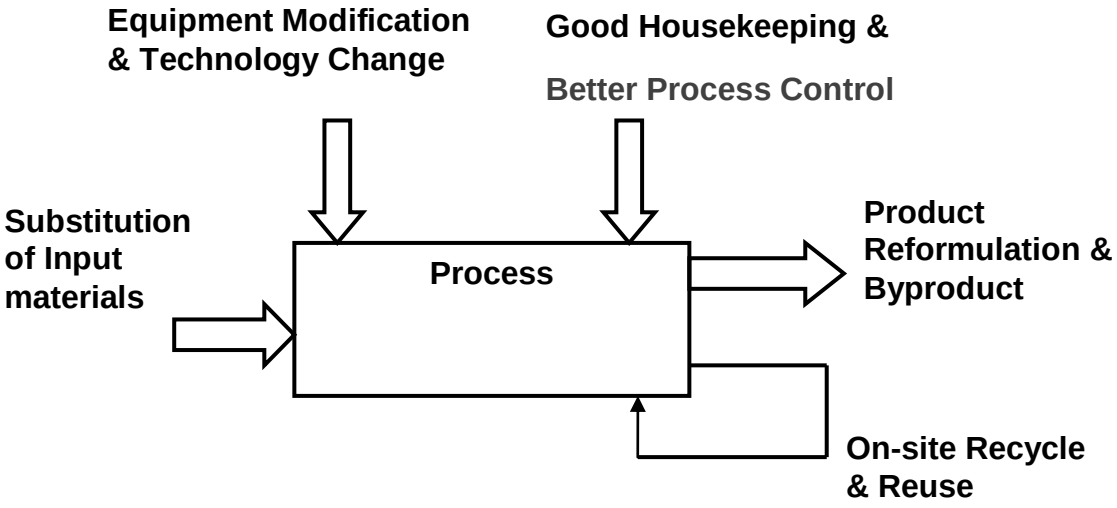


Figure 4 Five Technique of Cleaner Production

Cleaner Production (CP) Methodology

A systematic working method (CP Assessment) is conducted for development of Cleaner Production concept and approaches, generation of options on the basis of five techniques mentioned above, analysis of generated options and implementation of feasible options tailored to the company's products, processes and operations.

As Cleaner Production focuses on the production process that causes the environmental impacts, the Cleaner Production option generation and implementation method is based on an examination and re-evaluation of the production processes. Such Cleaner Production assessment is conducted using 5 phases and 20 steps as mentioned in figure 5 below: *(Van Berkel, 1995; 1996).*

The Cleaner Production Assessment Procedure (Van Berkel, 1995; 1996).

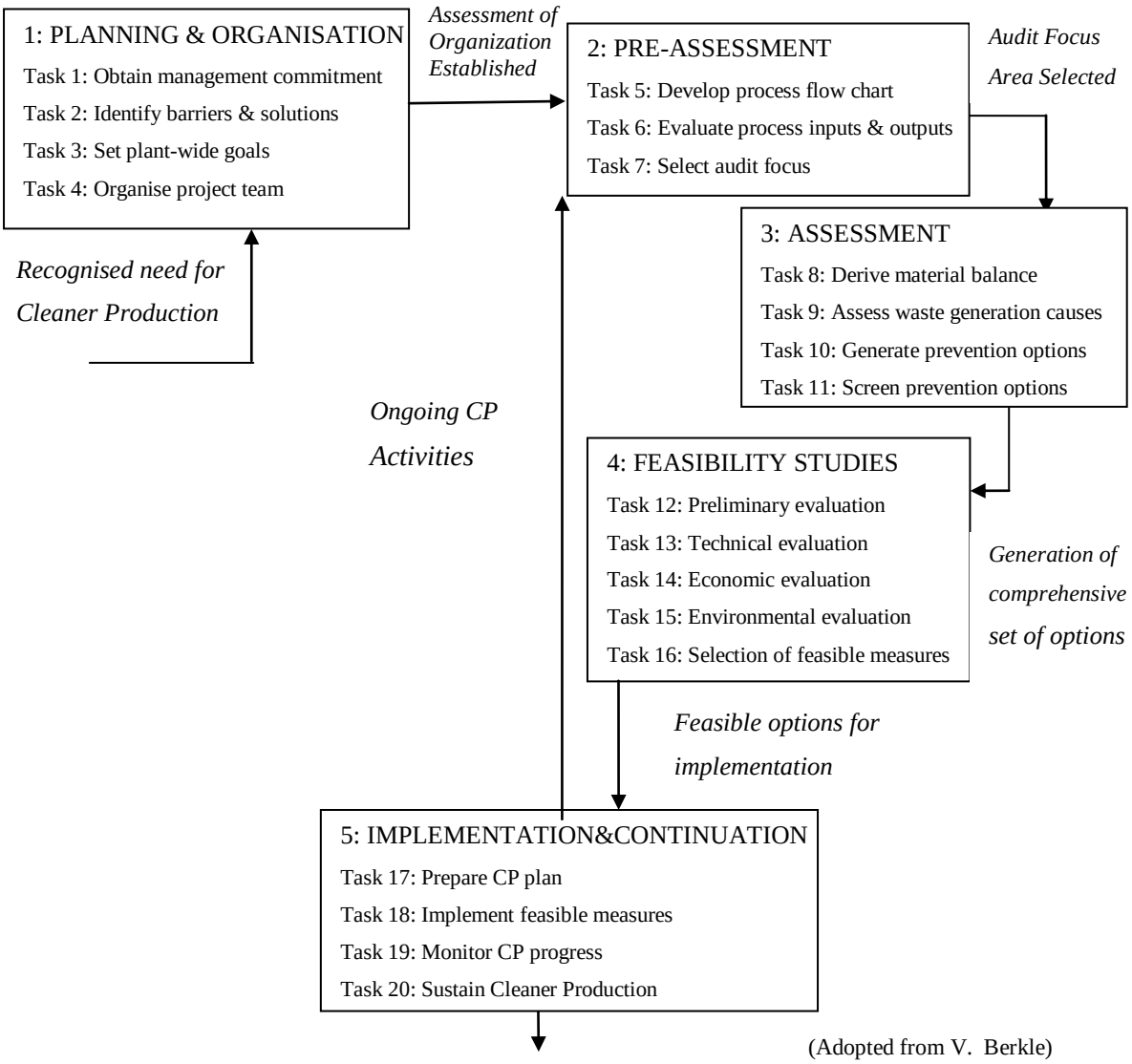


Figure 5 Cleaner Production Assessment Procedure

Barriers on implementation of Cleaner Production

The major obstacles to increased waste reduction are institutional and behavioral rather than technical *(U.S. Congress, 1986).*

According to *Betsy, Walter, and Mark (2004),* the following barriers are identified for implementation of Cleaner Production

a. Misunderstanding of Cleaner Production:

Although the Cleaner Production improves the overall productivity through reduction of waste generation, better working condition leading to market competiveness, industries in developing countries have suspected on successful implementation of Cleaner Production and they think that Cleaner Production is totally related to Environmental issues only and anything related to environmental concept increase the cost of production which adversely affects their market position.

b. Attitude (lack of awareness):

Another barrier on successfully implementation of Cleaner Production is the lack of awareness toward environmental issues. The industries and working people considered that environmental issues are not their concerns. They think that industries could not produce without waste and emission generation leading to polluting to the environment. It is very difficult to educate them about the relationship of industrial production and environmental degradation. Thus, changing their attitude toward this relationship is not easy.

c. Lack of Resources:

The constraint of resources both financial and human is always in industries of developing countries. Trained technical specialists in the manufacturing sector are rare. The production is run and managed by non professional individuals leading to unproductive production from the point of view of both cost and environment.

d. Traditional Technology:

Most of the industries in developing countries are small in size and have no modern technology. The industries are always at a lack of money to modernize and perform market expansion. Technology used being traditional and non productive, generates more wastage and emission leading to high cost and environment degradation.

Woolen Yarn Dyeing

Dyeing is an integral part of the carpet industries. At the same time Dyeing industries are the main sources of wastewater and air pollution generation in Kathmandu valley. There were about 40 dyeing units in Kathmandu. But due to recent decline in carpet business, only about 20 job-oriented dyeing units are in operation (*Woolen yarn dyeing industries Association)*. Dyeing of woolen yarns requires large volume of water and it discharges equally volume of liquid effluent with high COD, BOD, TDS, TSS and others. The waste water is generally discharged into the sewerage or river or on land with or without any treatment.

In general, industrial effluent load in the Kathmandu valley is alarming. It has been estimated that total industrial waste water volume in the Kathmandu valley is approximately 2.1 million cubic meter, to which, nearly 76 % is contributed by carpet factories *(Devkota & Neupane, 1994).* Government of Nepal has already gazette the wastewater discharge standards for wool dyeing industries. Although the standards are mandatory, the enforcement has really not started. The air pollution created from the operation of dyeing units in Kathmandu valley is another bigger problem for the people of Kathmandu valley. It must be acknowledged that the sector generates wastewater, smoke and dust, which have clearly contributed to poor quality of surface water and polluted dusty air in Kathmandu valley. The valley has many sacred rivers, ponds, lakes and blue sky with green mountains and can boast of unique social cultural and religious monuments. The present prevailing industrial rules/regulations do not permit to establish any new dyeing industry within the municipality area.

Although the establishment of dyeing industries in Village Development Committee is not prohibited, they are not allowed to operate without installation of wastewater and air pollution treatment plants. The wastewater discharged should meet the discharge standard set by the Nepal Government *(PACE Nepal, 2006).* Nepal standard for discharged wate water from wool processing industries is as follow:

The Nepal Standard for discharged waste water is as follow:

Table 1: Tolerance Limits for industrial Effluents to be discharged into Inland Surface water from Wool Processing Industries

Particulars	**Tolerance Limit**
pH	5.5 - 9.0
TSS	100 mg/lit (Max)
BOD (5 days at 20^0 C)	100 mg/lit (Max)
COD	250 mg/l (Max)
Oil and Grease	10 mg/l (Max)
Total Chromium	2 mg/l (Max)
Sulphide	2 mg/l (Max)
Phenolic Compounds	5 mg/l (Max)
Discharge temperature	40 deg C (Max)

Source: Nepal Gazette published on 2001.04.30, Ministry of Environment

The general characteristic of wastewater discharged from the woolen yarn and fabric dyeing industries running in Nepal are given below in Table 2 below:

Table 2- Characteristic of effluent discharged from woolen yarn dyeing industries

Characteristics	Concentration (mg/l) dyeing process		
	Characteristics according to UNIDO, 1997[1]	Characteristics, ESPS project 2001	Present finding[2] Before Improvement
Temperature (^oC)	60-85	60-85	46.5- 80
pH	4.0-5.5	4.3-6.9	4.5- 11.4
Suspended solids (mg/L)	20-150	12.9-204	14-927
BOD (mg/L)	130-790	-	138 - 600
COD (mg/L)	500-2,800	499-2,808	290-2,150
Oil & Grease (mg/L)	10-80	1.8-42.2	2 - 43
Total Chromium (mg/L)	0.02-0.24	0.2	0.024-0.17
Sulfide, as Sulphide (mg/L)	-	1.7 – 6.5	<0.2
Phenolic compound, as C_6H_5OH (mg/L)	-	-	0.3 -0.42

Source: Updated Baseline Study on Woolen Yarn Dyeing Industries 2006, PACE Nepal Pvt. Ltd

[1]*Source: UNIDO, 1997" Assistance in reducing the water pollution emanating from the textile and carpet industries in the Kathmandu Valley. Technical report: Field mission of the consultant in treatment of textile industry effluents. 02 January 1997*

[2] Analysis result from Water Engineering and Training Center Pvt. Ltd.

Theory of Environmental Ethic

The increasing deterioration of the environment is a serious threat to world today. The environment is becoming one of most important issues facing world population today. The rapid population growth and industrialization are the main causes of environmental deterioration. The increasing the population makes more demands for foods and shelter which we generally get from the environment. As the population is exceeding the carrying capacity of our planet, natural environment is being used for human habitation. Thus Balance in Nature is destroyed depleting the natural resources leading to environmental pollution from the human activities, which is endangering to our future generations including human beings. But environmental ethics brings out the fact that all the life forms on Earth have the right to live. environmental ethics believes in the ethical relationship between human beings and

the natural environment and brings out the fact that all life forms in the earth have right to live and grow *(Oak 2011).*

Environmental ethics is the discipline in philosophy that studies the moral relationship of human beings to the environment and its nonhuman contents. Although the philosophy toward the nature has long history, contemporary environmental ethics only emerged as an academic discipline in the 1970s *(Brennan 2011).* The discipline of environmental ethics took off in the 1970s, in response to the environmental movement protesting against air and water pollution. Industrial civilization started in 1970s brought the ecological crises in the world. This crisis was composed of all types of environmental pollution, all types of resource and ecological imbalances *(Yang 2006).*

Environmental ethics is radically theoretical. Traditional ethics concerns primarily with human and they are concerned with nature only after human beings. Environmental Ethics Theory can be viewed from the four different sights and it is called "Fab Four" types of Environmental Ethics:

The “Fab Four” types of environmental ethics:

1. Anthropocentrism: (Human interests only) “What’s in it for me?”

2. Sentientism/: Only people, mammals, and birds count.

3. Biocentrism: Plants, animals, and all life forms have interests to live; and thus, all life forms have intrinsic rights.

4. Holism: Whole system on earth is most important. The whole is greater than the sum of its parts. (*Botkin and Keller. 2000)*

These four schools of thoughts on environmental ethics are also emphasized as stated below (Yang 2006):

1. Anthropocentric (Modern views)
2. Animal liberation/rights theory

3. Biocentrism: all live form
4. Ecocentrism - moral patient' to include nature as a whole

The value of the environment will totally depends on how we see our role and function on earth and also how we choose to share these natural resources with others. However, the views of the people on the environment are different. In the literature on environmental ethics the distinction between *instrumental value* and *intrinsic value* (meaning "non-instrumental value") has been of considerable importance. The former is the value of things as *means* to further some other ends, whereas the latter is the value of things as *ends in them* regardless of whether they are also useful as means to other ends. *(Brennan 2011).*

Different researchers and philosophers interpret the nature and its relationship with human beings differently. The instrumental value and intrinsic values of nature can be interrelated with other two distinct views on the nature: anthropocentric and the bio-centric.

There are mainly two different views on theories of the natural environmental ethics such as anthropocentric and the bio-centric (Non anthropocentric). The material condition for anthropocentric ethics is "respect for persons", whereas the environmental, biocentric ethics begins with the notion of "respect for nature". **John Passmore**, the philosopher from Australia, views the environmental ethic as anthropocentric (man-centered), whereas American philosopher **Paul Taylor** views it as bio-centric (nature-centered). According to Taylor ***respect for nature attitude*** is ***an ultimate attitude***. And it is the most fundamental moral commitment that one can take. According to Taylor, Environmental Ethics is not the sub division of Human Ethics. He emphases that human ethics embodies the attitude of respect for persons, whereas environmental ethics embodies the attitude of respect for nature. But according to John Passmore, these are all ecological problems and such belief that nature exists to serve human. He pointed out four different basic ecological problems which human face today. These problems are Pollution, Conservation, preservation, and population. They are ultimately human's responsibility to solve these problems.

However, both authors are agree on that if the human being continues to exploit nature destroying biosphere as he/she is doing till today and nothing is done as regards to relation of man to nature, human species may face the possibility of total existence (*Leszek Pyra,2007)*

Anthropocentric (man-centered) theory holds that it is the moral responsibility of human being to protect the environment. The other opposite view of bio-centric (nature centered) theory holds that although man centered theory is a part of environmental ethics, it is not sufficient to protect the environment. Only when human being has realized that protection of environment is part of the internalized process of self-perfection and acknowledged the ethic status of all things of natural existence, the environment can be effectively protected (Yang, 1998).

Consensus regarding environmental ethics

Although there are many debates on understanding of environmental ethics and their different approaches, but their goals are by and large the same. They have reached this consensus that the protection of the environment is the duty of every one lived in this world. *Principles of environmental justice, Principle of intergenerational equality and Principle of respect for nature* are three normative principles of environmental ethics (Yang 2006)

Only after we have kept an appropriate attitude towards nature and love and respect to all living and non living things, then only we can successfully solve the environmental problems and ecological imbalance faced by us today.

Theory of Motivation

Every management of the organization likes to have the efficient and effective work done from its employees. However, they do not know how to work to be done efficiently and effectively and they also do not understand what truly motivates a person. Motivation is taken as one of the most important tools of Human Resource Management. It is a complex concept and can help or harm an organization depending

on how it is used within an organization. Many philosophers of the world have been tried to understand what motivates to the people. However, they could not develop one theory which can describe all people. Every person is different, their need, attitude and level of satisfaction is also very different.(*Burton 2012)*

The word *motivation* is common in everyday language, and everybody uses it in his/her own understanding. However, it is not so easy to define rigorously in a scientific context.

According to Webster's New Collegiate Dictionary, Motivation is defined as the act or process of motivating. Psychologists have studied on various aspects of human motivation since long time back and have derived various theories on motivation being a function of needs of various types, extrinsic factors and intrinsic factors. (*Shanks, Nancy H*.)

With relation to the workplace, Ray Williams, who writes for Psychology Today, defines motivation as, "predisposition to behave in a purposeful manner to achieve specific, unmet needs and the will to achieve, and the inner force that drives individuals to accomplish personal organizational goals" *(Williams)* and *(Burton,2012). The person is motivated to achieve their own goal and or to achieve the goal of an organization.*

Researchers have developed a number of different theories to explain motivation. Motivation theories can be viewed from two different perspectives: Content and Process theories. Content theory mainly deals with" what" motivates to the people. It is generally related with the basic need and goal of the individual. Maslow, Alderfer, Herzberg and McCelland theories are viewed from Content prospective. However, Process Theories deals with "process" of motivation and it is concerned with "How" motivation occurs. Vroom, Porter & Lawler, Adams and Locke studied motivation from a "process" perspective (Ozgur Zan)

There are many different views and approachs on understanding of motivation. In 1911, Engineer Frederick Winslow Taylor published one of the oldest

theories on Motivation. He considered the Money as the most important factor of motivation and put forward the idea that workers are motivated mainly by pay. And in 1930, Elton Mayo (1880 – 1949) brought forward the importance of social need. According to him, people are not motivated only having a lot of money. He believed that workers are not just concerned with money but could be better motivated by having their social needs met whilst at work. He suggested following factors of motivation

- Greater communication
- Good teamwork
- showing interest in others
- Involving others in decision making
- Ensuring the wellbeing of others
- Ensuring work is interesting and non-repetitive.

(Riley,2012)

And, the following are some motivation theories that have been proven and accepted by society to -day. *(Burton,2012) and chapter 5*

1. Maslow's-Hierarchy of Needs Theory:

This theory was proposed by Abraham Maslow in 1943 and 1954. Maslow believed every person had needs that need to be met and is based on the assumption that people are motivated by a series of five universal needs such as Basic, Sefty/Security, Social , Esteem, Self Actualization. These needs are ranked, according to the order in which they influence human behavior, in hierarchical fashion. He interpreted these five needs in a Pyramid form as given in figure 6 below:

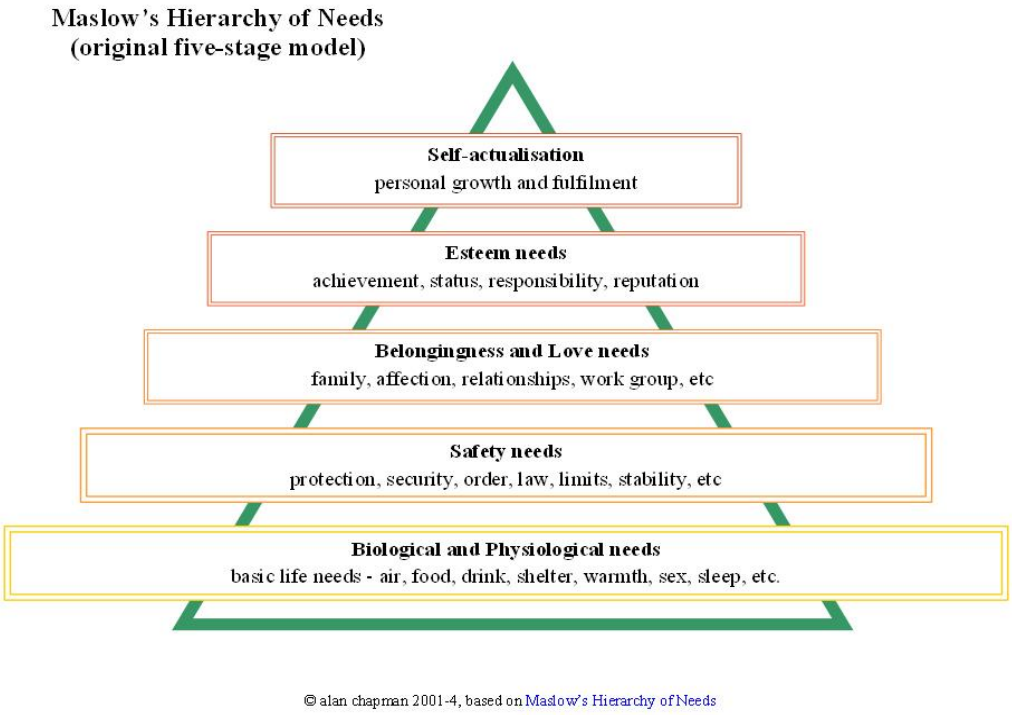


Figure 6:Maslow'Hierarchy Needs model

Adopted from: Abraham Maslow original Hierarchy of Needs concept 1954; Alan Chapman review and other material, design, code 1995-2012.

This Maslow's Hierarchy of Need Theory is one of the best theories for understanding of Motivation. Maslow believed that people like to fulfill basic need at first. They will not be motivated to have second layer of need until they fulfilled first basic need and so on. The first need of the people is Biological and Physiological needs, which include food to eat, cloth to wear and home to sleep/live. After fulfilling this basic need, people will be motivated to achieve second level of need i.e Safety and Security which means they like to have security of life, protection from the natural disasters, physical attack from bad people and animals, life security in old age, safety in working condition and job security.

The third level of need is Social. After fulfilling the second level of need, people need to have family affection, good relation with coworkers a, neighbors, support from the community. The people like to associate with all kinds of social

work and be social person. The fourth level of need is Esteem. People like to have reputation and respect from the society. The person must have high image of them self and encompass self respect. This level has two aspects: feeling of self worth and the need of respect from others.

The last and final level of the hierarchy of needs is Self Actualization. This need is defined as highest level of need that people like to have. It fulfills all needs of the people starting from basic need. In this particular stage, the talents of the person are being fulfilled completely. Maslow believes that no one is ever completely self actualized.

2. Alderfer's Hierarchy of Motivational Needs:

Alderfer's theory is rework of Maslow's Hierarchy Need. He tried to align its need more closely with empirical research. Alderfer's theory is also called ERG Theory. **E** stands for Existence, **R** stands for Relatedness and **G** stands for growth. Our concern regarding requirements for our existence is refers to our concern with basic material existence requirements; what Maslow called physiological and safety needs.

- Relatedness refers to the desire we have for maintaining interpersonal relationships. This is similar to Maslow's social/love need, and the external component of his esteem need.

- Growth refers to an intrinsic desire for personal development. This is similar to intrinsic component of Maslow's esteem need, and self-actualization

The main difference between Alderfer's ERG and Maslow's Need Hierarchy is that ERG theory does not assume a rigid hierarchy and more than one need can be operative at time.

3. Herzberg's Two-Factor Theory

Herzberg's Two-Factor Theory also known as the Motivation-Hygiene Theory. This theory is commonly related to Maslow's theory of hierarchy of needs. According to this theory, the things that satisfy the people at work are motivating and those things they don't feel good about are de-motivating.

According to Herzberg, the opposite of satisfaction is not dissatisfaction and there are two different factor scales, one ranging from satisfaction to no satisfaction and the other from dissatisfaction to no dissatisfaction. According to this theory, there is a set of factors if we neglect this in the work, there will be dissatisfaction and this is called Hygiene Factors. And there is another set of factors, if accept this in the work, there will be motivation and this is called Motivation Factor. These two factors are interpreted as follows:

Hygiene Factors.

Hygiene factors include such elements like quality of supervision, pay, company policies, physical working conditions, relations with others, and job security. When they are adequate, people will not be dissatisfied and at the same time they will not be satisfied too.

Motivation Factors.

If we want to motivate people on their jobs, Herzberg suggested emphasizing factors associated with the work itself. These are intrinsically rewarding factors in the work environment such as promotion and personal growth opportunities, recognition, responsibility, and achievement. Meeting these factors will increase motivation by creating a satisfying work environment.

The overall motivation theory combining all these three theories is presented in figure 7 below:

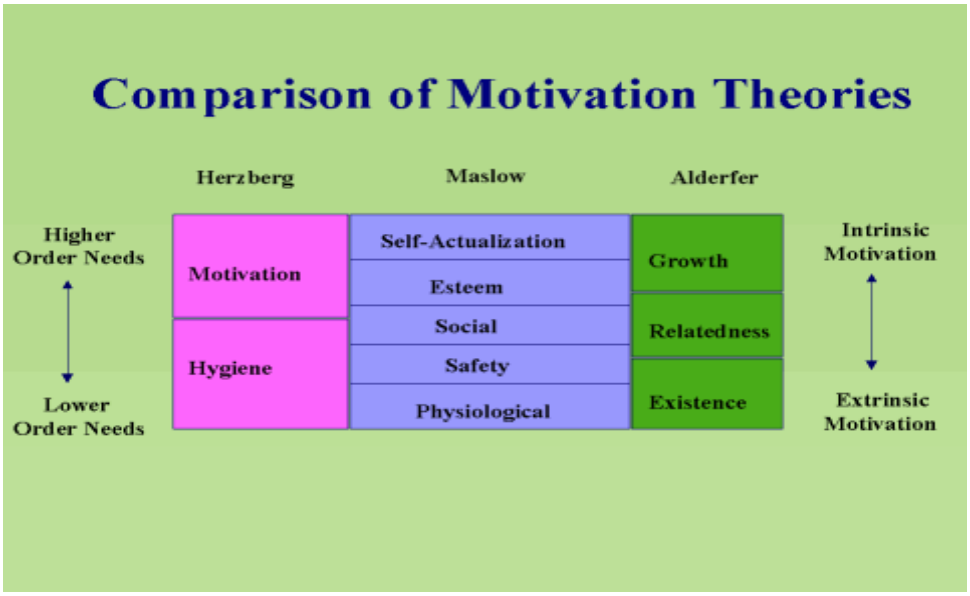


Figure 7: Comparison of all three motivation theories

Adopted from: Dr. Janet Fredericks,
http://www.neiu.edu/~aserafin/421/motivation/aMotivation/sld001.htm

Vroom's Expectancy Theory

Vroom's Expectancy Theory is viewed from Prospective of process. The main difference of this theory from Content theories of Maslow, ERG and Herzberg Two factor is that this theory does not provide any suggestion on what motivates the member of organization. Instead, it provides a process of cognitive variables that reflects individual differences in motivation to work. This expectancy theory has four assumptions as described below:

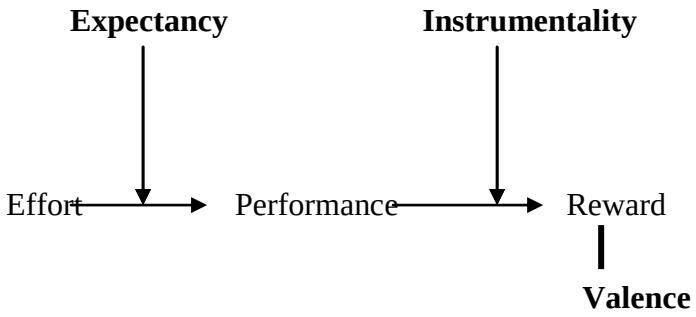
1. People join the organizations with the expectations about their needs, motivations and past experiences, which influence on how they react to the organization.

2. People are free to choose those behaviours suggested by their own Expectancy calculations.

3. People like to have good salary, job security, career and challenges.

4. People will choose among alternatives so as to get best result for them personnel.

The expectancy Theory based on these assumption has three key elements: Expectancy, Instrumentality and Valence. A person will be motivated to that extent that his/her effort will lead to acceptable performance **(expectancy),** performance will be rewarded **(Instrumentality)** and the value of reward is highly positive for further consideration**(valence),** which can be illustrated as fiven in figure 8 below*: Fred C. Lunenburg, 2011*



Adopted from: Fred C. Lunenburg, 2011

Figure 8 Basic Expectancy Model

Theory on Attitude

According to Wikipedia an **attitude** is a hypothetical construct that represents an individual's degree of like or dislike for an item, a person's perspective toward a specified target and way of saying and doing things.

Knowledge, Attitude and Practice constitute a triad of interactive factors characterized by dynamism and unique interdependence. Attitude refers to inclinations to react in a certain way to certain situations; to see and interpret events according to certain predispositions; or to organize opinions into coherent and interrelated structures. Values are inextricably related to attitudes. Value can mean:

a) the price attached to intellectual or moral status; b) a way of appreciation of merits; and sometimes c) the description of a set of "ethical actions". Ethics feature highly among the whole gamut of ingredients that make up attitude (*Badran, 1995)*

Attitude is very difficult to define correctly and also adequately. Different learners have defined the attitude differently. According to Thomas and Znaniecki (1918), Attitude is defined as "a mental and neural state of readiness, organized through experience, exerting a directive or dynamic influence upon the individual's response to all objects and situations with which it is related". It is one of the earliest definitions of attitude. Many consider the attitude as "predispositions to responds" *(Zimbardo & Leippe, 1991).* Then Zimbardo and Leippe (1991) defined attitude as "an evaluation disposition toward some object based upon cognitions, affective reactions, behavioral intentions, and past behaviors that can influence cognitions, affective responses, and future intentions and behaviors *(Simonson & Maushak, 2001, pp. 985-986)*

Attitudes are latent and not directly observable in themselves, however, they act to organize or provide direction to action and behaviors that are observable. Attitudes are related to how people perceive the situations in which they find themselves. Attitudes vary in direction and its degree for example attitude may be Positive or Negative and its degree may be Positiveness or Negativeness. Attitudes vary in its intensity also (amount of commitment with which a position is held) *(Smith, 1982).*

Attitude consists of four following components:

1. Affective response
2. Cognitions
3. Behaviour
4. Behavioral intentions

Affective responses reflect the one's attitude with sensation of pleasure sadness or other levels of physical excitement. Cognitive component of an attitude is

conceptualized as a person's factual knowledge of the situation, object or person including oneself. Cognitive component refers to how much a person knows about a topic or object.

The behavioral component of an attitude involves the person's obvious behavior toward a situation; object or person. The behavioral intention component involves the person's plans to perform in a certain way, even if sometimes these plans are never acted upon (Simonson & Maushak, 2001, pp. 985-986)

United Nations Conference on the Human Environment held in Stockholm in 1972 has turned the attitudes of the Third World toward environmental protection positively. Before that, the leader of third World was confirmed that their countries have no environmental problems as they are not industrialized countries. But the conference succeeded to change their attitude due to well prepared report on environment and development presented in the conference. (*Whitman Bassow, 1979)* At the same time United Nation Environment Program has helped to change the perception of environmental problem in developing countries. Now the developing countries already understood that industrial development, growth of unplanned cities and rapidly increasing population in developing countries can give adverse impact to environment and human health and quality of life.

There is considerable expressed concern about the lack of an appropriate attitude to the environment. At its simplest level this is seen in littering habits -- in contrast with an attitude that automatically seeks to protect the environment from casual degradation *(Judge, 2004).*

Attitude toward the behavior is defined as the individual's positive or negative feelings about performing behaviour. It is determined through an assessment of one's beliefs regarding the consequences arising from a behavior and an evaluation of the desirability of these consequences. Formally, overall attitude can be assessed as the sum of the individual consequence x desirability assessments for all expected consequences of the behavior *(Eagly, & Chaiken, 1993).*

According to Theory of Planned Behaviour the immediate determinant of behaviour is the individual's intention to perform or not to perform the behaviour in question and Intention is influenced by three factors: Attitude,Subjective Norm and Perceived Behavioral Control as shown in Fig 9 below:

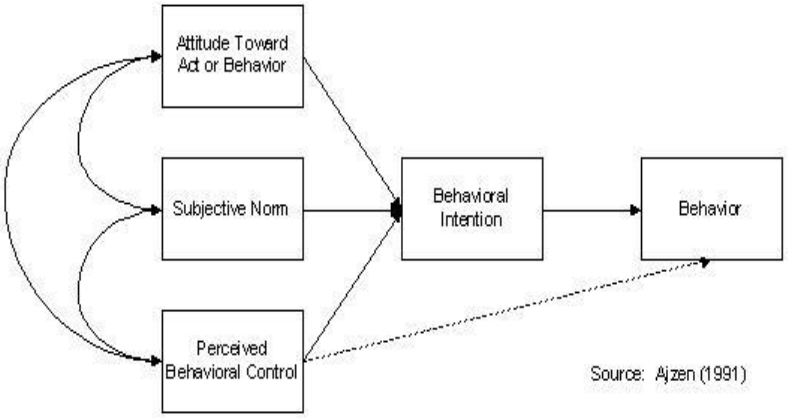


Figure 9, Theory of Planned Behaviors

Attitude, Subjective Norm and Perceived Behavioral Control are interpreted in the theory as follows:

1. Attitude - the individual's favourable or unfavourable evaluation of performing the behaviour

2. The subjective norm - the individual's perception of social pressure to perform or not to perform the behaviour

3. Perceived behavioural control - a measure of the individual's perception of their ability to perform the behaviour in question.

Actual Behavioural Control refers to the extent to which a person has the skills, resources, and other prerequisites needed to perform a given behaviour. Successful performance depends not only on a favourable intention but also on a sufficient level of behavioural control. The more favourable the attitude and the subjective norm, and the greater the perceived control the stronger should the person's intention to perform the behaviour in question (Ajzen 1991) *(Olgyaiová et.al, 2005, p.6)*

CHAPTER III

RESEARCH METHODOLOGY

This chapter reflects about the methodology adopted in the study. It also describes about the appropriateness of the adopted methodology for this study. The techniques and procedures used for data and information collection are described. The sites, areas or sectors where the study was conducted are described here. The participants and responds of interaction with them are also mentioned. The instruments and approaches used to collect the data and information are reflected as well. In general, this chapter highlights how the study is conducted and how the research methodology is used for collecting primary and secondary data and information.

Research Philosophy

Research is a process of collecting, analyzing and interpreting information to answer questions. But different authors define the meaning of research differently. According to Wikipedia, Research can be defined as the search for **knowledge**, or as any systematic investigation, with an open mind, to establish novel facts, solve new or existing problems, prove new ideas, or develop new theories. In general, research can be defined as a structured and systematic enquiry that utilizes acceptable scientific methodology, tools an techniques to solve problems and create new knowledge that is generally applicable. Scientific methods consist of systematic observation, classification and interpretation of data (Ranjit, 2005) but there are various methods and paths to find the answer or way to our question problem. The research methodology is the path to find the answer to our research question and plays a crucial role in achieving the objective of the research. Research methodology in education refers to the philosophical framework, view of being human, truth value, epistemological perspective and assumptions that are associated with a specific research method (Best & Kahn, 2007; Dooley, 2007; Johnson & Onwuegbuzie, 2004). Ontology in my research can be defined "as the study of what we know or rather what

we think we know and epistemology in my research as the study of how we achieve knowledge or rather how we think we achieve knowledge" (Dangal, 2010, cited in Freimuth, 2009, p. 2). Somekh and Lewin (2005) argue that epistemology and ontology have to do with the essence of knowledge, truth and being.

The basic philosophy of research in this study is the concept of Cleaner Production which is applied in the production process considering epistemology and ontology as its basic view point. Cleaner Production is applied in the production process with belief, attitude and truth of the working people. The main objective of my research is to reduce the pollution from the operation of the woolen yarn dyeing industries located in and around the rivers of the Kathmandu valley. The methods and approaches used for changing the attitude of the working people in the woolen yarn dyeing industries to fulfill research objective is the basic component of Research Philosophy. In this research study, I am the researcher/observer and a participant as well. I have also participated as an observer in the whole production activities in the industries from time to time during this study period.

Approach and Research Design

Research design, simply means measures of collecting, organizing, analyzing, interpreting and reporting data in research (Best & Kahn, 2007; Creswell, 2003). Creswell (2006) states that it represents different models of researching having distinct means and procedures. Research design in educational research is "a specific strength of qualitative work with its focus on located meanings is that it facilitates the development of substantive areas and research questions in the ongoing development" (Reay, 1996 as cited in Haywood & Mac An Ghaill, 1998, p. 133). Generally research design contains five stages as follows:

- Research Problem identification
- Methodology adopted
- Data and information collection
- Data analysis and interpretation
- Report/study with Outcomes/ recommendation

The approach adopted in my research thesis is the concept of Cleaner Production focusing on the people. The main objective of the research is to reduce the pollution in woolen yarn dyeing industries caused by the people. The most difficult task, if anything, in the world is to change the attitude of the people. My research design is focused on Cleaner Production and it is based on Management System tool called Deming Cycle or PDCA cycle (named after Mr. William Edward Deming). It is a four stage change management model used by industries for continuous improvement and incremental problem solving. This model/system is used for master planning or designing for conducting my study. The four stages represented by P- Plan, D- Do, C- Check. A- Act. The PDCA cycle is represented by a diagram given in figure 10 below:

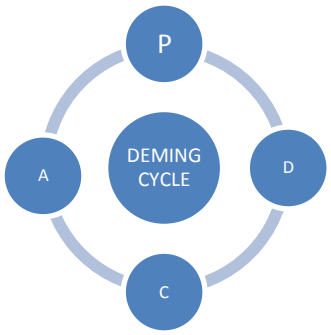


Figure 10 PDCA Cycle

This change management model benefits industry by providing a systematic approach to achieving continuous improvement in pollution control activities conducted under Cleaner Production approach. My thesis is based on this model which is described as follows:

P- Planning

The planning stage will be mainly focused on the problem identification, methodology for conducting the study, data collection techniques and tools is confirmed, Sample and sample size, area under study, site location etc. Based on the research problem identified and research type and area, research study is based on Qualitative Methodology and data are collected through questionnaires, interviews, case studies and focus group discussion (brainstorming).

D- Do

This is the implementation stage during which the plan is actually tried out in the operation. This is the stage of conducting the study according to planned structure. The data, information are collected using developed questionnaires, interviews with the concerned people are performed, observations of working practices are conducted and brainstorming among the concerned people is organized.

C- Check

This is analyzing stage. The implemented job according to planned structure (data collection, interviews, focus group discussion and review of case studies) are checked or analyzed whether they are in progress according to planned and whether it is sufficient for expected result and data analysis. If the work is not performed to get expected result, then planning (P) or implementation (DO) are reviewed and necessary modification, corrections are made. Data check sheet, control charts etc are used as methodologies and tools of Change Management. Successful Change Management includes 3 Key Elements such as People, Structure and Strategy (figure 11). In this study, change management is focused on people and their performance about perception and attitude toward pollution control and prevention. Change Management is about managing People, Structure and Strategies associated with workplace in the companies or industries and have to address all with equal focus and commitment. Schematically, it can be presented as follows: (Barron, n.d)

Figure 11 Key Elements of Change Management

(Adopted from www.*change-management-consultant.com*)

A-Act

After modification and correction in the collection of data and information for study through data sheet, questionnaires, brainstorming, case studies etc as required during the implementation and analyzing stages, final outcomes of the study is recommended and conclusion of the study is made for action.

Why Qualitative Methodology:

There are many reasons on why Qualitative Methodology is used in my study research. The reasons are as stated below:

My thesis follows inductive logic as a part of Qualitative Research Design. The task behind qualitative research consists of describing and understanding of the people, their perception, and experience and of course their attitude toward the pollution. *Frankel & Devers (2000)*.

The research design for qualitative research is very much flexible with various experimental techniques, encompassing a variety of accepted methods and structures viz from an individual case study to an extensive interview. As there is no standardized structure for this type of study, it needs to be carefully constructed and designed. Case studies, interviews and survey designs are the most commonly used methods (Martyn, 2008)

The production process and its associated operating practices in woolen yarn dyeing industries are very complex, flexible and differ from one to another. So no single method or single approach or single tool can solve the problem. Only integrated method/techniques are applicable for this study. The application of Qualitative methodology is much more suitable for such flexible and complex research study and it is unstructured research design.

My study is totally focused on the attitude of the working people. Qualitative research has its roots in social science and is more concerned with understanding why people behave as they do their knowledge, attitudes, beliefs, fears etc. Qualitative

approach to research is concerned with subjective assessment of attitudes, opinions and behaviour. Research in such a situation is a function of researcher's insights and impressions (Berg, 1995).

My research study is totally focused on the observations, case studies and interviews etc. And Qualitative methods are often closely allied with interviews, survey design techniques and individual case studies, as a way to reinforce and evaluate findings over a broader scale (Martyn, 2008).

Human beings are so complex and variable that study on their attitude is not easy and simple. It is very complex and difficult task. However, Qualitative Methodology/techniques are extremely useful when a subject is too complex and cannot answered by simple yes or no. Qualitative methodology being very flexible and unstructured, any research designs are much easier to plan and carry out in this methodology (Martyn, 2008).

The result of my research study is not concentrated on the sample and sample size. My study being historical, it covers results of many past observations and case studies along with present case studies. Qualitative research methods are not as dependent upon sample sizes as quantitative methods. Qualitative methods require a lot of careful and consistent thought and planning, to ensure that the results obtained are as accurate as possible. And at the same time a case study, for example, can generate meaningful results with a small sample group (*Martyn, 2008)*

Through Qualitative Research, researcher can get satisfactory answer to questions on the subjects being studied. And the answer can be very much valuable within depth meaning of the research**.** Qualitative Research associates with the studied collecting variety of empirical materials like case study; personal experience; introspection; life story; interview; artifacts; cultural texts and production; observational, historical, interactional and visual texts that describe routine and problematic moments and meaning in individual lives *(Denzin and Lincoln, 2005, p. 3)*

My research is totally depended upon my long years of working experiences. I, as an observer, have been associated closely with participants under study since many years. My personal working experiences in this field are reflected from my prologue given in page 1. Considering this reality, the reasons of Qualitative Methodology is being used are as follows:

- Qualitative methodology can be used very easily and successfully if the researcher knows a little bit about the research topic at the beginning. This means ethnographic observation and in-depth interviewing.
- Qualitative Methodology uses words rather than numbers. It flows from concreteness to abstractness. And compared to quantitative research it is relatively new. Thus, new techniques and strategies are emerging. Data collection occurs concurrently with data analysis. The researcher involves influencing the individuals being studied to varying degrees. In turn, the researcher is influenced by those being studied.

The reasoning process used in qualitative research involves perceptually putting pieces together to make wholes. From this process meaning is produced. However, because perception varies with the individual, many different meanings are possible.

Qualitative Design

The strategy behind this research work is Cleaner Production Concept. Cleaner Production is preventive approach in controlling pollution to environment and increasing safety of the working people.

Cleaner Production refers to the continuous application of an integrated preventive environmental strategy to processes, products, and services to increase eco-efficiency and reduce risks to humans and the environment (UNEP, 1994). According to UNEP, the concept of Cleaner Production is applied in the production for the improvement of environmental performance using 5 techniques as stated below:

1. Good Housekeeping and Better Process Control
2. Equipment Modification and Technology Change
3. Substitution of Input materials
4. Product Modification and Use of By product
5. In-site Reuse and Recycle

According to UNIDO (United Nations Industrial Development Organization) Cleaner Production requires a change in the old "end-of-pipe" treatment approach to prevention approach. Prevention approach implies changes in attitude of working people including management toward the reducing pollution instead of treatment of pollution. Thus Cleaner Production requires a change of attitude and acceptance of responsibility for reduction of pollution for better environmental performances (Guhl Nannetti et al, 1999, p. 6)

Although attitude is considered as main factor in pollution control activities in all five techniques, Attitude plays very critical role only in the First Technique (Good Housekeeping and Better Process Control). My research study mainly focuses on the First Technique for reduction of pollution from the dyeing industries.

The basis of this research thesis is my long years of working experience with working people of the industries and especially woolen yarn dyeing industries. Qualitative research is generally assumed to focus on the emotional and interpretive side of human experience; and it is, in fact, designed to do so (Louise, 2006).

Since my research is based on the attitude of the working people toward pollution, and it cannot be counted in numbers due to which my thesis totally is based on the perception and truth and belief of the people. The result of the research came out from the inner heart of the people and it is not based on number of data collected. It is possible only through the approach of Qualitative Methodology. Linking to Qualitative Methodology, based on the research problem, the procedures of research design are as given below:

1. Review of work, results, data or information collected during my work in such industries. The review was done subjectively giving importance of human factors in pollution control activities.
2. An appropriate Research Methodology (Qualitative) was identified
3. Questionnaires/ checklist were developed for current/present data collection in 2 woolen yarn dyeing industries.
4. Developed the model and materials of interviewing, focus group discussion(brainstorming), awareness program on attitude and pollution
5. Developed the model and size of sample
6. New data from two woolen yarn dyeing industries were collected through currently developed questionnaires, interviewing and focus group discussion according to appropriate sample and sample size.
7. Awareness program for separately for workers and management were conducted in the industries.
8. On the basis of data collected and result/ outcomes of the awareness program conducted at present and past experiences, the data were analyzed.
9. Trustworthiness of the Data was tested and data were collected repeatedly where it was necessary
10. On the basis of the analysis, the data were interpreted and the recommendation/s of my research thesis was made in the line of the research problem solving.
11. Research study report(Thesis) was prepared.

Site Selection

Generally the site of this research is all kinds of industries polluting the environment. The knowledge, feedbacks, guidelines as my working experience since last 15 years in this field is my basis of thesis. To date I am working in the same field with same objective. However specifically two woolen yarn dyeing industries are selected for this current study. These industries are located in Mulpani VDC, Kathmandu. The location of these industries is just adjacent to the Manohara River. At this time altogether twenty such industries are running in and around the

Kathmandu Valley and they are polluting rivers of Kathmandu valley. The present prevailing industrial rules/regulations of Government of Nepal do not permit to establish any new dyeing industry within the municipality area. Although the establishment of dyeing industries in Village Development Committee is not prohibited, they are not allowed to operate without installation of wastewater and air pollution treatment plants. The wastewater discharged should meet the discharge standard set by the government. Presently altogether 20 dyeing industries are in operation in and around the Kathmandu valley. Dyeing is an integral part of woolen carpet sector in Nepal. Carpet sector is first in rank in export business of the Nepal. This carpet sector is providing employment to about 200,000 people. However dyeing industries are polluting the rivers of the country.

Twelve dyeing units located in and around Jorpati area (highly populated area) in rented land have taken initiative to relocate to less populated area in Mulpani VDC with own land and infrastructure like a cluster of dyeing unit here. Some industries are already in operation and some are in construction phase under operation and some are planning to relocate soon. Two running industries in this new location are under this study. This is good start from the side of the industries in running the dyeing units with less adverse impact to environment and better working condition. The new location in Mulpani being adjacent to Manohara River, there are still risk of polluting rivers and surrounding. But due to open space with new initiation and enthusiasm, the management of these industries is very positive in controlling the pollution. So my study and its outcomes helped them in controlling the pollution leading to overall benefit of country.

Interaction in the Field

Since last 15 years, I am associated with this sector. Two present participants namely Boudha Dyeing House and Rajan Dyeing Industries are most proactive industries. But at that time the purpose of interaction was promotion of dyeing industries. However my first interaction with these industries was 11 years back with this objective. At that time, the program was Introduction on Cleaner Production.

And two years back March 2010, I first time visited these two industries again regarding my PhD assignment. I introduced them about my purpose of visit and explained them what I like to interact with them regarding my thesis. The main reason of interaction with them was to have feedback and data regarding pollution level and their attitude toward pollution. The management and workers were ready to interact with me and provide necessary information. They made commitment to support my thesis and provide necessary data and information.

The main supporting actors are management level and supervisors and workers of the both industries. First interaction with participants was a general meeting in which I explained them about my research methodology and information required. Then walkthrough visit of both industries was carried out to have overview of the production process, working practices and pollution.

Many interactions with participants regarding this research work were carried out. The participants were very positive toward this research work.

Pre-Data Collection Process

The topic of this thesis is related with pollution, Cleaner Production and attitude of the working people. Based on this objective, pre-test to participating industries was made before conducting data collection and implementation. Immediately after acceptance of research proposal by university, I contacted both industries and made first interaction with them. My second series of interactions with participating industries was during November- December 2010. The objective of this visit was pre-data collection.

Pre-test was conducted as follow:

1. Meeting with participants to explain about questionnaires developed.
2. I asked them questions one by one. I Filled questionnaires as they answered. Questionnaires were filled by all participants available at that time in the industries.

3. Interview with some selected participants were conducted. Interview was conducted on an individual basis. The contents of the interview was as per check list as given in annex. The style and explanation of interview were different for management and workers.
4. Awareness program on pollution and attitude was organized in the premises of the industries. Presentation was made on how workers can reduce the pollution simply by changing their working attitude, The concept of Cleaner Production and its benefits were explained them and joint walkthrough visit to production was made.
5. During this pre-test possible pollution from the industries are identified. Water pollution is most severe in these industries. The main parameters of the pollutions are pH, Chemical Oxygen Demand, Biological Oxygen Demand, Oil and Grease. Analysis report of waste water generated from the industries was collected from the industries. The national discharged standard for waste water from woolen yarn dyeing industries (Nepal Standard) was reviewed.
6. During this pre test, the production flow chart of the dyeing process was noted and presented as given in figure 12 below:

PROCESS FLOW CHART

The general woolen yarn dyeing process can be illustrated as follows:

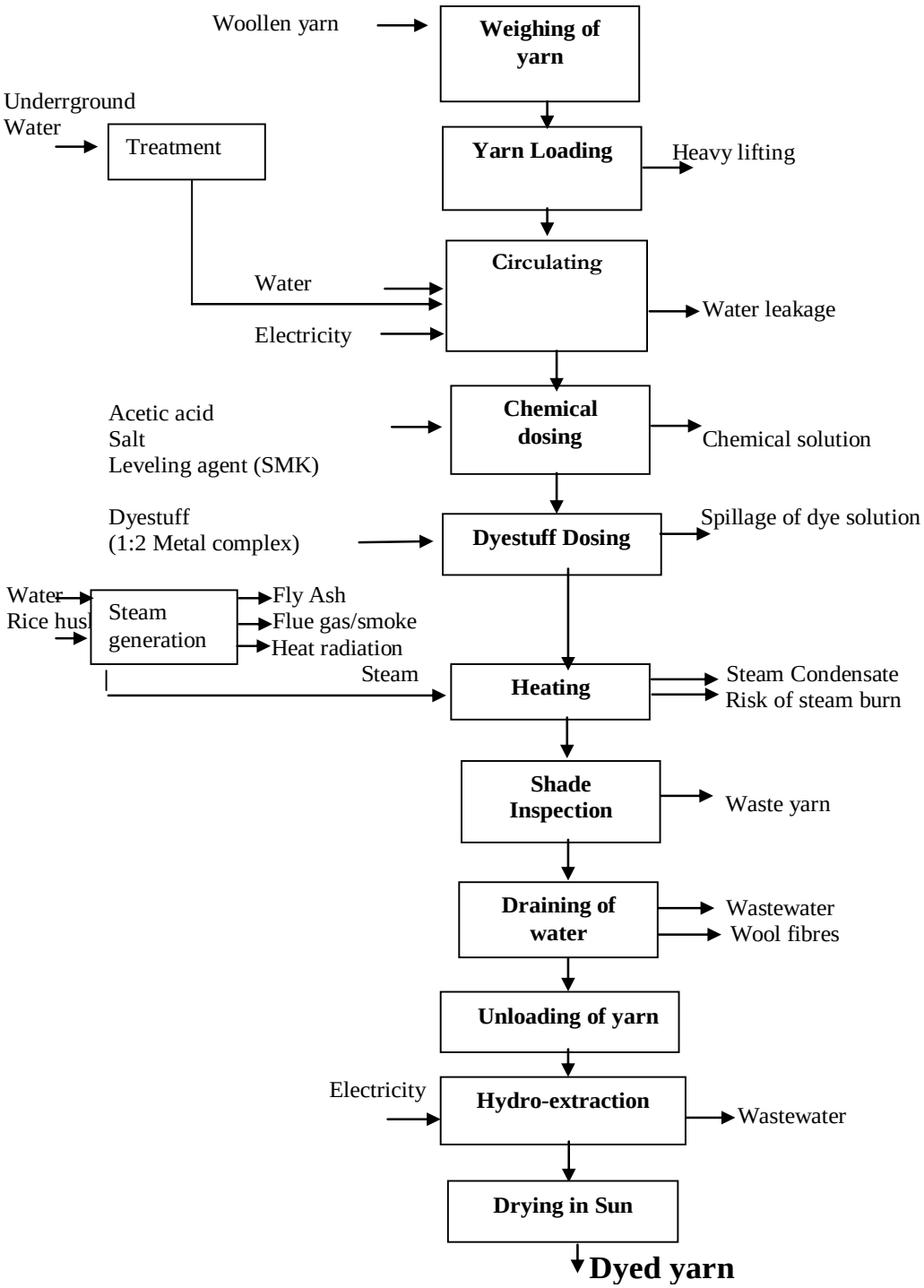


Figure 12 Process Flow Chart for woollen yarn dyeing

Sampling and Sample Size

It is not possible to visit or to collect data and information from total population or objects under study. At the same time it is not necessary to have data from total population. Instead a smaller group of the total population or object, called sample, is selected for the research study purpose. So sample is subset of the total population. Sampling is the strategy or approach of selecting a smaller size/section/part of the total population that will represent the total targeted population object correctly with expected result. (CEMCA, 2012, chap13)

There are many sampling methods used in qualitative research. However, the sampling strategies used for research should be identified correctly so that it meets the purpose of the study.

Sampling in qualitative research is purposeful. And the process or reason adopted for selection of participants should be clearly described. Purposeful sampling selects participants for a specific reason with expected result (e.g., age, culture, gender, level, experience etc). It should not be random (Law et al.1998, p 6). My research study is totally focused on the direct working people in the industries. The purpose of selection of these participants (working people) is very clear. The topic of my thesis is "Reduction of pollution through changing the attitude of the working people applying Cleaner Production concept". Although there may be many causes of pollution from the industries, my thesis study focuses only on the attitude of the working people on the pollution control and prevention. So, purposive with quota sampling method is used for my study. Purposive sampling strategies are designed for Qualitative Methodology to enhance understandings of selected individuals or groups experience(s) or for developing theories and concepts. (*Devers & Frankel*, 2000, p. 264)

Sample Size

Qualitative methods insist that we should not take the viewpoint of the actor as new invention, and we should give them feeling or perception that we understand their motives, reasons and actions correctly. (Andrew, 2010, p.1)

The sample size for qualitative research is very much flexible and it cannot be defined or calculated exact number of participants. It is totally depends on the researcher ability and topic under study. The parameter of sample size in qualitative research is the point at which redundancy, or theoretical saturation of the data. The researcher should be well experienced to confirm that the information/data received was sufficient to meet the purpose of the study (Law et al.1998). An appropriate sample size for a qualitative study is one that adequately answers the research question (Marshall, 1996, p. 522)

In short, **purposive sampling** along with snow ball is best for my research study with small numbers of working people in the industries, and it is sufficient for understanding human perceptions, problems, needs, behaviors and contexts (overall attitude).

Two woolen yarn dyeing units are taken samples among all industries and all working people from shop floor to top management are the sample size for my research study.

Data Collection

Data is the outcome of activities and work recorded in various forms according to nature of data and its importance. The outcome of the research study is evaluated on the basis of the data collected. Data can be defined as the quantitative or qualitative values of a variable. Data is one of the most important and vital aspect of any research studies. Data collection is the process of gathering information on various subjects by using systematic methodology so that it enables to answer the stated questions and evaluation of outcome is done on the basis of this data collected.

Data collection is an important aspect of study. Wrong data can impact the research result negatively leading to invalid results.

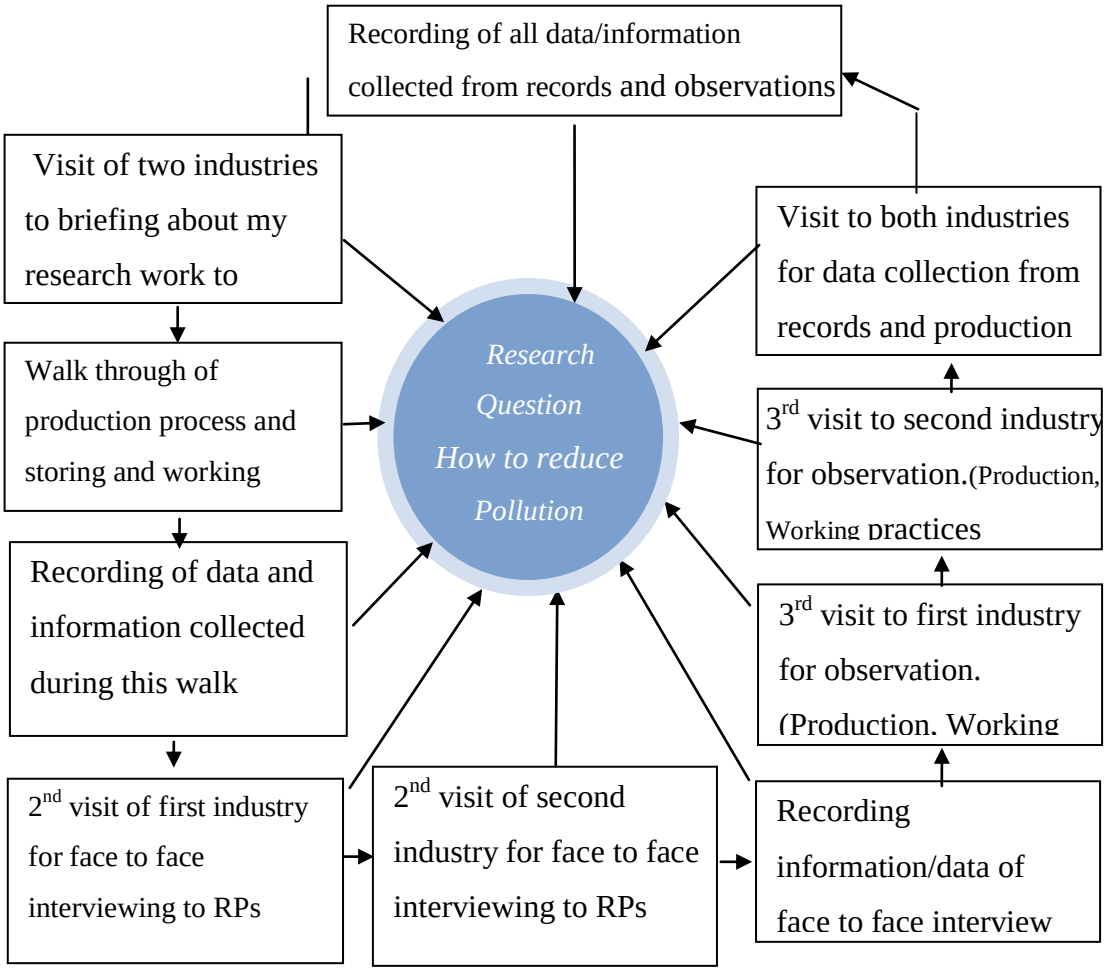
The planning of the data collection should be done on the basis of questions to be answered and information source available. Data collection means gathering information according to questions developed on the basis of to research topic and type of methodology used (Leeds, 1992, p.16).

The woolen dyeing industries generate a large quantity of wastewater and discharge to nearby river without treatment. It is the main reason for environment pollution. So the data for my research study are all raw materials including chemicals, dyes and water used and discharged waste water. The data collection is the gathering of information regarding materials used, water and fuel consumed and discharged waste water and generated waste.

The main purpose of collecting data is to answer questions whose answers are not immediately obvious (NCTM, 2000) .The data collection is required to evaluate the outcomes of the study. The main purpose of the data collection in my study is to compare the consumption and waste generation (pollution) before and after the Cleaner Production Intervention program including awareness and training program for changing the attitude of the working people toward the pollution and its control.

Primary Data Collection

Primary data for my study are based specifically on the two woolen dyeing industries. However the data and information collected by me during my work experience of 15 years in this field are also treated as primary data for this study. The steps used for collecting Primary data are as given in figure 13 below:



RPs - Research Participants (in my case Workers, Operators, Managers and Directors of the both industries under study)

Figure 13 Steps for Collecting Primary Data

Data Collection Technique

Research study done using Qualitative Methodology should give the sense of personally experiencing of the events and phenomenon being studied. The working experience of the researcher in this field under study has to be described so that the readers evaluate this study positively and their confidence to this study has been increased. The role of researchers, level of participation and relationship with Research Participants also need to be explained as it influence the data provided by participants and consequently in findings.

Before describing the data collection technique, I would like to provide some information about the object being studied and my working experiences associated in this field. The field of my study site as stated above Woolen yarn dyeing industries located in and around the Kathmandu. Presently about 20 dyeing industries are in operation as job work. Woolen yarns dyed from these industries are used for making Nepalese hand knotted carpets which are exported to third countries. Carpet sectors create direct employment to nearly 200,000 people and help in economical development of the country. However, they are polluting the rivers of Kathmandu with adverse impact to environment. I, being related professional of this sector, have been working with the industries since last 15 years. I have very good relationship with management and working people as I provide them awareness programme, training and technical suggestions from time to time. So, to get Primary data and information required for the study and interact with Research Participants was easily accessible to me. I am confident that the data and information given by Research participants are correct and help to fulfill the objective of the study.

The techniques used for collection of Primary Data are as follows:

Participant Observation

Being Qualitative Research Approach, Participant Observation is one of the best methods for my study. My study is concentrated within the industries where many operations, action activities are going on and secondly study is focused on attitude of the working people of the industries. To study on the attitude of the participants, it is very necessary to observe them and their ways of operating practices. I myself without any assistant visited both industries for this study many times. Observations of the production process, working posture, operating practices of working people were done to collect correct and practical information regarding waste generated, and unsafe working condition leading to pollution.

The data/information regarding the consumption of all input materials and waste and pollution is measured by applying Material Balance technique of Cleaner Production.

In-depth Interviews (face to face)

Since my study was concentrated on attitude of the working people, observation alone is not sufficient to get desired finding. So second technique used for data collection is in-depth face to face interviews with workers, operators/ supervisors, managers and directors. During this in-depth interview (repeatedly interviews), perception and attitude of the working people was studied. Many open ended chain type questions regarding their attitude towards pollution generated by the industries were asked to them. Answer to questions by Research Participants was very helpful to get deeper insights into the research problem. To have in depth interview I had visited participants many times within my data collection period which lasted from Nov 2010 to Sept 2011. The main purpose of the in-depth interview was to collect the data every time after observing the improvement made by changing the working attitude through providing awareness and training program on Cleaner Production.

Focus Group(Brainstorming)

Brainstorming session among the concerned participants is the main source of data collection for generation of Cleaner Production options toward pollution reduction and improvement of overall productivity of the industry.

Focus groups are a formal method of interviewing a group of people/participants on a topic of Interest (Law et al., 1998*).* The focus group interview is one of the best approaches for the rapid collection of the data (Kumar, 1987). Focus groups discussions mainly conducted among the participants to discuss on a particular topic/issue to come to some agreement regarding that topic or issue.

The main purpose of focus groups is to review the outcomes of individual interviews and make conclusion with group based techniques. The focus group interview represents a group situation in which the participants talk with one another under the guidance of a moderator for the purpose of generating relevant ideas and information. Focus Group should be conducted carefully with the notes of records of discussion, moderator's observations and his own ideas (Kumar, 1987).

Focus Group Discussion is the main activity for generating the options toward reduction of pollution. During the data collection, focus group discussion was organized among the research participants on the topic "possibilities of reduction of pollution through changing the attitude of the working people". Two focus group discussions were conducted among the participants of workers group and managers group separately.

Historical Research

Last data collection technique used is Historical Research. Historical Research relates the study and analysis of data and information of past activities. Methods used are flexible and open. The main purpose of this technique is to learn and get picture about the past events/activities related to our study. Historical research plays important role providing important information about the impact of the past on present and future events. The researcher as historian must make explicit all observations and interpretations of past records (*Law et al 1989).*

My research study is also based on data and information and my experiences of 15 years in this field. Past data and information from both dyeing industries under study were also collected and used for this study. I had also used the data collected from the other industries since last 15 years. Past data enhanced the confidence level on outcome of my research. Qualitative Research Methodology needs all past records and data for enhancement of data collection procedures and data analysis.

Case Studies

Selected Cleaner Production options were taken for case studies. The results obtained after implementation of some related Cleaner Production options in other industries of Nepal were also taken as Case Studies for primary data of the study.

Research Shape in Field

I made my deep quest in exploring the appropriate method for my study. I worked regoriously during the study. Finally, I discovered the diamond of data collection that real comfort and was indeed a convenient tool for my study. The

experience of walking through and playing with a research design was also allowing me to bring more self-confidence to succeeding research work (Schooley, 1995).

As a researcher, I was also adventurous and efficient to undertake the journey I began. Research is never possible only with the willingness or with mere study; it requires sufficient inputs for the productive output: technology, time, investment and skills. I got wonderful supports while playing with research diamond presented in figure 14 below except in some cases at the time of conducting in-depth interviews and various cases.

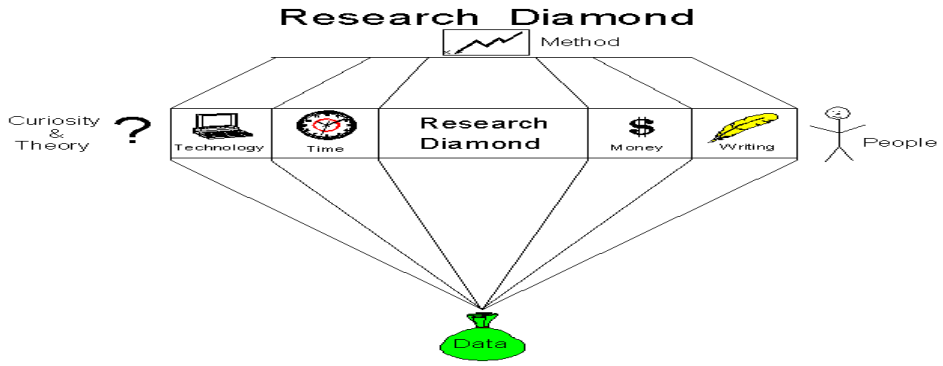


Figure 14 Research diamond

(Schooley, 1995)

The essential feature in qualitative research interview is its theme orientation. It aims to explore the personal sense, understanding and central themes with reflection on the research participants' views. To achieve this, the approach of interviews subscribes to an informal, non-directive, interactive procedure (Creswell, 2003; Wengraf, 2004).

The face to face, personal's in-depth interview was used as the interview mode in this study. The advantage of such interview is that it empowers the researcher with the freedom of questioning (Babbie, 1986; Gravetter & Forzano, 2006; Schall, Ospina, Godsoe, & Dodge, n.d.).

In-depth interviews was considered an appropriate procedure given the goal of obtaining richness in data through a detailed and frank discussion with both the decision makers and consumers (Breatty, 2004; FHI, n.d.; O'Donnell & Cummins,

1999; Palmerino, 1999; Tuten & Urban, 2001 as cited in Alam, 2005; Underwood, 2003 as cited in Alam, 2005).

Some interviews were audio recorded with the research participants' consent. The interviews were conducted in Nepali, English both. The interviews were transcribed later according to time convenience. Direct quotations of interviewee were accounted in version in analysis part.

The process of conducting in-depth interviews in my research was essential for exploring multi dimensional views of cleaner production. In-depth interviews are excellent tools to use in research. In my research, in order to administrative in-depth interview curst eliciting that was well suited for uncovering reality and perceptions of the research participants. The main goal of the interview was to explore the informant's point of view, feelings and their perspectives regarding this research study.

Secondary Data Collection

The most commonly used secondary data are documents, physical data, and archived research data (Johnson, & Christensen, n.d.). It is different from primary data as it involves the utilization of existing data collected for the purposes of a prior study. The secondary analysis of the primary data enhances the trustworthiness of original work. The essence of secondary data again lies in the essence of primary data in real practice (Heaton, 1998).

Data collected from a source that has already been published in any form is called as secondary data. Secondary data is the data that have been already collected by and readily available from other. The main sources of secondary data for my study are Cleaner Production Assessment reports of various industries, conducted from 2001to 2005 by Environment Sector ProgramSupport Project under Ministry of Industry, Nepal and supported by DANIDA. Similar types of Cleaner Production assessment reports conducted in industries of other countries were also my sources for secondary data. I had collected secondary data from the case studies published in

Cleaner Production reports of other countries like SEAM Egypt, Cleaner production case studies in India and other documents. The sources of secondary data also are literature reviews, internet search, and Baseline study on Woolen Yarn Dyeing Industries, conducted by ESPS/DANIDA and PACE Nepal.

Process of Keeping Field Notes

I have used various kinds of data keeping system depending upon the types of field work conducted. Data and information collected from face to face interviews are kept in questionnaires sheets on an individual basis. Basic information and data regarding baseline of the production process and pollution type and pollution loads are kept in first diary and then transferred in the form of log sheet and report in computer. Data and information regarding awareness and training programs are kept as report including program schedule and pictures. Some interviews with some participants of since long years of study on Cleaner Production concept and its benefits are also kept in audio video.

Data Analysis

Qualitative data is not done in numbers. Qualitative data comes in various forms. It contains words, text, explanations, observations, and pictures. Before understanding the qualitative data analysis, it is very necessary to understand what the qualitative data is. Whereas quantitative data deals with numbers, qualitative data deals with meanings. This includes the meanings of those we are researching and Meaning is expressed through actions as well as text (or images). In contrast to quantitative data, qualitative data does not simply count things, but is a way of recording people's attitudes, feelings and behaviours in greater depth. As with all other data, analysis and interpretation of qualitative data are required to bring it in order and better understanding. If the collection of qualitative data is complicated, then data analysis is more complex. Data analysis is the most complex and mysterious of all of the phases of a qualitative. General Qualitative Analytical Process is as given below in Figure 15 below:

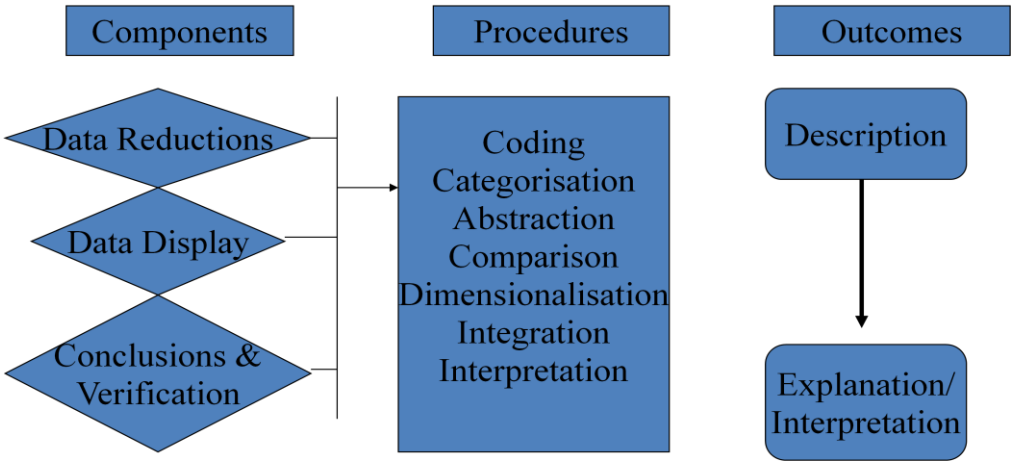


Figure 15 General Qualitative Analytical Processes.

(Adopted from: Brennan, 2005)

Primary sources of data for my research study are observations, face to face interviews, answers to questionnaires, case studies, Focus group discussion, and historical records and documents. And secondary sources of data are past Cleaner Production reports of ESPS/DANIDA, Nepal and Cleaner Production reports of PACE Nepal Pvt. Ltd and some reports from internationals organizations and institutions. Firstly all raw data in various forms are transferred to text or narrative form that requires analysis.

In data analysis, I followed some steps as shown in figure 16, which were followed in various qualitative researches by researcher. These were the processes in qualitative data analysis in my research:

Steps of Data Analysis	My Concern and Way Out
Reading / Data Immersion	- Themed and developed tentative explanations. - Explored rich and deep responses. - Found how vivid and detailed were the descriptions of observations
Coding/ Identifying Emerging Themes	- Identified sub-themes and explored them in greater depth processes. - Closely matched the language and ideas in the textual data - Inserted explanatory notes during the coding process - Captured meaning and lead to explanations flexible coding scheme
Displaying Data	-Took an inventory of what data had been related. - Captured the variation or richness of each theme - Noted intensity and identified different phenomenon
Data Reduction	- Made information visible and most essential - Got an overall sense of the data - Separated essential from non-essential data
Interpretation	- Identified the core meaning of the data based on faithful to the perspectives with wider social and theoretical relevance
Intuition	- Used ability for producing concrete judgments - Regarded as the starting place in deriving knowledge of human experiences
Interim Analysis	- Used to describe existing reality for better result. - Continued until the researcher is interested.
Data Entry and Storage	- Transcribed all collected data in my laptop which was supported by my research assistant.
Reflection	- Involved a careful reading of an expression - Described thoughts, feelings, examples, ideas and situations that reveal the essence of reality.

Figure 16 Steps followed in Qualitative Analytical Processes

Interpreting Data

Interpretation of the data can be understood as meaning and significance to the analysis. It is very necessary to understand that the data analysis and interpretation in qualitative research process are not two separate topics. They go together. The researcher engages simultaneously in data collection, data analysis and interpretation of research findings.

My data collection mainly focused on Cleaner Production concept, pollution from the industries and attitude of the working people toward production activities. The main objective of my research is to reduce the pollution. The pollution is measured from the generation of waste water and air pollution. So the interpretation of data collected is carried out on the basis of pollution generated and reduction after conduction some awareness and training program on Cleaner Production. The contents of awareness program and training program conducted are discussed in Chapter IV, Chapter V and Annexes.

Pollutionn level for woolen yarn dyeing industries as per Nepal Standard is measured through following parameters:

a. For waste water

1. pH
2. Chemical Oxygen Demand (COD) in mg/l
3. Biochemical Oxygen Demand (BOD) in mg/l
4. Oil and Grease (O/G) in mg/l
5. Total Suspended Solid (TSS) in mg/l
6. Total chromium in mg/l
7. Sulphide in mg/l
8. Temperature at disposal

b. Air Pollution

1. Total Suspended Solid Particles (TSP)

2. Contents of Carbon Dioxide
3. Content of Sulphur Dioxide

As mentioned above, improvement options are generated through application of five CP techniques. Baseline data on pollution parameter collected before awareness and training program on Cleaner Production and pollution reduction parameters after CP program are interpreted from data on the attitude changing point of view. The details of results and procedure are described in Chapter IV.

Quality Standard

Three crisis- crisis of representation, crisis of legitimization and crisis of praxis are addressed as follows:

Qualitative researchers have to consider three crisis namely crisis of representation, crisis of legitimating and crisis of praxis during the process of data collection, data analysis and data interpretation. (Onwuegbuzie& Leech, 2004). Denzin and Lincoln (2005) argue about this crisis as follows:

Crisis of representation can be understand as a text/report written by a researcher about the perception, feeling and live experience of the Research Participants and asks how the researcher can use the text representing the experience of other authentically. The crisis of Legitimating refers to reliability, validity and generalizability of the text/report. This crisis relates to Qualitative report/study conducted without any detail assessment or without any cross checking from different sources. Crisis of Praxis is argued that how text alone developed by qualitative researcher can be evaluated regarding changing the effect in world.

Thus the crises of representation, legitimating, and praxis threaten qualitative researchers' ability to extract meaning from their data. To reduce the possible negative impact from this probable crisis's to result of my study I had conducted the study with following methodologies and approaches:

a. Regarding the crisis of representation, I had used my long years of experiences in data collection. I considered the view, understanding and expression of the research participants as my prime concern. During data collection through observation of the participants, I used not only observation, but I interacted with participants and asked them questions about their intention, thinking and feeling on the data collected. Data collected by me is the first hand thoughts of participants.
b. Regarding crisis of legitimacy, I had used the data collected from various sources. (even the data from industries other than two dyeing industries under study) During the data collection I combined the attitude of the participant on one hand and result of pollution on the other hand. I correlated these two data to get the objective of the study. Pollution results show the correctness of data provided by participants. My long years of experiences and cross checking of data from other industries show the validity, reliability and credibility of the result leading to fulfil the objective of the study.
c. Regarding the crisis of praxis, I presented the qualitative data not only in the text form, but also in the form of photography and document. Although it is qualitative research, I felt the need to quantify the pollution reduction data in figure too.

   So there are very little chances of this crisis in my study.

Ethical Issues

I followed researcher's ethics during data collection phase. There was no harm of any participants while collected data. I respected all my research participants.

Voluntary Participation:

The research participants were not forced to participate in my study. All research participants including management of industries participated in my study according to their willingness. Nobody was forced to express their thinking, feeling

and perception. All data received or collected from the participants are their own voluntarily expressed data.

Informed Consent:

All participants were fully informed about my study, its type, objectives and expected data from them. All participants were, well in time, pre informed about the date of interview, observations, awareness and training program. No participant was forced to stay overtime or during a time that was not suitable time for them.

Risk of Harm:

No participant was put in a situation where they might get risk of harm as a result of participation. The voluntary participants had the consent of their respective management to participate in my study.

Confidentiality:

I guarantee the participants' confidentiality. All research participants including management were assured that the information/data collected by me and provided by them would not be made available to anyone who is not directly concerned in the study. If any data or information is required to be given to someone other than the person/organization pre informed to the participants before the study was conducted, I will take the permission from the respective participant.

Anonymity:

All participants were anonymous through the study. They were not obliged to provide any information to even researcher. I guarantee them privacy.

Right to Service:

If the program is beneficial to participants, all the participants will have right to participate in that program.

Concluding Remarks

This chapter guided and interpreted my whole thesis. In this chapter I have discusses all the relevant matter with respect to Qualitative Research. My research design is based on the past positivist, ontology, epistemology and inductive approach. On the basis of these strategies and approaches data collection, data analysis and data interpretation were done. Considering the possible Crisis of Representation, Legitimacy and Praxis during data collection, discussion on the approaches taken for solving the crisis has also been addressed.

CHAPTER IV

CONSIDERATION OF ENVIRONMENTAL POLLUTION

The observation part of my thesis is principally based on the observation and work done since last 15 years in the industries in the field of pollution reduction through attitude change. At the same time during this thesis writing period March 2010 to May 2012, special observation was made in woolen yarn dyeing industries of Kathmandu Valley. Some qualitative data related to pollution and attitude was collected through questionnaires filled by research participants and interviews taken to research participants working in different capacities including managers and directors of the woolen yarn dyeing industries. The details of interviews and format of questionnaire are given in Annex-5 and 6 respectively. Observations on working practices were made and discussion with all level of workers and directors of the industries on pollution and its causes were carried out. On the basis of these observations and interviews, collected data was analyzed and interpreted as described in the following sections.

Environment

Environment is the most important thing that we have to consider to make our living in this earth happy. Different people view the environment differently. Environment as an object is very difficult to define. *(Heberlein, 1980)*

According to Wikipedia environment is a natural unit consisting of all plants, animals and micro-organisms (*biotic* factors) in an area functioning together with all of the non-living physical (*abiotic*) factors of the environment. It is also known as ecosystem. The natural environment is contrasted with the *built environment*, which comprises the areas and components that are strongly influenced by humans

According to ISO (2004), Environment is defined as "Surroundings in which an organization operates including air, water, land, natural resources, flora, fauna, humans and their interrelations (Standard. 3.5)"

According to IFC, World Bank (2007), environmental issues during the operational phase of textile processing primarily include the following:

- Hazardous materials management
- Wastewater
- Emissions to air
- Energy consumption
- Solid and liquid waste

A study was carried out among the European citizens in all European countries with topic title Attitudes of European Citizens towards the Environment and most of the citizens said that the environment is associated with Pollution in Towns and Cities (EUROBAROMETER, 2008)

During the interviews and discussion with workers, the working people said that they do not know how to define the environment but they know that"environment should be good and human being should not destroy the environment and it should be saved" and similarly management level of the industries understand the environment as our surrounding including human beings. They added that "human being could not stay away from the environment and so we have to save the environment" According to them, Environment is such an object which we have to keep always clean.

It is true that in general environment refers to the surroundings of an object. However there are two types of environment viz. i. Natural Environment and ii. Built Environment.Natural environment is all living and non-living things that occur naturally the on Earth. It includes all vegetation, animals, microorganisms, soil, rocks, atmosphere and natural phenomena that occur within their boundaries. There will not be any massive human intervention on natural environment. Built environment is considered as man-made surroundings that support all human activities starting from small shelter to big physical structure. Built environment is

strongly influenced by humans and human activities.The production from the industries can be influenced by the human activities and their attitude.

The industries produce a large quantity of waste and pollutants which go to the environment making it unfavourable to human being, aquatic life, floor and fauna. The fate of environment in and around the industries largely depends on the attitude of the working people toward the environment. It is self understandable from the definition of the environment that the environment is all living and non living objects of our surrounding including ourselves. It means that human being cannot live happily by neglecting the environment. Human beings have to survive within the surrounding. If our surrounding is favourable, our life will be favourable.

It is very much necessary to understand the environment and its importance for living and non living things of our surrounding. It all depends on the working attitude of the working people toward environment. From the research associated with working people of the industries, it revealed that all working people understand the environment and its importance to our life.

Types and Sources of Environment

Two types of environment can be considered. First is internal environment and another is external environment.

Generally, internal environment is concentrated or limited within the organization or shop floor of the industry or household. It is generally considered as a condition within the organization, industry and household which gives the negative/positive impact to certain number of people or object living or working within the organization or industry or household. In other words, it can be understood as a working condition or living condition. In this case adverse impact is limited to working people only.

External environment is referred to the condition outside the premises of the organization/industry/household. Its impact is extended outside the premises of the

organization/industry and households. The surrounding objects like, water bodies, land, mountain, flora, fauna and other that surround us are an instance of the external environment. Some pictures of internal and external environment associated with the activites of the industries are illustrated as follows:



Internal Environment



External Environment

The working people of the industry said that "they are suffering both from internal and external environment. Occupational Health and Safety condition in the shopfloor is considered as internal environment and the condition of rivers, mountains, land which are in and around the industry is considered as external environment".

My observation in the different industries revealed that there are both internal and external environmental problems in the industrial activities. Internal environment is although limited to certain limited people, its immediate adverse impact is high. The external environment is mainly depended on the internal environment too. If the

internal environment is improved, the destruction of the external environment can also be controlled as the waste generated from the internal source will not be discharged or emitted to external environment. If the internal environment is not favourable, the waste or pollutant will be generated and working people will not be ready to save the external environment, be it physically or mentally.

National Air Quality Standards, 2009 for Nepal is already gazetted. It is mainly focused on air quality. Standards should be followed by all organizations even by households. However, it does not cover internal solid waste and waste water management.

So, it is very much important to provide the understanding and positive attitude toward the importance of internal environment to save both internal and external environment.

Waste

According to Wikipedia, waste is also known as rubbish, trash, refuse, garbage, junk, and litter and they all are unwanted or useless materials.

According to the Basel Convention Waste is defined as *"Wastes are materials that are not prime products (that is products produced for the market) for which the generator has no further use in terms of his/her own purposes of production, transformation or consumption, and of which he/she wants to dispose. Wastes may be generated during the extraction of raw materials, the processing of raw materials into intermediate and final products, the consumption of final products, and other human activities. Residuals recycled or reused at the place of generation are excluded."*

Similarly under the Waste Framework Directive, the European Union, 2008 defined the waste as *"an object the holder discards, intends to discard or is required to discard"*.

Zero Waste America defines waste as "a resource that is not safely recycled back into the environment or the marketplace in a manner that protects human health and environment."

The working people of the industries are very confused with the understanding of the waste. *At first they said "waste is unusable thing, it is pollution, it is abandoned thing, and it is useless thing and so on" but working people who attended the training awareness program on Cleaner Production started to say "Waste is useful thing, it is not abandoned thing".*

The data on understanding of waste by the research participants was collected through questionnaire distributed to research participants of mainly two types. First type of research participants had already undergone awareness program on attitude change regarding waste and pollution and another type had not yet undergone the awareness program. The attitude of the research participants was analyzed through questions with 5 types of options such as (Strongly Agree, Agree, Undecided, Disagree and Strongly Disagree). The research participants that had undergone awareness program strongly agreed that waste is useful products and other participants who had not undergone awareness program totally disagreed that waste is useful product.

It was very interesting to know that even an educated person considered the waste as a useless product. But to some extent, although it is also true, waste should not be considere as useless product.

When we start to think about the source of generation of waste, of course it is generated from human activities. The source of generation of waste is our kitchen, store room, dining hall and in the same way, industrial production, shop, restaurant and so on. These all are activities carried out by human beings. So, waste is generated by human being due to their activities. It is not a natural phenomina. The waste is not created by nature. Then again we have to think why the waste is generated. The waste may be generated due to surplus, wrong handling, mistake in

performing the activity, carelessness, wrong processing, unknown application area, traditional technology, inappropriate tools used and so on. But, from any perspective it can be safe to say that waste is generated by human being. It means if we give value to above mentioned matters and do the work accordingly, waste generation definitely will be reduced. Under this circumstance, it will be very much appropriate to understand **waste as valuable resource at the wrong place or at the wrong hand.** Nothing in the world is a useless product. Each and every thing has some value and application area. So if we think that the waste is useful product, it will not be thrown out. However, our first intention should be not to generate waste. If the waste is already generated, it should be reused or recycled if possible and if not; at last waste should be used for recovering energy. The only one thing that we have to consider that waste is indeed a valuable thing and it should be at the right place and at the right hand.

Types and Sources of Waste

Although there are many types of waste, basically waste is divided into three categories such as Solid, Liquid and Gas. Waste from industry can be in the form of smoke, heat, or steam. It can also be considered toxic, or hazardous and radioactive waste. Factories, mills, and mines are industries that produce a lot of different kinds of waste. All of these wastes produce pollution and adverse impact to environment. Manufacturing industry waste comprises many different waste streams arising from a wide range of industrial processes. Some of the largest waste generating industrial sectors includes the production of basic metals, food, beverage, dyeing, tanning and pulp and paper products etc. (*Eionet, 2009), http://scp.eionet.europa.eu/themes/waste*.

Waste is also defined as **i**t is any activity or process that adds cost but adds no value (for the customer), **(***manufactus, 2011).* According to this concept, all eight sources/types of waste generation identified as follows are the sources of pollution.

1) ***Overproduction***

This is when the company is producing more than the customer requires. It can be the producing of items for which there are no orders or producing more than is immediately required. This is the worst waste as it multiplies all the other wastes. It increases defects, inventory, processing, waiting, unnecessary motion and transportation.

2) ***Inventory or storing***

Inventory is the quantity of parts on stock which are required to manufacture a product. These goods also cause costs to the company. When they are not used the parts take up valuable space, become obsolete and requires raw material which cannot be used for more important goods. Competitive organisations make sure that their systems control inventory so that money is not wasted on unwanted goods.

3) ***Defects (scrap, rework)***

Scrap and rework are required when products are defective and have to be reworked. Defects are caused by bad manufacturing processes (caused by human errors or equipment breakdown). Rework takes additional time and therefore increases the cost of the finished product.

4) **Waiting**

Each task in a manufacturing process is dependent on the processes upstream and downstream. If people, equipment, information or materials delay the production process, time is wasted and the cost of production will be increased.

5) ***Transportation***

This is the unnecessary movement of information, products or items from one area to another. Unnecessary transportation is usually paired with unnecessary motion, product damage, loss of product, and systems to track the movement.

*6) **Motion***

Not required motion relates to people moving around the work space wasting time and effort. All kind of unnecessary motion can be caused by poor standard work practices, poor process design or poor work area layout.

7) **Over processing**

Over processing involves taking not needed extra steps in the manufacturing process. It can also mean producing products of a higher quality than required. This may be due to malfunctioning equipment, errors in rework, poor process design, bad communication and not checking what the customers' needs are.

*8) **Not used creativity of employees***

This waste involves losing time, skills, ideas, improvements and learning opportunities by not listening to your employees. Employees have to be integrated into the complete manufacturing processes. So they can generate ideas which are needed to eliminate the other seven wastes. This will help to improve your processes continuously by using the available knowledge and creativity and it helps to increase employee satisfaction.

During the intervention and observations in the woolen dyeing industries under this research, the working people (research participants) said that *"they all know about types of waste generated in their industries and their sources. They considered the waste generated sources are chemicals handling and storing, production process including boiler and fuel feeding, transportation of products and raw materials including fuels. They also considered that waste is generated due to their carelessness and not seriousness in the work" They further added that the main causes of waste generation or losses are follows:*

a. *Mistake in weighing and dosing of chemicals due to negligence of the workers*
b. *Leakage and spillages of Water, chemicals and dyes*
c. *Improper loading of yarn in the machine*
d. *Wrong handling of water, chemicals*

e. Feeding of fuel in boiler not as per instruction, more/less airfuel ratio

f. Condition of machine and equipment (Repair and maintenance)

g. Mismatching of sample dyeing

h. Miscommunication from the customer

Of course, many types of waste are generated in industries. Types of waste generated in the industries are evaluated by two bases. One sector is based on the quality, constituent and stages of the waste and other sector is based on the sources and causes of waste. In the context of Nepal, mainly three types of waste: Solid waste, Liquid waste and Gaseous waste are emitted from various sources into the environment. Due to the absence of big chemical industries, the waste generated from our industries do not contains high amounts of heavy metals and hazardous/toxic chemicals except some industries like leather tanning, pulp and paper and textile processing. Most of the industries produce solid waste in organic and inorganic nature.

The woolen yarn dyeing industries under this research study produce high volume of liquid waste. The production process of woolen yarn dyeing itself generates the liquid waste. However the industry people claim that it is not so harmfull as dyes used are mostly environmental friendly and exhaustion of dyes is up to 98%. Although the residue of dyes in waste water is very small, It contains heavy metals and other toxic components. And, the chemical used such as acetic acid, formic acid, sulphuric acid, detergent, leveling agent and scouring agents etc are also make the waste water polluting to environment. The chemical waste during the storing, handling and feeding to machine also make the waste water more polluting.

Similarly the smoke and black dust generated from the operation of boiler is another source of waste. The smoke and black dust emitted from the chimney of the boiler depends on the operation of boiler and fuel feeding practice by the workers..

According to interview taken and my long years of observation in this sector, the average losses or wastes in this sector are considered as follow:

1. Material =1%
2. *Water = 20%*
3. *Fuel = 10 %*
4. *Dyes =7 %*
5. *Chemicals = 20%*
6. *Electricity = 10 %*
7. *Labour = 15 %*

The quality of smoke emitted from the chimney of boiler and its volume totally depend on the air fuel ratio, fuel feeding practices and daily maintenance of the boiler. Similarly, loss of input materials also depends on the handling and dosing practice. It all depends on the attitude of the working people. If the working people care a little bit on handling and using of chemicals without seepage and leakage and also controlling the weighing and dosing of the chemicals, the waste generated will be very less. Similarly if the working people are serious in the feeding of fuel into boiler and its control boiler operation, the emission is improved and the fuel consumption can be reduced. Thus if an industry has its people trained in Cleaner Production and awareness program, the harm on environment can be reduced. On the other hand, if the industry does not train its working people, the environment will be affected and the industry will has to bear the obstacles from many sources. Also there will be a monetary loss as well.

The relation between waste and pollution is a direct one. The more waste, we generate, the more pollution we get. There is direct link between pollution and environment. The more pollution we discharge or emit, more unfavorable environment is created. Thus the betterment of the environment where we breathe and live totally depends on the waste generated by us. Thus the attitude of the working people plays the main role in waste minimization.

Pollution

"Pollution is an undesirable change in physical, chemical or biological characteristics of our air, water or lands that may or will harmfully affect human life, flora, fauna and materials". And Environmental Pollution is defined as "Any solid, liquid or gaseous substances present in such concentration as may be, or a tend to be injurious to environment is known as "environmental pollutant" and their presence indicate the environmental pollution" (Central Pollution Control Board, 2008)

The term pollution refers to the act of contaminating ones environment by introducing certain hazardous contaminants that disturb the ecosystem and directly or indirectly affect the living organisms of that ecosystem. Pollution in general is the activity of disturbing the natural system and balance of an environment *(Hassan, 2011)*

The industry pollutes the environment. It is not staff and low class workers who are responsible for pollution caused by the industry. Workers and staffs do the pollution due to careless and rough handling. It is management who is responsible for pollution, because the management makes the system, develops the working practices and runs the production. Thus a majority of the staff and workers do not contribute to the pollution but become the victims. Hence with proper awareness among the factory workers and senior officers, pressure can be built up to reduce the pollution" (*Hegde, 1998)*

The working people including management of the industry related to the study said that *"the pollution as a bad thing, it is generated due to production, which is unavoidable. They all know that pollution thus generated from the production goes to nearby river, land and atmosphere and make then adverse impact. However, the working people who underwent the training on awareness and Cleaner Production revealed that pollution control is not unavoidable. It can be controlled and reduced. They confessed that they are responsible in some extent for polluting our environment".*

In the context of attitude index, questionnaires filled by the research participants who had undergone the awareness program strongly agreed that pollution caused negative impact to environment and working people and it added to the cost of production. They strongly agreed on that the fact that pollution is caused was mainly due to waste generated by the workers themselves and pollution can be reduced in great extent if the workers want. They have to be aware about the spillage and working practices. The participants not having any awareness program on attitude change and Cleaner Production disagreed that. Lastly they confessed that the pollution was caused due to workers's wrong working practices and negligence.

It is well known that pollution is a bad and undesirable thing. The magnitude and characteristic strength of pollution is increasing. The increase in the pollution both in quantity and characteristic over the years has caused severe damage to the earth's ecosystem. Global warming is one of the results of it. There are many misfortunes that are taking place due to pollution and even the survival of living beings is at question.

Pollutions are created due to the various activities carried out by industries during the production. In Nepal, fast expansion of urban centers and industrialization has been leading to the problems of solid waste disposal, and environmental pollution. Water pollution resulting from sewage and industrial waste provides clear examples of environmental degradation. The carrying and decomposing capacities of the rivers are sustained to their maximum by the increase in urban population and by the development of industrial complexes leading to the disturbance in river ecosystem. Industries based on local raw materials such as cement and marble factories and boulder and stone crushing industries pollute the environment and de-stabilize soil. Similarly pulp and paper and leather pollute water bodies. In Nepal, rivers frequently change their color due to the discharge of effluents from those industries, which use chemicals during their production process (*Nepal, 2006).* And the working people themselves are responsible for pollution generated by the industries.

Internal pollution is more sensitive to the working people. It directly affects the health of the working people. Depending upon the magnitude of exposure and its quality of adverse impact, working people feel the short term and long term health hazard. But it is our misunderstanding to say that it is unavoidable. Of course it is quite true that it is not possible to produce our desirable product without any pollution. At the beginning, all working people usually say that production is not being possible without pollution. They continued saying that pollution will be controlled only after stopping the production. But one thing that to be cleared that pollution that is discharged by industries is not created by nature and it is generated by human being from their activities. The generation of pollution totally depends on the ability/expertise and attitude of human being that is associated with that particular activity. The quantity and magnitude of pollution is caused by the way of performing that particular activity. So, it is very much possible to reduce the pollution if the job performer is motivated to work in a better way.

Types and Sources of Pollution

Ye it is ture that pollution is an undesirable and unwanted phenomenon. There are many types of pollution in the environment that we are facing such as air pollution, solid waste, water pollution, noise, thermal (heat stress), Light (Dazzling), radioactive. However, in general four types of pollution such as Air Pollution, Land pollution (solid waste), water pollution (Effluent) and noise pollution are considered as a usual and spreading pollution for living and non living creature of the earth. And they have perilous affect on our lives *(Hassan 2011). According to Marriam-Webster* the Pollution is the action of environmental contamination with man-made waste.

During the interaction and personal interview, the working people in the industries said that *the pollution is affecting adversely to them, and they have to face all four types of pollution all the time. They are facing the problems caused from solid waste (fly ash from boiler, chemical handling, and slippery floor due to seepage of greasy products like soap), liquid waste (chemical mixed water and dyes), and air pollution due to burning of fuel in boiler. Noise generated from the machine*

operation is another pollution that we have to accept. They further added that they have to accept the complaint from the neighbours and pressure group".

Industry is complex. It consumes a lot of resources and discharges waste accordingly. There are many activities to be performed to produce one item. So there are many sources of pollution. The industries operating in Nepal mainly produces four types of pollution namely solid waste, waste water, air pollution and noise. The pollution caused by dazzling light, radioactive substances is not observed by us. The waste water generated from the industries mainly consists of mainly organic matters and some chemicals. Solid waste is mainly organic and inorganic which are mostly reusable or recyclable. Air pollution is mainly due to burning of biomass and coal and petroleum products. Noise is only from metal fabricator, crushers which are in localized form. And noise pollution is observed in low range only.

The woolen yarn dyeing industries which are now under sample study produce three types of pollution namely solid waste, waste water and air pollution. On the basis of interviews taken and my long years of observation in this sector, the sources of pollution generation and its level of quantity are as given follows:

Solid waste

The solid waste is generated from the sorting of yarn and sample dyeing. The quantity of such solid waste goes up to 1% due to mistake in dyeing. Another source of solid waste is fly ash generated from the boiler operation. All most all dyeing industries use rice husk as fuel. The ash generation is about 20% of fuel used. According to interviews with different industries, at present 20 MT per day of woolen yarn are dyed by 24 dyeing units located in and around the Kathmandu valley and their consumption of water, dyestuff, chemicals and fuels are as follows:

Water -800,000 liters/day

Chemicals (acetic acid, formic acid, leveling agent, scouring agent etc) - 500 kgs/day

Dyestuff – 500 kg/day

Fuels – 40MT/day

On the basis of this, solid waste generation – 0.5% of 20 MT = 100 kg/day

Fly ash generation = 20% of fuel used = 8 MT/day

The Government of Nepal has not yet formulated any standard or limit of solid waste till date. However, the solid waste generated by this sector is woolen yarn pieces, which are recycled to second grade yarn itself and used for woolen product making. Other solid waste is fly ash enerated from boiler operation which is used by the farmers as additives in the field. If the soil is acidic, this ash is used as neutralizer. Samples of solid waste are as shown below:

Solid wastes from the wool dyeing industries

Waste water:

Waste water is another type of pollution generated from this sector. The total quantity of waste water generated is around 800,000 liters/day. Waste water contains high COD, Oil and Grease. Dyestuff residue in the waste water is very negligible as yarns are dyed in light shade only and dye exhaustion is very high up to 98%. The general characteristic of waste water generated by this sector in past is as given in table 2. However, the sample analysis results taken during this study period from the sample industries are as given in table-3 below. For detail refer Annex 4 A

Table-3

Waste water Analysis Report after 1st improvement

Sr No	Parameters	Unit	Result of sample tested	Nepal Government Standard
1	pH	-	8.5	5.5 – 9.0
2	Total Suspended Solid,	mg/l	48	Max 100
3	Biochemical Oxygen Demand (BOD) for 5 days at 20degree C	mg/l	185	Max 100
4	Chemical Oxygen Demand (COD) ,	mg/l	464	Max 250
5	Oil and Grease (O/G)	mg/l	15.1	Max 10
6	Total Chromium (Cr)	mg/l	0.09	Max 2
7	Sulphide	mg/l	<0.8	Max 2
8	Phenolic Compound	mg/l	<0.05	Max 5

Result shows that many parameter of wastewater generated from the sample industries still do not comply with the Nepal Government Standard.

Nepal Standard for waste water discharged is only for quality assessment. It limits only discharged characteristic parameters. And it does not address the quantity or pollution load. However, this result shows better result compare to past ones.

Air Pollution:

The yarns are dyed at boiling temperature. Steam generated from boiler is used for heating the water. Mostly rice husk is used as fuel for firing the boiler. During the firing, smoke and dust particles are emitted from the boiler operation and it pollutes the environment. The air pollution is depends on the feeding practice of fuel and condition and type of the boiler used. On burning the fuels Green House Gas (GHG) is generated which makes the adverse impact to environment and human health. In an average 53 MT of GHG is emitted from the burning of 40MT Rice Husk.

Till now, Nepal emission standard for boiler is not yet finalized. It is in the process of finalization of the standard. The emission standard varies according the capacity of the boiler used. Although it is not yet gazette, it is recommended the maximum Total suspended particulate emission permitted for small size boiler (2-10MT) 800 mg/Nm^3 and for bigger boiler it is 600mg/Nm^3. The results of recently collected samples from improved boiler having 2 MT capacity are within 500 – 600 mg/Nm^3 (536 mg/Nm^3), which are under the recommended standard and before study it was 1247mg/Nm^3 which does not meet emission standard.

No industry has system or management to control the pollution. No waste water or air pollution control system is installed. Pollutions in the form of waste are discharged directly to environment without any controlling.

All kinds of pollution at different level are making adverse impact to working people of the industries as well as outer environment. The working people even do not know about the possibility of adverse effect of raw materials, fuels they used and risk of accident and health hazard from the method they followed. At the same time, the industry does not have any system or practices to inform or to train the working people for safety handling, storing and transporting the chemicals and other hazardous materials. This is the one of the main causes that the pollution is generated in high volume. The working people and even the management itself do not care about the short term health hazard and external pollution until someone complains or big problem happened. Air pollution and waste water are considered as two big problems and complains are lodged because of their easily visible to the people. Other pollutions even they are severe, if they are not visible to the people and these are not taken as problem. We have habit to blame others. Similarly working people do not blame themselves for pollution caused by the industry. The pollution is totally depended on the working habit and practices of the workers at the first level and then the equipment, machineries and materials they used. So if the working people could be made positive toward the environment and its degradation due to pollution caused by them, the pollution from the industrial development to the environment will be reduced.

Occupational Health and Safety

The Occupational Health and Safety (OHS) matters in the industries are great concerned to the reduction of the pollution. Any activity whether it is manual or machine operated has risk of accident and health hazard. If the condition of working shop floor is comfortable, safe and no health hazard, the waste generation will be minimized leading to less pollution

Textile dyeing industries operating Nepal is a sector where the worker's safety and health are given very little importance. Textile dyeing and finishing operations are performed along with the use of various toxic dyes and chemicals and steam under pressure. So, there is always risk of burn, cut and chemical hazard. Workers have to work under stress and fears (*Karanjit, 2004).*

Occupational health and safety hazards during the operational phase of textile manufacturing projects primarily include the following *(IFC, 2007)*

- Chemical hazards
- Physical hazards
- Heat
- Noise
- Ionizing and non-ionizing radiation

OHS is the science of anticipation, recognition, evaluation and control of hazards arising in or from the workplace which could impair the health and well-being of workers. It also impacts on the surrounding communities and the environment. In any country workers can improve their productivity quickly only when the workplace is safe and healthy.

Gautam and Prasain (2011) revealed that most of the industries in Nepal are prone to risk of accident and health hazard. However, they added that it can be prevented or minimized through necessary control interventions which not only

protect workers from disease and accident but also limit the damage to the environment.

As per the observation and interview with employees (Research Participants), it was revealed that the working condition in the industries of Nepal is very unfavorable. They mentioned the compulsion of working in unfavorable environment under stress with high risk of accident and health hazard. They further added that they have to carry and handle chemical and dyestuff in open containers without lid with bare hands who are not even provided with basic personal protective equipment like hands gloves Employees have to work under the fear of accidents like burnout, fell down, hand/leg cut, and often suffer from health problems like skin irritation, headache, coughing and eye diseases. However, the management of the industry does not accept these complain and further blames workers for not using personal protective equipment provided to them

According to questionnaires regarding to attitude index, research participants having already awareness program on Cleaner Production strongly agreed that the pollution is caused due to unsafe working condition and it is the responsibility of the workers to keep workplace free of pollution for safe workplace. They also agreed that the workplace can be safe only if the workers attitude toward waste minimization and good working practices is positive. They advocated the roles and responsibilities of management of to keep workplace safe.

The working condition of the industries in Nepal is not favorable There are a lot of chances of accident and health hazard. The floors are slippery due to leakage and seepage of milk, and milk products in dairy, chemicals and water in dyeing and chemical industries, soap pieces and oil in the soap industries, acid fumes in galvanizing industries, smoke and dust in food industries and congested due to haphazard storing of materials all over the shopfloor. At the same time there is big risk of accident in and near of moving parts (V belt, fan, conveyor, spinning etc). There is big risk of boiler bursting, fell down from the height and so on. In such a working condition, worker cannot perform his/her duty efficiently and effectively and

it generates waste in the form of rejected and broken materials, rework, replace, high inventory, date expiry etc. These all wastes create the pollution to environment and human health. Some examples of bad working conditions in the industries are given in pictures below:

Chemical handling with naked hand and storing openly

Chemical dosing by hanging in the machine

Ash handling risk of eye damage

Chemical acid fumes in the shopfloor of galvanizing unit

From this observation, it can be concluded that the working condition in industries is not favorable for good operation of production in the line of waste minimization leading to reduction of pollution to environment and human health.

Environmental Attitude

(Sultana, 2011) has conducted a survey research about attitudes and beliefs of design professionals regarding environmentally conscious design. The principal purpose of this research was to investigate interior design professionals' opinions, beliefs, and positive actions regarding environmentally conscious design. The study

revealed that although design professionals strongly supported environmentally conscious design, only few applied the concepts in reality. The study added that the constraints to the implementation of these are high cost of implementation, lack of availability of products, and lack of acceptance by clients.

A study survey on Attitudes toward waste minimization in Finland and Czech Republic – barriers and drivers was carried out in Czech and Finish companies about waste minimization leading to Pollution. The study revealed that the answer received on question asked about the barriers for waste minimization is that although lack of money and technology constraints were mentioned in both of the countries, the most significant barrier was insufficient environmental awareness and concern. However, the quantity of barriers was higher with Czech companies, which corresponds with the fact that Czech Republic is still in the second stage of environmental awareness where Finland has already reached the third level (*Kristina Olgyaiová et.al, 2005, pp. 9-18)*

A study was carried out among the European citizens in all European countries with topic title Attitudes of European Citizens towards the Environment and the study revealed that almost all Europeans consider the protection of environment to be highly important (*EU Commisssion, 2008).*

A study was carried out by Tantawi *et al* about the attitude of Egyptian toward the environment. The study revealed that although Egyptian consumers do not consider going green to be one of their priorities and rank first their environmental concerns, they have positive attitude towards the protection of environment. The study further added that such contradiction on attitude toward the environment is due to economic condition of the Egyptian and they blamed to Government for pollution caused by industries and citizens. Egyptian consumers think that although every citizen is responsible for protecting and preserving the environment, the major responsibility falls on the Government part (Tantawi *et al, 2007).*

A study carried out by JICA revealed that many enterprises in Japan recently pointed to social responsibility as a motivation for pollution control measures. The

Japanese industries considered the pollution as one of the major priorities. They are very much conscious toward the environment. Based on this new awareness, more and more enterprises are introducing environmental management systems as well as preparing and publicly disclosing environmental reports.

As per the interviews taken with different working people under this research study, it revealed that almost all interviewed employees were aware of impact on environment and they told that environment should be protected and preserved, but in reality, their actions are not according to their words. They always blame management or other stakeholders for pollution caused by the industries. They pointed out the constraints of space, poor working condition of machine and equipment, non availability of required materials and no concern of management toward the environment. Similarly management and director of the industries blamed workers for pollution caused by industries. They said that even they are equipped with required tools and materials; workers handle materials improperly and damage them. They do not care about the pollution. The management even now thinks that the consideration of environment is not their priority. It was observed that the management is giving more priority in producing goods and services. Regarding the attitude Index, the questionnaires filled by research participants having awareness program strongly agreed that the attitude is the prime concern for better environment through reduction of pollution. The research participants without any awareness program disagreed on that the responsibility of workers is to keep the environment free of pollution.

It is true that operation of Nepalese industries is not environmental friendly. They do not have any Environmental Policy and operating code of practice. They are not aware of it. Management is concerned only with production and profit. It is mainly due to poor enforcement of environmental law and regulation. In other hand workers think that the responsibility of protection of environment is not their concern. Waste water is generated and emission of smoke from the chimney is the main source of pollution. When they are asked who is responsible for pollution caused by their industry, they all unanimously said that they are responsible for such pollution. But in

reality, they do not think like that. Attitude and behavior are two different things. Even when attitude is positive, behavior does not necessarily seem to be positive. But it is also true that first attitude should be positive, and then only behavior can be changed.

From the long years of my working experience with workers and observation in the industries shows that the changing of attitude toward the waste minimization or pollution control can be successfully implemented by awareness program. The negative or correctly neutral attitude toward pollution is mainly due to lack of awareness of both management and employees working in factories. They are also not aware of occupational health and safety. Unmanaged production of shop floor, haphazardly storing of materials, unguarded machine and equipment, uncontrolled use of resources, unplanned work schedule, unsafe working posture, improperly application of hazardous materials are some of the examples of negative attitude toward the environment.

The workers and management of small scale industries do not have exposure to environmental education. They have never received any form of training or awareness on environment and attitude. They even do not understand the adverse impact of the chemicals that can happen if proper preventive measures are not applied. They handle very concentrated acid or caustic soda (Sodium Hydroxide) without any glove. Chemicals are stored in an open vessel without any lid or cap. The chemical fumes and seepage of chemicals can be seen in shop floor. These are the some of the main causes that they are not so serious toward the environment and pollution.

Concluding Remarks

It is true that the production of goods and services generates pollution. But we should not forget that the production is managed by person. The quantity and quality of waste totally depends upon the production process, technology applied, handling and use of materials, operation practices and system to be followed. The operating

practice, materials handling and systems followed are all about the attitude of the working people and waste can be minimized by workers if they have positive attitude and concern towards waste minimization.

The present condition of the woolen yarn dyeing industries in Nepal is not satisfactory in terms of management, operating practices, working safety, pollution caused by the industries. This was mainly because of the wrong attitude and reactive behaviors of the working people towards their responsibilities in operational practices, waste minimization and pollution.

However, the worker and even the management after awareness program on attitude and environment, they started to change their attitude toward the reduction of pollution. There are many cases that after awareness programme, they changed their working attitude and made improvement in production, waste minimization and control of pollution was already done.

The attitude and behavior of workers and management can be changed with small effort of conducting awareness program to make them more responsible. There are many cases when workers significantly changed their attitude in waste minimization and controlling pollution in production process after the awareness program was conducted.

CHAPTER V

POLLUTION REDUCTION

This chapter deals mainly analysis part with recommendation for improvement of the pollution caused by the attitude of the working people. The concepts and tools used during the study period are also discussed here. The training and awareness program conducted to change the attitude toward the protection of environment and safety of the working people are also emphasized here. The improvement result after the awareness and training and intervention program conducted in the industries are presented here. However, some results and experiences of my last 15 years study in this field are also taken in consideration to discuss.

The following concepts and tools have been used during the discussion, training and awareness program to change the attitude of the working people toward the reduction of pollution.

Good House Keeping (5S) and Kaizen 5S

Good Housekeeping (5S):

This is Japanese Concept developed for Good Housekeeping. This is productivity concept too. 5S is derived from the five first letters of Japanese words: Seiri, Seiton, Seiso, Seiketsu and Shitsuke which are understood as follows:

Seiri (Sorting):

Seiri means sorting of materials available in the shop floor. All materials are divided into three categories. Sorting means organizing the items as important or frequently used items, not frequently used items and useless items or items that are not need as of now. Important items should be kept for use nearby and items that are not to be used in near future should be stored in storeroom and useless items should be discarded or removed from the shop floor.

Seiton (Systematic Arrangement)

After discarding useless items, the remaining items (frequently used and not frequently used items) should be arranged for the most efficient and effective retrieval. There should be a specific place for everything and everything should be always placed in its own place. The place for each item should be clearly labeled or demarcated. Items should be arranged in a manner that promotes efficient workflow, with equipment used most often being the most easily accessible. Workers should not have to bend repetitively to access materials.

Seiso (*Shining/Cleaning*):

This involves cleaning the work place. After the first thorough cleaning when implementing 5S, daily follow-up cleaning is necessary in order to sustain this improvement. It also takes care of the inspection required of the work place to make sure everything is as desired.

Seiketsu (*Standardizing):*

Work practices should be consistent and standardized. Work stations for a particular job should be identical. All employees doing the same job should be able to work in any station with the same tools that are in the same location in every station. Everyone should know exactly their responsibilities.

Shitsuke (*Self Discipline)*:

Once the previous 4 S's have been established, they become new way to operate. Considering 5S as a way of life and bring about self-discipline among the employees of the organization. This includes wearing badges, following work procedures, punctuality, dedication to the organization etc.

5S implementation contributes significantly to occupational safety and health and also ties in to cleanup in the vicinity of the plants and other environmental activities. The 5S can be diagrametically interpreted as in figure 17 given below:

Figure 17 Concepts of 5S

Adopted from Takasago's domestic group companies

Kaizen: Kaizen (Ky ‘zen):

It is a Japanese term that means continuous improvement, taken from words 'Kai', which means continuous and 'zen' which means improvement or it is also translated as Kai means "Change and Zen means "Good" or literally “to change and make good”. Basically kaizen is for small improvements, but carried out on a continual basis and involve all people in the organization. The principle behind this concept is that “a very large number of small improvements are more effective in an organizational environment than a few improvements of large value. This pillar is aimed at reducing losses in the workplace that affect our efficiencies. By using a detailed and thorough procedure we eliminate losses in a systematic method using various Kaizen tools. These activities are not limited to production areas and can be implemented in administrative areas as well.

By applying Kaizen concept or working with kaizen mind, not a day should go by without some kind of improvement being made somewhere in the company. Every day at least one improvement should be implemented.

Kaizen is a system that involves every employee - from upper management to the cleaning crew. Everyone is encouraged to come up with small improvement suggestions on a regular basis.

The Main elements of Kaizen Include

- Teamwork
- Personal discipline
- Improved morale
- Quality circles
- Suggestions for improvement

Western philosophy may be summarized as, "if it is n't broke, don't fix it." The Kaizen philosophy is to "do it better, make it better, and improve it, even if it isn't broken, because if we don't, we can't compete with those who do"(John Parker, 2012).

During the interview with working people of the industries under observation study, they were asked about the housekeeping system and role of good housekeeping in pollution reduction. The workers did not know about the 5S and Kaizen concepts. However they know that bad housekeeping makes more waste generation leading to pollution. They said that the housekeeping is very important activity for reduction of pollution generated. More broken items, damaged products, date expired materials, seepage, leakage etc are the main causes of bad housekeeping. And the management said that to start with small improvement in store and materials handling practice without any expenses is the best options for reducing the pollution.

Good housekeeping is the one of the best options for reducing the pollution through control of waste, seepage, leakage and damaged materials. Good housekeeping options are low cost or no cost option. So Japanese 5S concept is very much applicable to Nepalese industries especially for small scale, where technology used is not modern and process is traditional, investment for environment protection is not possible and man power are not qualified. Good housekeeping is one the best techniques of Cleaner Production too. During my assessment in the industries, 5S concept has been given to all industries. The industries got some saving of materials, labour time and safety to workers through implementation of Good Housekeeping concept. The saving of materials, time and provide safety and good working condition to workers means the reduction of pollution.

Kaizen means continuous small improvement. Small improvement daily is the challenge for big improvement. Kaizen is based on making little changes on a regular basis: always improving productivity, safety and effectiveness while reducing waste. 5S and kaizen are implemented side by side. Kaizen starts from Good Housekeeping and Good Housekeeping is started with Kaizen. One example of improvement in industry after Good Housekeeping is as shown in picture below:

Bad Housekeeping

Good Housekeeping after improvement

After Good Housekeeping and Kaizen, there was reduction of material spillage and damaged materials which gave financial benefit from materials saving and protection of environment from not sending spilled chemicals and dyes to environment. The implementation of this option was mainly due to change of the attitude of the working people toward good housekeeping. After implementation of this option (improvement of the housekeeping) the working people felt easy in the working and safety in handling the chemicals and other materials leading to less waste and pollution. Thus, 5S and Kaizen practice is one of the techniques of Cleaner Production and it helps to reduce the pollution

Production Management

Production:

The meaning of production is defined by different person in different way. Business Dictionery.com defines the production as the processes and methods employed to transform tangible inputs (raw materials, semi finished goods, or

subassemblies) and intangible inputs (ideas, information, knowledge) into goods or services.

The satisfaction of needs originates from the use of the commodities which are produced. According to *Green Facts* the production is the process of creating, growing, manufacturing, or improving goods and services. It also refers to the quantity produced.

In general Production refers to the volume, value or quantity of goods and services produced by a worker, plant, firm or economy. It is the sum of total of the results achieved by the various factors together.

Productivity:

Productivity, on the other hand, is concerned not merely with the total value or volume of output of product, what is more important is that it shows us the efficiency of the production. In fact Productivity refers to the quality of production. The clear definition of Productivity is the ratio of output to aggregate inputs. As per the International Labour Organization (ILO), the output and aggregation input, if done in monitory terms, gives the exact value of productivity.

Productivity is a measure of the efficiency of production. Productivity is a ratio of production output to what is required to produce it (inputs). The measure of productivity is defined as a total output per one unit of a total input.

The Production and Productivity can be differentiated as follows: Productivity is a concept, whereas production is a fact. Production is achieved by means of resources; productivity is measured through means of maximum manpower, machinery, and financial support.

Production is a variable, dependent on many factors such as labour availability, motive power, etc. Whereas productivity is the optimum measure of what or how much can be achieved or realized. (Devanil, 2009)

During the process of interviews to workers and management and discussion with them during observation, the workers even the management think that the increase in production means good operation of the industries and the business is going well. They added that they do not know about the productivity and its importance in evaluation of business status and they never calculate the Productivity. They calculate and keep the records of production only. The management further added that although now they know the difference between Production and Productivity, they are still not habituated on this.

This is one of main weaknesses of the industries that they do not understand the meaning of Productivity and its application in evaluating the efficiency of the Production. They emphasize only in the increase of production without considering inputs and its quantities and due to which waste has not been calculated and it has been discharged or emitted to environment as pollution. This is also one of the main causes of pollution caused by negative attitude toward waste generation. Cleaner Production gives the emphases on the understanding of Productivity. In the process of implementation of Cleaner Production, the material balance of production is done considering all inputs and out puts including waste and emission. Higher the waste generation indicates the lesser the productivity.

Now, the industries after training in Cleaner Production started to precede the Material Balance of the production calculating the outputs in respect to input. And it gave them higher the overall productivity through less waste leading to less pollution. So it is very much necessary to develop the attitude toward productivity calculation

Production Management

Production Management is also called operations management, planning and control of industrial processes to ensure that they move smoothly at the required level. In manufacturing operations, production management includes responsibility for product and process design, planning and control issues involving capacity and

quality, and organization and supervision of the workforce processes to ensure smooth and efficient operation. Production management's responsibilities are summarized by the "five M's": Men, Machines, Methods, Materials, and Money Production management (*Encyclopedia Britannica,* 2012).

During the intervention and observation in the production process, it was noticed that the worker and even the management of small industries do not know anything about production management. They know only about the requirement of machine, materials, man and money to produce the desired product.

Yes, it is true that according to production management theory, "five M's" are required to be considered for streamlining the production process. However, this study and my long year of experience in this field revealed that only that "five M's" along cannot streamline the production process smoothly and efficiently. Although the five M's capture the essence of the major tasks of production management, it is not sure to the management for efficient production. To streamline the production smoothly and efficiently, another one "M" is to be considered. This is very important "M" that regulates to all other remaining "M's". I named this "M" as *Mentality*. The *Mentality* is the most important factor that should be considered in the production process to produce the goods as we desire in most efficient way. Even we have good Machine, better Method, best Materials, Skilled Man and a lot of Money, if the Mentality of the working people is not positive toward improvement and waste reduction, the production cannot be efficient and effective. To reduce the waste leading to pollution, Mentality is the most important factor to be considered by the industries.

By implementing this concept, the industries are reducing the waste, improving the overall productivity of the industries. Seepage and leakage of the water and materials have been controlled and breakage of materials during packaging and handling are reduced. The risk of accident in the shop floor is reduced due to improvement in the working condition.

Cleaner Production

Cleaner Production is the main concept used in this research for reducing the pollution through Attitude Change of the working people of the industries. Cleaner Production is self-developing, self-motivating concept used by the industries voluntarily. The Cleaner Production (CP) concept was introduced in Nepal for the first time in 1997. The credit for this goes to the project named "Industrial Pollution Control Management" (IPCM) implemented by Ministry of Industry, Commerce and Supplies with assistance of UNIDO/UNDP. Cleaner Production component was incorporated in this project with the name of "HOPE" (**H**idden **O**pportunities for **P**roductivity & **E**nvironment. At that time a CP demonstration program was launched in 5 units of different sectors and various scale including small scales. Most of CP options generated are low and no cost. These options also provide substantial saving potentials. Since then, Ministry of Industry has taken initiation in promotion of Cleaner Production among the Nepalese industries. DANIDA Project from 2000-2005 enhanced the promotional activities of Cleaner Production by implementing in 332 industries of Nepal. Even after termination of DANIDA project, Ministry of Industry, Nepal has continued to promote Cleaner Production in Industries. Nepalese industries now have taken Cleaner Production as one of the major tools for overall productivity enhancement through waste minimization. Since 1997, I am associated with Cleaner Production activities in Nepal.

United Nations Environment Program(UNEP) has defined Cleaner Production (CP) as continuous application of an integrated preventive environmental strategy to processes, products and services to increase efficiency and to reduce risk to human and to environment.

For production processes, Cleaner Production includes conserving raw materials, water and energy, eliminating toxic raw materials, and reducing the quantity and toxicity of all emissions and wastes before they leave a process. For products, the strategy focuses on reducing impacts along the entire life cycle of the product, from raw material extraction to the ultimate disposal of the product.

Organizations achieve cleaner production by applying know-how, improving technology, and changing attitudes of the workers. *(UNEP, 1995)*

If we look back into the history of response to pollution from industries, we notice that the response has been changing over time. In the beginning, pollution was considered to be unavoidable with industrial production, thus, it was just *ignored*. When pollution levels in industrial centers became a great concern due to adverse impacts on health, industries were operated in dispersed ways so that the resulting pollution got *diluted* and the adverse impact was diminished. *Dilution is the solution to pollution* was a popular phrase. With further industrialization, dilution possibility was limited due to limitation and carrying capacity of the environmental media and infrastructure availability. The next response was to *treat* the generated waste to keep the pollution within tolerable limits. The treatment process, which is also known as the pollution control measure, is a costly affair. It increases the cost of production per unit. It often transformed the pollutants from one medium to another. Raising costs of treatments together with high level of competition in the global market led to change in the response from treatment to *source reduction* or *prevention of pollution* at the source itself. Various organizations like to call this approach by different names. United States Environment Protection Agency (USEPA) uses Pollution Prevention (PP or P2), United Nations Industrial Development Organization (UNIDO) called it Waste Minimization (WM), Asian Productivity Organization (APO) uses Green Productivity (GP) and United Nations Environment Program (UNEP) calls it Cleaner Production (CP) (*ESPS, 2004)*

In any industrial production process, one or more inputs are processed to produce desired output or product. Most processes, in course of the conversion process, generate some waste. The general process of conversion is diagrammatically presented in figure 18 below (*ESPS, 2004)*:

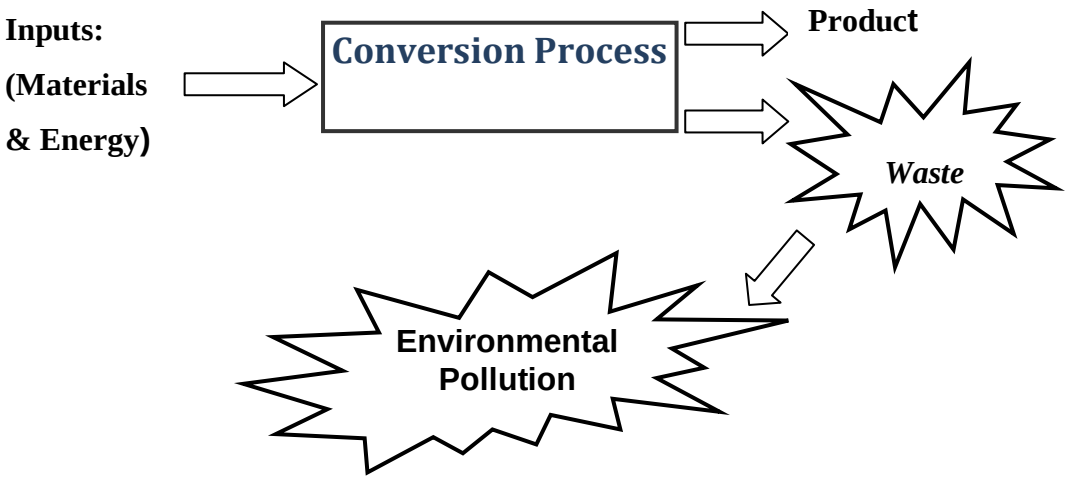


Figure 18 Material Conversion Process

This waste generated during the production process is responsible for environmental pollution. It may be in the form of discharge to water body, emission to air or in the form of solid waste deposited in soil or land*(ESPS, 2004)*..

In any industrial production process, one or more inputs (Raw materials, energy, water etc.) are processed to produce desired output or product. Most processes, in course of the conversion process, generate wastes and create hazardous environment. These wastes and hazardous environment are responsible for environmental pollution and threat to safety and health of workers

The key difference between pollution control and Cleaner Production is one of timings. Pollution control is an after-the-event, 'react and treat' approach, whereas Cleaner Production reflects a proactive before pollution generated, 'anticipate and prevent' philosophy. Prevention is always better than cure. It is important to stress that Cleaner Production is about attitude as well as technological change. In many cases, the most significant Cleaner Production benefits can be gained through lateral thinking, without adopting technological solutions. A change in attitude on the part of company directors, managers and employees is crucial to gain the most from Cleaner Production (UNEP, 1994). Cleaner production is not only about changing raw

materials, processes and products, it is also about changing corporate culture and the attitudes of working people (Stone L, 2000)

Techniques of Cleaner Production

Cleaner Production is implemented applying five following Techniques:

Cleaner Production may be applied to industries by exploring and analyzing any or combination of the following five techniques. The examples of the techniques are illustrated in figure 19 below:

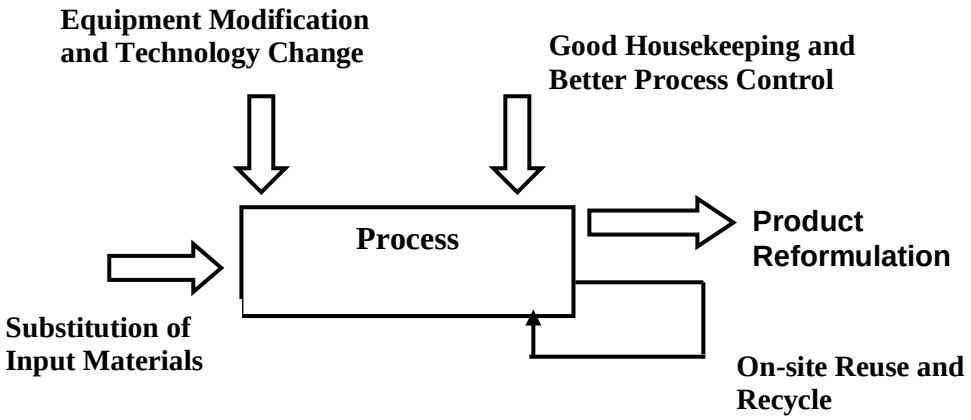


Figure 19 Five techniques of CP implementation

The description of five techniques used in wollen yarn dyeing industrie under this research is given below:

1. **Good Housekeeping and Better Process Control:**

- Reduction or avoidance of loss due to leakage and spills of chemical and dyes.
- Improvement of material handling to reduce spills
- Closing of taps and turning off electricity when not used
- Maintaining process parameters such as temperature, pressure etc. at desired or recommended level (steam pressure, temperature in the dyeing cabinet)
- Reduction of cleaning waste by appropriate batch size
- Improving inventory management to avoid spoilage/ deterioration

- Improving maintenance practice to avoid shutdown loss and higher consumption of inputs
- Use of processing chemicals more optimally
- Training of operators in process control.

2. Substitution of Input Materials:

- Elimination or reduction in the use of hazardous raw material such as heavy metal hazardous dyes. Replacement of chlorine bleaching with oxygen bleaching
- Use of purer or high quality raw material to avoid rejection
- Use of cleaner fuel
- Use of high absorption dyes

3. On-site Recycle and Reuse:

- Recycling of cooling and process water and other materials wherever possible
- Recovery and recycling of steam condensate
- Reuse of spent dye liquor
- Recovery of heat to minimize loss of energy

4. Equipment Modifications and Technology Change:

- Modification of equipment to improve efficiency (installation of thermostat);
- Installing measuring and process control devices/ instruments (temperature, pressure gauges)
- Installing more efficient motors
- Changing equipment or layout to improve material flow and to increase efficiency
- Use of equipment equipped with better process control.

5. Product Reformulation and Useful By-product:

- Converting wastes into useful by-product
- Increasing product life
- Reformulating product to reduce waste
- Eliminating unnecessary packaging.(ESPS, 2005)

Cleaner Production Implementation Methodology

UNEP suggests following five phases and 20 steps methodology for implementation of Cleaner Production**.**

I. Planning and Organizing Phase

Step 1 - Management Commitment

Step 2 - Project Team Set up

Step 3 - Establishing Goals

Step 4 - Identification of Barriers and Solutions

II. Process Review Phase

Step 5 - Development of Flow Charts

Step 6 - Evaluation of Inputs and Outputs

Step 7 - Selection of Areas to be investigated

III. Assessment Phase

Step 8 - Material Balance

Step 9 - Cause Analysis

Step 10 - Generation of Options

Step 11 - Screening of Options

IV. Feasibility Study Phase

Step 12 - Preliminary Evaluation

Step 13 - Technical Evaluation

Step 14 - Financial Evaluation

Step 15 - Environmental Evaluation

Step 16 - Selection of Options

V. Implementation Phase

Step 17 - Preparation of a CP Action Plan

Step 18 - Implementation of CP Options

Step 19 - Monitoring and Evaluation

Step 20 - Sustaining CP Activities

Barriers

Some of the common barriers encountered in the assessment and implementation of CP in a manufacturing enterprise are enumerated below:

A. Attitudinal Barrier

- Resistance to change
- Negative perception e.g. "Does not work".
- Tired e.g. "We tried a lot."
- Lack of incentives and motivation
- Fear of failure

B. Inadequate Information

The cleaner production assessment needs various types of information like consumption of raw materials, water, energy; generation of wastes etc. Lack of such information and also on quantities and composition of wastes and emissions etc. may slow down the process.

C. Organizational Barrier

The organization barrier includes allocation of human resources, lack of cooperation and coordination between individual and departments.

D. Economic Barriers

The financial position and the economic/ financial policy of the company may sometimes become barriers for cleaner production.

E. Technical Barriers

Lack of technology & technical expertise and inadequate equipment may affect the cleaner production assessment and implementation. (*Participant's Work book and Source Book, IEM, ESPS, 2004)*

During the observation of production process, store management and working practices of the woolen yarn dyeing industries under this research, the working people generally said that they are working well and the waste generated during the production is normal. They don't like to seek for advice and suggestion for further improvement. They were very resistance to change. They are habituated to work as usual and suggestion from the management is not acceptable to them. During interviews, most of respondents told that they were aware about cleaner production (CP) concept. Workers who got training on cleaner production are now little positive attitude toward cleaner production and they expressed willingness to follow the cleaner production during working. The persons without CP training were explained briefly about the cleaner production and its benefits. After small explanation about the cleaner production and its benefits to employees and society, they agreed that they would follow the cleaner production methods citing its importance to implement the idea on daily basis. Most of the management level employees of the industries have been already trained in cleaner production. They explained the significance of cleaner production concept which should be implemented by all industries to reduce the waste and pollution. Management could not implement cleaner productions as required due to some constraints from the workers side. According to them workers are very rigid and undisciplined. They don't follow the instruction and code of practices. They added that to change their attitude toward the waste minimization, an awareness program from the outside consultant should be conducted for them regularly.

My experience and research in this field revealed that Cleaner Production can be applied in all kinds of manufacturing industries by exploring and analyzing any or combination of the following five CP techniques mentioned above. Cleaner Production is equally applicable even in household kitchen. The employees and even the management at first did not understand the Cleaner Production Concept and they have hegisted to implement Cleaner Production. They mentioned their various constraints like lack of fund, small industry and not available appropriate manpower in implementation of Cleaner Production concept. Generally they reply like that:

- We will discuss later
- Inform you later
- We have another problem
- Can you solve labour and electricity problems?
- Now business is not good
- It's good to talk about but won't work in practice.
- We don't have the time for this.
- Has anyone done this before?
- We do not have any suitable person for training
- What is wrong with the present system?
- We are already doing this
- You don't understand the problem.
- Talk to someone else. This is not my field.
- We are too big/too small for this.

Implementation of Cleaner Production

Cleaner Production has been implemented in the industries starting from Awareness Program followed by 3 phases of training. The duration of implementation of cleaner production depend on the size of industries and its requirement, and awareness program was conducted accordingly.

Environmental Awareness

Environmental awareness is defined as a combination of motivation, knowledge and skills (Partanen-Hertellet al. 1999). Alternatively, awareness can be viewed as the knowledge of causalities (Pongrácz, 1999). This knowledge has to be supported by will, information and abilities to behave in an environmentally friendly way. When the environmental awareness of an individual is combined with external stimulating physical and practical conditions, the result can be a desire and will to make environmentally friendly choices. It can be illustrated as stated in figure 20 below:

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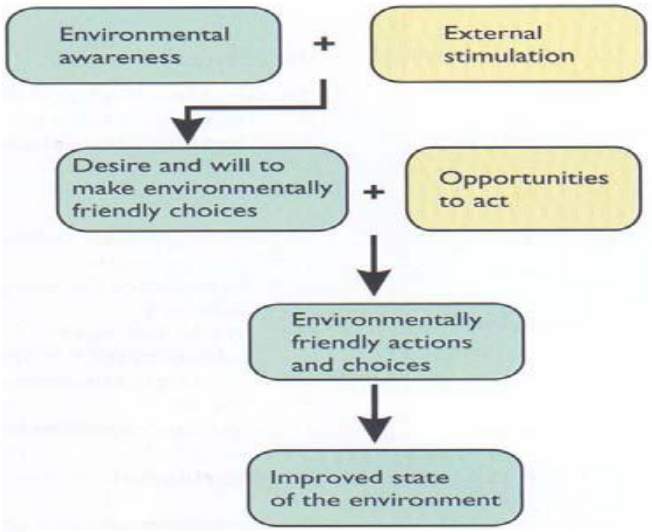

Figure 20. Environmental Awareness in Practice

(Partanen-Hertell *et al.*, 1999)

People start to know more and are aware about environment, when they feel the threatening from the surroundings and it cannot be controlled easily. Environmental awareness is further stimulated when they realize that environmental damages need a long time to recover. Partanen-Hertell*etalii* (1999) created a model that illustrates the development of environmental awareness. It is based upon research conducted as a part of a project that aimed to raise environmental awareness in Baltic Sea area. In that research study, the environmental awareness model is as shown in the figure 21 below:

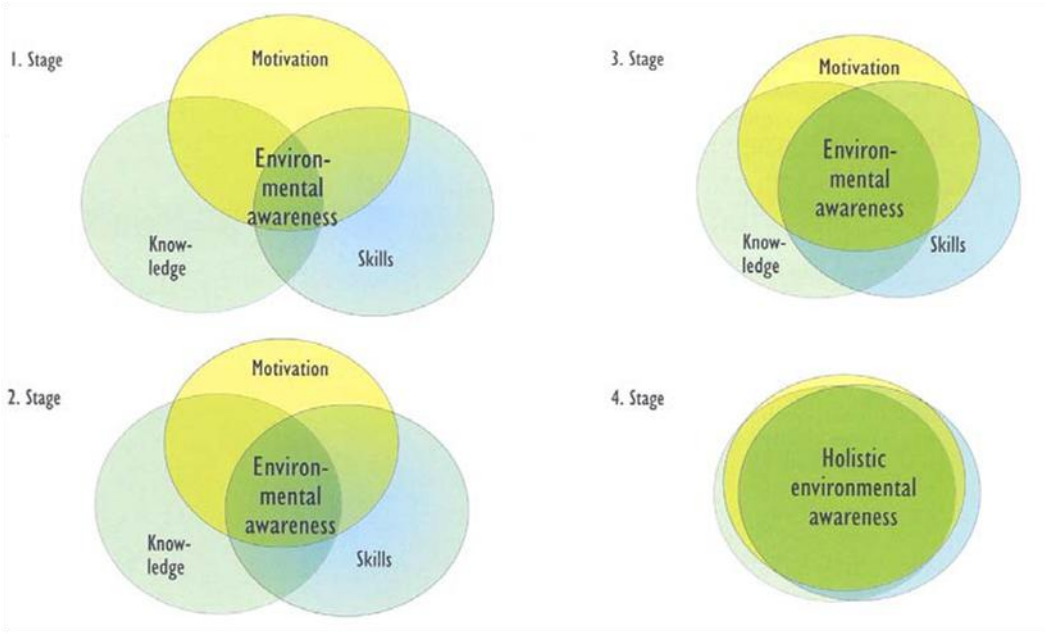

Figure 21 Environmental Awareness Model

Adopted from: (Partanen-Hertellet al., 1999)

In the first stage of environmental awareness, motivation for increasing the level of knowledge and skills is usually based on a growing concern over threats to health. Even though people and organizations think that the state of the environment should be improved, they do not see themselves as active actors in this process. They consider that somebody else, for instance scientists, environmental non-governmental organizations or international organizations should focus on, or solve environmental problems. In countries where environmental awareness is close to this stage, the first step in raising its level is to educate and train the most influential politicians, administrators, academics and business decision-makers *(Paranen-Hertell et al 1999)*

In the second stage of environmental awareness, basic environmental legislation and administrative structures are already functioning in the society. Also the foundations of environmental monitoring systems have been created. Facilities, systems and relevant technologies for pollution prevention are increasingly utilized. Nevertheless, the separate environmental protection measures do not support each other to have a positive synergy at this stage. The activities to raise environmental

awareness are targeted to the whole society. They start from the groups that influence the state of the environment the most (Ibid.).

In the third stage, motivation, knowledge and skills are in a growing synergy when increasing environmental awareness. Environmental matters become part of professional and public awareness. Raising environmental awareness supports the development towards sustainability. The driving force of the society changes from the growing production and economy towards a steady sustainable welfare. The aim is also to integrate environmental awareness as an inseparable part of general awareness of an individual (Partanen-Hertell et al. 1999).

In the fourth stage, environmental awareness becomes an integral part of professional skills and everyday life choices. Motivation, knowledge and skills build up an environmental awareness that has developed to a holistic one. The environment is not perceived from a human-centric point of view anymore, but it is also realized to have value as such. Therefore, the environment is no longer considered to belong to mankind, which in the earlier stages resulted in an excessive consumption of natural resources. (*Kristina Olgyaiová et.al, 2005, pp 2-3)*

As per the interview with workers and observation in production process and its operation, the working people said that they need awareness and training program on various concept and tools so that they are motivated to work minimizing the waste leading to less pollution. The working people are needed to aware about the importance of environment and natural resources regularly.

The working people in the industries especially in cottage and small industries are not well educated. They do not have any exposure to external world except their own industry. Most of labors in Nepal are politically affiliated and guided by political ideologies. They do not even think that they could minimize the waste leading to reduction of the pollution to environment and human health. The working people in the woolen yarn dyeing industries are also of same standard and condition. So, before starting Cleaner Production activities in industries, awareness on attitude change of

the working people is very essential, otherwise the activities could not be implemented. During the awareness program, I focused on the following matters:

a. Safety and Health during the work in the shop floor is our main concerned
b. Knowledge and thinking gained from the awareness program is equally applicable in the household activities too.
c. Saving of resources gives the economical benefits to working people too.
d. Pollution to environment and human health is the sin
e. Waste minimization and pollution control is the ethic of human being

Conducting Awareness Programme:

During the interviews and questionnaire filling from 20 workers and operator and supervisors of woolen yarn dyeing industries, almost all workers mentioned the need of regular awareness program and training. Awareness program have brought positive changes amongst workers and this type of program should be continued. At the same time they expected some motivational scheme to be initiated by the management. The management of the industries has felt the need of regular awareness program for all level of workers. The management level people further added that they are providing some incentives and bonus as a motivation toward better work.

Regarding the attitude index, the questionnaires filled by almost all research participants strongly agreed that the awareness program should be organized for them regularly. The awareness program on Cleaner Production on the context of attitude change can change their attitude toward the pollution reduction through waste minimization in the shop floor.

Awareness followed by motivational scheme has been proved as one of the best approaches to change the attitude of the working people toward reduction of pollution. As a working definition, *Motivation is the driving force that causes an individual to act in order to achieve a specific goal,* (Olgyaiová 2005)

According to Maslow's Hierarchy's Need, workers' first need of food, clothing and accommodation should be fulfilled. Motives are far more effective in motivation than stimuli, because their influence is natural and long lasting *(Olgyaiová 2005).*Their second need is Safety and Health during the working in the shop floor. Considering these needs of the working people, I conducted the awareness program first to top management. The awareness program for top management is conducted in the form of the face to face meeting. It is named as Management Commitment Meeting. Because they do not prefer to sit in the class room and listen lecture together with their subordinates. I have told them the main objective of the Cleaner Production is the sustainable development of the industry enhancing overall productivity through waste minimizing and creating better working environment to workers. I explained them about the outcomes and importance of motivational scheme in improving the overall productivity through waste minimization, which is very essential for reducing the pollution to environment and improving the working condition to workers. I have given them many examples of success cases of other industries and benefits they got. They accepted my suggestions and they have implemented some additional motivational scheme like awarding "Certificate of Appreciation" along with financial rewards to the best workers at the end of each fiscal year.

Immediately after awareness program to top management, I have organized the general awareness program for all employees of the industries starting from middle management to lowest class workers. The awareness program was conducted for about2-3 hours as shown in pictures below. The contents of the awareness program are as follow:

1. Inspiration from Lord Ganesh
2. Understanding of the waste
3. Why and how waste is generated
4. Who is responsible for waste generation
5. What to do keep shop floor always clean
6. Viewing of old woman and girl combined picture

7. Discipline, morality, ethic in working in the shop floor
8. Never say I am only right
9. It is not necessary that the way you think and method you follow and work you performed should always be correct
10. Changing of our past practices to betterment
11. Better working practices to save environment and to save ourselves

Awareness to employees of wool dyeing industries

The awareness class consisted of exhibiting picture, cartoon, telling stories and experiences from other events. Awareness class which was about 2-3 hours was able to bring positive changes in attitude of the employees towards the protection of environment through effective and efficient use of resources and producing less wastage. For example, the participants before the awareness class have said that waste is useless thing. However, the same participants at the end of the program have said that the waste is useful product and nothing is useless in the world. They have now understood that "*The waste is very much valuable resource, only it should be placed in the right place and in the hand of right person".*

To prove this statement I have taken the example of Cauliflower (Govi). I showed the picture of cauliflower of same size and quality to all participants. Then I ask them how much each participant could maximum utilize Cauliflower. Answer varied from people to people. Some said they could utilize up to fifty percent, some said sixty percent and few of them advocated their voice for hundred percent

utilization of Cauliflower. Then I started to analysis their answer in accordance to my question asked them first. The analysis is as follows:

Sixty percent utilizer used additional ten percent thrown by fifty percent utilizer, seventy percent utilizer used additional ten percent thrown by sixty percent utilizer and hundred percent utilize, in this way used whole cauliflower without any waste. It means that wastage thrown by anyone is not useless thing anymore. It is useful product. Wastage for one person can be resource for another. So anything in this world becomes valuable resource if it can be properly utilized.

As my experience I shared my knowledge and skills through stories, cases and quotation and gave them some example of industrial waste, which can be saved from being wastage if the workers work properly and handle carefully for proper utilization. At the end workers have been convinced that they start to say that the waste can be a useful product. Thus, they change their attitude about the understanding of waste. The picture of waste shown to participant proved that this waste is valuable resource at wrong place.

There is another case of neatness and cleanliness of our workplace. The workers agreed on this matter. Then I asked them what we have to do to keep our workplace always clean and safe. Different people answer differently. Some said that we have to clean daily; some said we have to put all litter or waste in proper place, and some said that we have to have all required tools and materials for cleaning and sweeping. Then I displayed a picture of good housekeeping depicting three categories: third class workplace, second class workplace and first class work place. Then I ask them that even though, so many efforts and human resource used, why couldn't the second class work place be of first class? Then I point out them toward one gentleman who was continuously throwing the waste paper haphazardly and two other workers who were picking up the litters made by him. However, the workplace could not be clean. So until and unless littering is there, the workplace cannot be clean regardless of whatever the preventive measures are taken. In this matter everybody agreed. Thus to keep our work place always clean and safe, there should

not be any spillage, leakage and other littering. The best outcome is *"No littering makes our workplace always clean and safe"*

During this awareness program, I used different kinds of pictures, stories and quotation and proverbs. I generally asked questions which deceived many of them, resulting participants to confess their activities were wrong and helping them to realize their working practice and changing their attitude. Thus they admit that they can reduce the unwanted waste materials which ultimately reduce the pollution in environment. All materials for awareness program are conceptualized and developed by myself. And some of them are given in the annex -1. The materials for this awareness program to change the attitude of the working people toward the reduction of waste leading to reduction of pollution are my own creation. It is all already proven awareness materials for this purpose. I have many successful cases; few of them are presented in last session of this chapter.

The awareness program has helped to change the attitude of the working people toward understanding of waste management. It has also helped working people to create safe and clean working condition. After the awareness programme, the industry has been able to save energy, reduce waste materials and improve the working condition.

The some pictorial awareness materials are given in Annex-1

Training on Cleaner Production

After awareness program for all employees of the woolen yarn dyeing industries under this research study, training on Cleaner Production (CP) was conducted for managers, middle management level employees, supervisor, operators and store in charge ,despatch supervisors and others as suggested by top management. CP team was formed representing all sections and branches. Three phases training on CP was conducted for them. Group training for CP teams of 8-10 industries of different sectors was also conducted. The duration of training was 2 days in each phase.

The main contents of training are Concept of Cleaner Production, Introduction to Productivity, Cleaner Production Techniques, Methodology of CP implementation, Success cases and quiz and documentaries. The training program on Cleaner Production was conducted immediately after awareness program. The main reason of conducting the training immediately after awareness program was to strengthen the positive attitude toward the reduction of pollution perceived from awareness. To give better understanding of the Cleaner Production toward the pollution reduction and safe and healthy working condition, mind teasing stories and small games were presented in between the classes. To make the CP concept easily understandable and entertainment, the training classes were conducted using real picture of events by two ways interaction program. The Active and Passive ratio of the training was maintained 2:1. The success cases presented during the training program really helped to give clear understanding of Cleaner Production and its proper application. After intervention including training program in the woolen yarn dyeing industries, the many options on improvement have been generated. The some of the improvement options are classified under the heading of five CP techniques as stated below:

1. Good Housekeeping/ Better Process Control (GHK/BPC)

- Stopping leakage and spill of chemicals, dyestuff and water
- Practice the preventive maintenance of machines/equipment
- Improve the materials handling and storage of chemicals and dyestuffs
- Develop and implement Good Standard Operating Practices
- Keep the containers of chemicals and dyestuffs closed
- Stop the idle running of machine and boiler
- Awareness and training to operators
- Maximize the use of day light by using translucent sheets.
- Make proper feeding of fuel to boiler etc.

2. Substitution of input materials (SIM)

- Use of quality dyestuff
- Use of formic acid instead of acetic acid
- Use of clean energy (Oil fired boiler instead of rice husk)

3. Equipment Modification and Technology Change (EM/TC)

- Use of float trap for condensate recovery
- Better insulation of steam pipe lines and boiler body
- Installation of process control equipment like thermometer and pH meter in machine

4. Onsite reuse/recycle

- Reuse of dye bath of lighter shade for darker shade
- Reuse of hot dye bath for heating of feed water
- Recovery of steam condensate

5. Product reformulation and useful by-product

- Make length of hank as per machine (dyeing cabin) height.
- Use of waste wool fibre for making small woolen items (felt item)

The training materials on Cleaner production are presented in Annex -2. However, the benefits in the form of win - win - win situation amongst the investor, working people and societies from the implementation of Cleaner Production Concept are presented as an awareness style in Annex-3.

Results

Attitude Change

This sub-section illustrates the change in attitude of working people of the participating industries over the intervention period with regards to waste generation, work safety and pollution issues. As discussed in previous section, prior to the intervention, workers were asked if they understood the meaning of waste and its importance in reducing the pollution, they thought that they were not responsible for the waste generation and pollution caused by the industry. However, after the awareness/training and intervention programme, the same worker has said that the waste could be utilized depicting the significance of reuse and recycle of wastage and taking responsibilities for pollution caused from industries. They started on saying that waste can be a valuable resource if properly utilized. It becomes useless only if the thing is at wrong place or in the hand of wrong person. At the same time they confessed that they are responsible for the waste and pollution generated by the industry. Thus their attitude and working behavior have been changed toward positive working practices leading to less waste and less pollution.

Questionnaires were developed and distributed among the research participants including directors of the dyeing industries under this research study. There were two types of research participant's i.e. participants who got training on Cleaner Production and involved in awareness program and other type of participants who had not got any form of such training and not involved in any awareness program. The research participants having undergone awareness program on Cleaner Production were very positive and strongly agreed that the pollution can be reduced through changing the attitude of the workers. The research participants without awareness program still could not understand the importance of waste and its reduction practices. However, they expected to have awareness program to change their attitude.

The result of waste water discharged from the Boudha Dyeing House (Research Participant) after the Cleaner Production with awareness program showed

that there was significant change in quality of wastewater discharged from industry. The waste water was much less polluted in comparison to previously discharged wastewater under the same condition. The pollution load is also reduced significantly. The result of waste water after improvement is given below in table 4: For detail refer Annex -4

Table 4: The analysis result of waste water discharged after CP intervention after 2nd improvement

Parameter	Unit	Tolerance limit mg/lil[1] Max	Concentration in the wastewater of (mg/l) Boudha Dyeing House		
			Previous Finding Before Improvement	After [3] 1st improvement	After [2] 2nd improvement
PH	-	5.5-9.0	4.5- 11.4	8.5	8.6
Total Suspended Solids	mg./lit	100 max	14-927	48	100
BOD	mg./lit	100max	138 - 600	185	-
COD	mg./lit	250 max	290-2,150	464	185.6
Oil & Grease	mg./lit	10 max	2 - 43	15.1	6.9
Total Chromium	mg/lit	2 max	0.024-0.17	0.09	<0,04
Sulphide	mg/lit	2 max	<0.2	<0.8	0.004
Phenolic compound	mg/lit	5 max	0.3 -0.42	<0.05	-

[1]Tolerance Limits for industrial effluents.
[2] Analysis result from Soil Test.
[3] Analysis result from Enpho.

Concluding Remarks

The awareness program together with some motivation scheme played positive role in controlling the waste generation and performing assigned task effectively and efficiently. Now the workers understood that their safety and health totally depends on them. The overall productivity can be enhanced through preventing the risk of hazard and accidents at the work place.

The results after awareness program, training on Cleaner Production, Intervention in the industries had shown significant positive impacts and changes. There were many improvements in saving raw materials, energy, manpower on one hand, on the other hand working people got safe and healthy working condition and pollution to environment was reduced in great extent. Till now, more than 300 industries have been already audited. Awareness program has been conducted in all these industries benefiting more than ten thousands employees. The result of awareness programming changing the attitude of the working people of the industries is very effective and practical too. Some successful cases from different other industries are presented below:

Case 1 Improvement of Dyeing Vat, Woolen Pashmina Dyeing Industry

Before the Cleaner Production Intervention

Small woolen yarn (Pashmina) industry produces various products using handloom. For dyeing purpose they use small aluminum pot openly as shown in the picture 1. The pot is filled with water containing chemicals and dyestuff. Grey Pashimina products are dipped into the pot containing chemical mixed water and dyestuff. Aluminum pot is then slowly heated until water is boiled and stirred regularly up and down for some time so that product was dyed well. Liquidfied Petroleum Gas (LPG) was used for heating purpose. But there were many weakness & losses in this production process. Being open type stove there was high risk of burn and turn down of vat filled with boiled chemical mixed water spiling all chemical mixed water as shown in the Picture 1 and this wastewater has been discharged to environment creating pollution and health hazards to environment. At the same time there was high consumption of LPG energy

Picture 1

Cleaner Production Intervention:

Awareness program on Attitude and Behavior change regarding operating practices, understanding of waste and pollution, waste generation and minimization practices was conducted for the operators and workers of the industry. Walkthrough visit was made and group training and focused group discussion and interaction on Cleaner Production among the working people was conducted.

After Cleaner Production Intervention:

The LPG stove was encapsulated by brick and mud and put dyeing vat under iron frame sothat it became stable and that there is no fear of fal down of vat during the stirring as shown in the picture (2). It saves water and chemicals and reduces possible pollution to environment. When stove was encapsulated, there was no more risk of burn and heat stress. It gave 25% efficiency in fuel (LPG) consumption too. The total expense was only NRs 500 for encapsulation of stove. It does not have any other operating expenses

Picture 2

Case 2: Reduction of use of acetic acid, woolen yarn dyeing industry

One carpet yarn dyeing industry has to use acetic acid in dyeing process. Dyeing is done in a dyeing cabinet of different sizes. The dyed yarns are used for making hand knotted carpet. At that time the production capacity of the industry was around 233,200 kg/annum.

Before Cleaner Production

The industry did not have any measuring cylinder and correct weighing scale for measuring chemicals and dyestuff. The workers were not aware of spillage and leakage of chemicals. Storing of chemicals was no good. There was no any record of chemicals used and waste. The industry had only record of annual purchased quantity. The acetic acid consumption for 50 kg batch was 0.325 kg and generally they have to re-dye for 20% production. Purchased record showed that the annual consumption of Acetic acid was 6238kg.

Cleaner Production Intervention:

Awareness programon attitude and behavior change regarding operating practices, understanding of waste, pollution and causes of pollution etc was conducted for the operators and workers of the industry. Walkthrough visit was made and group training and discussion and interaction on cleaner production among the working people was conducted.

After Cleaner Production

Measuring Cylinder, storing vessel with cover and stopcock and correct weighing scale were managed. Workers started to measure correctly and there was less spillage and leakage. Good housekeeping in the store was done. Then annual consumption of acetic acid was only about 2000 kg including extra consumption for 20 % re-dyeing and some spillage. Saving of acetic acid was =6238-2000 = 4,238 kg. Consequently the pollution was reduced by 30% in overall. Saving is mainly due to proper record keeping, less spillage and leakage and proper handling of chemicals during storing and carrying.

Case 3: Good housekeeping in store, Plasticware manufacturing Industry

One Plastic industry producing plastic household's items is operating since last 25 years. It is well established industry adopting latest machineryequipment and modern technologies. Its daily production was about 1MT of various plasticwares for household's uses.

Before CP Intervention

Although the production is regular and business performance is quite appreciable, its housekeeping was not so satisfactory. The plastic products are soft and can easily bend. However, it cannot bear high pressure. The storing of plastic goods in store was very haphazard. There were about ten percent damaged products, which gives the additional cost to the industry due to need of its recycling. At the same time it gives pollution to the environment as it produces fumes during its processing.

Cleaner Production Intervention:

Awareness program on attitude and behavior change regarding operating practices, good housekeeping 5S (Japanese Concept), understanding of waste and pollution and Causes of pollution and its adverse impact to human and environment etc. was conducted for the operators and workers of the industry.

After Cleaner Production Intervention

The employees after awareness program realized that they are responsible for pollution caused. So, they started to work on good housekeeping practices. They stored the products according to types and sizes of the products so that they are not damaged and at the same time the required productscan be found easily at lowest possible time, which helped to enhance the productivity and reduce the mission pollution to environment.

Case 4: Reduction of Redyeing, Woolen Yarn Dyeing Industry

Redyeing (to repeat the dyeing) for woolen yarn dyeing industries is normal phenomena. Dyeing of woolen yarn consumes a lot of chemicals and dyestuff along with water. Dyeing process also needs the steam which is produced from boiler used ricehusk as fuel. Burningof fuel emits smoke and ash to environment. Redyeing consumes additional chemicals and dyestuff and water and fuel, which all are discharged to environment directly after use.

Picture 1

Before Cleaner Production

The industry did not have any record and controlling mechanisms to reduce the re-dyeing. The lay - out of the plant and machineries was not proper, housekeeping was very bad as shown in the picture 1. Dosing was not done with accurate weighing. Sample preparation was not serious. The industry had to do normally 20% more re-dyeing using 20% more chemicals, water, dyestuff & fuel. Consequently they are polluting environment 20% more.

Picture 2

Cleaner Production Intervention:

Awareness on attitude and behavior change regarding operating practices, good housekeeping (5S), understanding of waste and pollution and causes of pollution and its adverse impact to human being and environment was conducted for the operators and worker of the industry.

After Cleaner Production

The industry itself relocated to open area having wide shop floor. Housekeeping was done properly. Working people were made aware of spillage and leakage. Dosing was made proper and sample dyeing was done correctly. The re dyeing now is reduced by 10% and pollution was also reduced by 10% accordingly.

Case 5: Use of Manual Stainless Steel cream filling machine instead of paper

One small scale bakery industry produces different kinds of bakery. Its annual production capacities were just about 100 MT. The bakery products were baked in traditional oven made of mud and brick. Fire wood was used as fuel.

Before Cleaner Production

The industry uses waste newspaper for filling the cream to roll manually as shown in figure. Daily 50 pieces of papers cone were used for filling the cream to bakery. But from the use of waste newspaper, there were problems of unhygienic and possibility of contamination of food and at the same time there was solid waste (newspaper) as shown in picture. There was 600 kgs paper solid waste along with cream and 450 kgs of cream was wasted.

Cleaner Production Intervention

Awareness programon attitude change and better operating practices and training on Cleaner Production was conducted for all working people of the industry. Interaction and Brainstorming programwas organized too.

After Cleaner Production

Introduction of manual and paddling type cream filling equipment made of stainless steel as shown in picture was made. Now there is no any paper solid waste and cream waste. The saving from no waste of cream was about NRs 26,250/- and investment for purchase of filling equipment was only NRs 25,000/-. At the same time there was reduction of pollution of 600kgs of cream contaminated paper.

Case 6: Change of stove design

Small scale bakery industry is producing bread, cake, doonut and others. The furnace used for baking the bread/bakery is traditional type, and fire wood is used as fuel. Doonut is normally fried in traditional stove.

Before Cleaner Production

The industry was producing doonut using traditional stove. The industry used to produce 60 kgs doonut daily and 40 kgs fire wood was consumed for cooking the doonut. Stove used for cooking the doonut was open type as shown in the picture 1. Being open type stove, a lot of heat loss was observed and thus fire wood consumption was not efficient. At the same time lots of smoke has been emitted polluting environment and human health.

Picture 1

Cleaner Production Intervention

Awareness programon attitude change and better operating practices and training on Cleaner Production was conducted for all working people of the industry. Interaction and brainstorming programamongst the management and consultants was organized.

After Cleaner Production

After the awareness programand training on Cleaner Production, management was so convinced that they are ready to make new improved stove for cooking doonut and other bakery products. So, new improved stove as shown in picture 2 was constructed and used for cooking the doonut. The consumption of fire wood in this stove was only 25 kgs per day for the same quantity of doonut to be cooked. The fuel saving was 15 kgs i.e 37%. The pollution to environment and human health was also reduced by 37% accordingly.

Picture 2

Case 7: Use of airtight lid in cooking lokta used for Nepali paper making

Handmade paper is one of the exportable products of Nepal. Nepali handmade paper is made from fibers named Lokta. One Small scale handmade paper industry uses lokta to make Nepali paper. The industry normally consumes 30 kg lokta daily.

Before Cleaner Production

Before making paper, Lokta is soaked in water for 24 hours, then it is sorted and cooked with water. Ten percent caustic is added to cook the Lokta quickly. After cooking Lokta becomes soft. Then it is beaten in a beater to make soft pulp which is poured on a wooden screen frame and dried in sun. Thus Nepali paper is made.
At present the industry is using open thin drum to cook the lokta. Either fire wood or kerosene is used as fuel for cooking Lokta. Being open vat without any lid, the evaporation of water was high and consequently the more water was needed to keep the lokta under water, resulting more time required for cooking.The duration of cooking was 4 hours and consumption of kerosene was 4 litre/ 10 kg batch. 1 kg Caustic was added per batch.

Cleaner Production Intervention

Awareness program on attitude change and better operating practices and training on Cleaner Production was conducted for all working people of the industry. Interaction and brainstorming program among the management and consultants was organized.

After Cleaner Production

The lid made of drum part itself was put over the cooking drum and made airtight using some rubber gasket. Now the cooking time was reduced to 3 hours and kerosene consumption was only 3 liters/batch (25% reduction). The caustic was also reduced by fifty percent i.e. only 0.5 kg was enough for the same batch. The caustic mixed water pollutes the environment. By reducing caustic consumption, the pollution was also reduced accordingly. The 25% fuel reduction means reduction of flue gas emission to environment by 25 %.

Case 8: Reuse of wastewater from washing of distemper (paint) vessel

Medium scale paint industry is producing all grades of Enamel, Primers, Distemper, Cement paint, Emulsion. Although paint industry does not generate much waste water, some waste water is generated from washing process of paint vessels. Having many shades of paints required, varieties of containers are also needed to process them.

<u>Before Cleaner Production</u>

Distemper is one of the main productions in this industry. Mostly white shades of distemper are produced. The workers normally wash the vesselof distemper after each production and discharge the wastewater directly to drain.Wastewater generated from washing of containers contains high COD about 6,000 mg/l (1.2 MT) . And 198 Cu. m. waste water was generated per annum, which had been discharged directly to drain polluting the surface water.

<u>Cleaner Production Program</u>

Awareness programfor all employees of the industry was conducted. Group Discussion on pollution was organized and working practices were observed together with workers.

<u>After Cleaner Production</u>

Working people became convinced and attitude was changed toward waste minimization and pollution prevention. Now all containers used for water based paints are washed with Demineralized water and this washed water is not discharged to drain. But it is reused for making the same kinds of paints again. By doing this, annual saving of water was 45 cu. m./yr (22%) and COD load was also reduced by 22%.

Case 9: Use of Formic Acid instead of Acetic Acid.

Woolen Carpet is one of the main export items of Nepal. This sector is providing high employment too. But the yarn used for carpet knitting has to be dyed to make colorful and beautiful carpet. Dyeing process generates high volume of chemical mixed waste water which pollutes the environment. A dyeing industry produces the dyed woolen yarn at average 1MT/day and generates waste water about 40,000 lits/day

Before Cleaner Production

The industry used Acetic acid in dyeing process. Woolen yarn is usually dyed in acidic medium. Previously considering all losses including re dyeing, acetic acid consumption was 2730 kg for dyeing 152 MT woolen yarn. COD load to environment was 2730 kg as 1 kg Acetic acid gives 1 kg COD.

Cleaner Production Intervention

Awareness program on attitude change and better operating practices and training on Cleaner Production was conducted for all working people of the industry. Interaction and brainstorming program among the management and consultants was organized. The trial use of Formic acid instead of acetic acid was done. The quantity of formic acid was 3 times lesser than the acetic acid used.

After Cleaner Production

Trial was success. It was better for darker shade. The consumption of formic acid was three times lower than the use of acetic acid. So, it reduces the COD to environment by three times. Being strong acid, it is advised to dilute the formic acid by 3 times before storing and using for safe handling and to make it equivalent to acetic acid in dosing.

Case 10: Insulation of Boiler and Steam Lines

Large scale pulp and paper mill produce printing and writing paper and craft paper. Its annual production is generally 5,000MT. Its main raw materials are waste paper, straw dust. It uses rice husk as a fuel in a boiler. It consumes a lot of hazardous chemicals and even chlorine. It generates high volume of waste water too.

Before the Cleaner Production

Un- insulated boiler body

Boiler of 10 MT capacities consumed 36 MT rice husk daily. It was emitting black smoke to environment. Flue gas emission was 48 MT daily. Boiler being not insulated (naked body) consumed more fuel and temperature of steam in process house was always not enough, due to which there were high quantity of rejected paper. For reprocessing of rejected paper, a large volume of additional water was needed again generating more waste water accordingly.

Cleaner Production Intervention

Awareness programon attitude change regarding operating practices, Good housekeeping 5S (Japanese Concept), awareness regarding wastage, pollution and Causes of pollution and its adverse impact to human health and environment was conducted for the operators and workers of the industry. Group Training on Cleaner Production was organized. Brainstorming among the technicians and management was conducted.

Insulation of boiler body

After Cleaner Production

The naked boiler was insulted completely. Feeding of fuel into boiler is now controlled. Air and fuel ratio is set properly. Boiler operators made aware about the consumption of fuel and generation of steam. The consumption of fuel was reduced by 20% for generation of same amount of steam emitting less smoke accordingly. Consequently the flue gas emission to environment was also reduced by 20%. At the same supply of steam became better and paper rejection was reduced by 20% leading to reduction of pollution by 20% accordingly.

CHAPTER VI

SUMMARY, CONCLUSION AND IMPLICATION

This chapter recapitulates the major findings of my research on *"Reduction of Pollution and Enhancement of Productivity through Attitude Change and Cleaner Production"*. This chapter includes the summary of the research study, the outcomes of the research study and its implication in another sectors and dissemination. This research is concerned with reduction of pollution caused by the industries through changing the attitude of the working people by applying Cleaner Production. Thus this research focused on the working practices of workers in industries and their attitude toward environment and pollution caused by the industries. However, the main objective of this chapter is to conclude the study with outcome so that, the finding of this study can be applied by others in their own activities.

Research Summary

Finally, I have concluded my research study with following summary:

I am actively involved in this sector since last 15 years. Initially I did not have any planning to do my research on this subject matter. But when the issue of creating something new that could contribute for the betterment of human being through reduction of pollution caused by industries strike in my mind; I thought that this creation should be disseminated to the people through my thesis. I still remember the starting day of my thesis and all the pressure that I have undergone. Although I completed this thesis, it will be only the part of my final destination. My enthusiasm and interest on this sector will be still continued. Deeper research work will be continued and outcomes will be published through research papers.

The working attitude of the Nepalese people is very much different from the rest of the worlds. Being poor in economic development sector, basic need of fooding, clothing and shelter are to be fulfilled first. Theory of Maslow Hierarchy Needs also states the same concept. So, the management in industries ignores the safety of working people, pollution and effect on human health and environment.

According to theory of Maslow Hierarchy Need, job security/safety is second level of need after fulfillment of first basic needs. However, this statement is little bit not correct in our context. Now the matters regarding this statement are reviewed chapter wise as follows:.

Chapter I is the introduction to different phenomena, concept and understanding of environment and pollution. Environment is understood as the surrounding that comprises of air, water, land including human beings. So we cannot stay apart from environment. Better the environment better will be the health of human beings. And pollution is an undesirable change in physical, chemical and /or biological characteristics of our environment such as air, water or land that may harmful effect to flora, fauna and human life.

Environment and development are considered as two sides of the same coin. They go together hand by hand. The process of environmental degradation was accelerated with the development of socio-economic activities, e.g. agriculture, industrialization, transport, civil construction growing population. As long as the assimilation capacity of receiving water, land, air was more than pollution load encountered them from the external sources, the importance of environmental degradation was not really valued. Today, there are places where rivers are polluted to the extent that they have no assimilation capacity due to domestic waste and industrial effluents e.g.Bagmati and Bishnumati Rivers in Kathmandu valley in context of Nepal. It is true that industrial development increases the GDP and enhances the national economy.

A well-conceived industrial development has magnificent beneficial impacts such as employment generation, import substitution, infrastructure development and so forth. However, establishment of an industry may also have negative impact on the environment, which may make the industry unsustainable. So for sustainable development of the industry, environmental protection measures should be implemented. To make balance between environment and development, government has made compulsory to have study on initial environmental examination or

environmental impact assessment compulsory before the establishment of any industry and other development activities.

For sustainable development of any business activities, program and other activities should be operated in win-win-win situation like saving to investor, safe working condition to workers and fresh water and air to public. So, if we start to work on the second level of our need only after fulfilling the first basic need, it will not be easy to get that second level of need, because we never fulfill the basic need. Without considering the safety of human being and environment where we operate our activities and live, our activities will not be sustained. There are always the risk of hazard to human health and environment, which obstruct on the fulfillment of basic need. First of all basic need and safety has to be fulfilled at the same time. They are in the same level of the platform.

I started Chapter I by introducing my concept and intention of this research study through describing objectives, scope of study and problem statement of the research study. This chapter gives the overall scenario of my thesis work. I tried to explain the condition of industries in terms of working practices, working condition, waste and pollution generation and working attitude of the working people in Nepal. Woolen yarn dyeing industries are taken as an example under specific study.

Although Nepalese hand knotted carpet sector is the backbone of Nepalese economy, its business is declining because of not being cost effective, problem of workers and also political situation in the country. The contribution of manufacturing subsector to GDP is reduced to 6.5% in the fiscal year 2010/11 from 9.0% in the fiscal year 2004/05 (MOF, GoN, 2010/11, p. 6). I tried to explain that the industries operated taking consideration of safety of the workers and positive to waste minimization are sustained. It is because of being competitive in market and no disturbance in the production due to accident and no complaints from the pressure group due to environmental friendly production.

In this chapter I tried to introduce the concept of Cleaner Production as a tool for the reduction of pollution from the industries.

Generally, research is the combination of substantial views of other studies and own original knowledge. Substantial knowledge is produced by literature review whereas original knowledge is gained by primary data collected during the research period and own experience in that particular field. In Chapter II, I tried to explore knowledge and information by literature review. Getting necessary materials was not simple and easy. I reviewed many literatures published by different organization and authors. Few documents or papers were in the context of Nepal.

In Chapter II, I reviewed various literatures on five different headings. All of reviewed documents are related to pollution reduction strategies. I started the literature review from understanding of the basic phenomenon of the environment, waste, pollution, concept like Cleaner Production, environmental attitude. I began rising the questions on this like: how to understand these phenomenon's, why they have to be considered and who is the responsible for the pollution caused by the industries.

In the first part of Chapter II, I tried to give the understanding of meaning of environment, its types and importance to human lives. The understanding of environment reviewed from different perspectives especially from industrial pollution and their role in preserving the environment. The literature related to (man -made) environment and pollution is considered under this research study.

In the second part, I tried to give the correct understanding of the waste. Waste is not useless thing. Waste can be valuable if properly utilized. If anything is put in the right place nothing will be wasted. There is nothing useless in the world. Different types of waste and their sources of generation are reviewed. Waste management system for different types of waste is reviewed.

In the third part, I tried to describe about the Cleaner Production Concept. Cleaner Production is a preventive approach applied in the Production Process,

services and products. The main objective of this concept is to manage activities that can minimize the waste generated at source itself, rather than managing waste after its generation. The well-known proverb *"Prevention is better than cure"* is correct understanding of Cleaner Production. In this part, techniques and methodology of Cleaner production implementation is also reviewed. Five Cleaner Production implementation techniques are reviewed; good housekeeping and better process control technique is the best amongst these five techniques. The Cleaner Production concept is taken as problem solving tools used for reduction of waste and pollution.

In the fourth part, the waste generation and environmental condition caused from the pollution generated from industries in context of Nepal is reviewed. The operation condition of industries especially polluting industries such as woolen yarn dyeing industries is very critical. The waste generation and pollution creation is high because of waste is considered as usual and unavoidable in production process. The water bodies such as rivers, ponds and drain and atmosphere of Kathmandu valley is so polluted that they have no more assimilation capacity.

In the fifth part, attitude and attitudinal change is reviewed. Attitude is very abstract thing which does not follow any specific tool to change attitude. Even if the attitude is positive, the work performance may not be positive, which dictates behavior. Developing countries still do not consider the environment during planning and execution of development activities. In this part, I reviewed three theories viz theory on Environmental Ethic, Motivation Theory and the planned behavior theory linking to attitude toward the pollution reduction through waste minimization.

Methodology is discussed in Chapter three. This chapter started by reviewing the research philosophy with ontological and epistemological parts of my research. This chapter reflects the tool making and tool using mechanisms in research. I have used working methodology gained during my 15 years of experience in this field. And during these 2 years of journey of thesis writing, I incorporated outcomes of my professional job. I started my PhD journey immediately after acceptance of my thesis proposal two years ago. I stated the theme of my thesis along with problem statement.

As per the nature of my research study, I used qualitative methodology incorporating the results and outcomes and finding during my 15 years of working experience. There would be very less importance of sampling and sample size. Although I considered research participants of industries from various sectors, more focus is given to the workers of two woolen yarn dyeing industries located in Kathmandu valley. However, I used purposive sampling method too for identifying participants. I developed questionnaires and distributed to research participants mainly from woolen dyeing industries. For in-depth interview, I divided the research participants into three groups, Workers & Operators in first group, Supervisors & Managers in second group, and Directors & Officials of Industrial Associations in the third group. Ten participants each from first and second group and five participants from third group were taken with whom I had frequent meeting, discussion and brainstorming programs. Detailed in-depth observation was done during their working hours by following their working practice and I frequently interacted with them in necessity.

The techniques used for qualitative analysis are in depth interviews, awareness session, brainstorming, success cases, observations and interaction with research participants. All these information are depicted in the form of reports and pictures. The audio and video clips were also recorded for comments from entrepreneurs on this aspect. Secondary data collected from various sources are in the form of records. I took precautions while collecting secondary data taking into consideration of trustworthiness and authenticity. Finally, I set the methods of data analysis, ethical consideration and assessment of trustworthiness of my research. I spent a lot of time in collecting the data and designing this chapter.

The Chapter IV is the analysis part of the data collected through interviews and observation. The whole chapter is mainly based upon observations and analysis of collected primary data. For this chapter, I gathered all raw information during this research period and during whole 15 years of my work experience. Primary data were transcribed and secondary data were extracted in some places. All transcribed and extracted data were assembled and coded dividing the coded data into themes. I derived my final themes through a process of data reduction using categorization,

abstraction, comparison, integration and finally interpretation was done. All final themes related to my research works are also divided into two parts. Chapter IV contains the present status of the operation of the industries along with waste generation and pollution. This chapter is based on research participant's perception along with the supporting secondary data by linking them with theories. In this chapter Nepal Government policy and regulation are reflected linking with the Participants' statement. This chapter mainly focuses on the condition of industries regarding environment, pollution and working attitude. On the basis of information given by the research participants during interviews and my observation, the present consumption of resources and waste generation are analyzed. Pollution level created by the industries is explored. Although the environmental attitude of the working people is positive, the condition of industries regarding waste, pollution and working attitude of workers is not satisfactory. The management is also not following the Government rules and regulation regarding waste management and pollution control. In this chapter, various sources of waste and pollution generation and its role in adverse impact to environment are discussed. Research participants are mainly workers, operators, supervisors and management. Almost all the participants accepted the reality of waste generation and pollution made by the industries which I really appreciated.

The importance was given by the research participants toward the environment and pollution control activities. In fact it was found that the industries are not operating with the view of reducing the waste and pollution. The management is also not serious about waste and pollution caused by the industries. Finally, I concluded the Chapter IV discussing qualitative analysis of the data supported by some picture.

Chapter V is Experiment and another part of data analysis. In this chapter, analysis of data regarding the concept, tools and techniques experimentally used and adopted for reducing the pollution through changing the attitude of the working people was done. The awareness program, training on Cleaner Production and motivation scheme are the main concepts or techniques to be adopted for changing the attitude of the working people toward waste and pollution reduction. The procedures

and topic of awareness and training on Cleaner Production and type of motivation schemes were implemented in the industries specifically woolen yarn dyeing industries. The success cases on reducing the pollution and saving of resources are also discussed and analyzed. The success cases are taken also from other industries where the similar awareness and the implementation of Cleaner Production were conducted. The results of wastewater and air emission after the awareness and Cleaner Production intervention are also analyzed. Thus, the major theme of my research is to change the attitude of the working people towards reducing the waste generation and pollution creation through awareness and training program to employees. And lastly Chapter VI is the summary of all five chapters mentioned above and this chapter also contains Findings and Implications as stated below:

Research Findings and Discussions

The big research question of my thesis is "*what is the effective and efficient way-out of reducing the pollution from the industries to environment and human health?"* There are many ways to reduce pollution and they can be primarily grouped into two ways. First way-out is legal enforcement. By enforcing the regulation, industries are forced to compliance the discharge standards. To meet such discharge standard, the industries have to modernize the production process and treat the waste water and air emission at the end. For this operation the industries have to invest big amount for purchasing the treatment plant facilities and continuous expenses for regular operation and maintenances and this compels the industries to increase its operational cost which ultimately makes them uncompetitive in market. At the same time, law enforcement is also not that easy. The political instability and strength of Nepalese government is very weak which has very less possibilities of effective enforcement of environmental laws in controlling pollution. It has changed the attitude of the management not to continue this option resulting increase in pollution to environment and effecting human health. So, even if the management implements this option, it will be for short period just to show to the government or public so that they are reducing the pollution through pollution treatment mechanisms. And it has been already proved that this option is neither effective nor efficient.

There is another second option (Way) for reducing the pollution to environment and adverse effect on human health. This is software option, which does not need of any money or even if needed it will be small amount. We generally called it as no cost low cost option.

Although modern plants are installed and better raw materials are used, it is human beings who are responsible for controlling the waste generation leading to pollution. Production cannot be initiated without human beings involvement. So, anyhow, human factor is prime concern in controlling any activities. Considering this truth, my thesis is totally based on the human factor. So the best option for reducing the pollution effects on human health changing attitude of the working people towards waste management and pollution is of utmost importance. However, changing the attitude of the people is not easy, specifically when they are old aged, who is not changed according to time. For successfully changing the attitude of the working people, effective awareness programs have to be developed, which is possible only from a person having long years of working experience in the same field.

Motivational scheme has to be incorporated together with awareness program for sustainability of the changed attitude. The people from three sectors are involved in the industrial activities: investors, employees and the government or pressure group. When I had interaction with the investor (Industrialist) about the savings and profit convinced them citing the importance of Cleaner Production and profit through waste minimization and efficient production processes. Then interaction with working people was more focused upon health and safety measures. Of course they are aware of need and importance of health and safety measures. They became even more convinced from my explanation that Cleaner Production provides safe and healthy working condition. Besides this, I added that the industry will be able to provide them additional benefits due to saving received after implementation of Cleaner Production.

Lastly pressure group were also convinced that they will get better environment with lesser pollution after implementation of Cleaner Production due to

less wastewater, less solid waste and less smoke to environment. On the basis of these strategies, I had conducted awareness program on attitudinal change and training on Cleaner Production focusing on attitude. The awareness program materials which I developed became effective to change the attitude of the working people toward reducing waste leading to less pollution. Investors (industrialists) are happy with saving of resources, working people are happy getting safe healthy working environment, Pressure group or government are satisfied having less pollution to environment and compliance with discharge standards. Thus, this research data revealed that this type of strategy in changing the working attitude has created win-win-win situation (high saving to investor, safe and healthy working environment to workers and less pollution to public and compliance of law to the government) in running the industrial business.

In the course of this research work, I observed that the result is better in cottage and small scale industries, where the top management himself/herself is associated in day to day work. The working people even the middle management do not implement any options without permission from the top management. There are some barriers and constraints in medium and large scale industries in implementation process. The top management never participated in training program as required who should actually be the one to be made aware about the importance of Cleaner Production and effects of pollution on environment and human health. However, other working people became so motivated to apply my suggestions and concept even in the household activities. It is true that our household kitchen is also small waste manufacturing unit. So this research findings are equally applicable also in household in reducing the pollution generated from the household activities. Some participants even told me that they have started to implement solid waste management and cleaning practices in their own houses and surroundings. And they got not only economic benefit but also appreciation from the neighbors in reducing the pollution. The reduction of pollution can be accelerated with these findings if the enforcement of law from the government side is made effective.

Conclusion

This research mainly discussed the importance of awareness and training programming changing the attitude of the working people toward the reduction of pollution caused by industries. The research also explored about the relevance of awareness and training materials for changing the attitude of the working people to reducing the pollution. It emphasized that the human factor play a prominent role in waste minimization leading to reduction of pollution. Industries cannot survive in this competitive and globalization market without improving the production activities in every step.

It is concluded that one of best ways to reduce the pollution caused from the operation of the industries is to change the attitude of the working people through awareness and training program incorporating suitable motivation scheme under Cleaner Production Concept. On the basis of these factors, I drew major following concluding remarks for successfully implementing the above mentioned findings.

- It is crucial to include human force in every aspect of the production for their positive support and initiation.
- An appropriate awareness materials for specific categories of working people have to be developed
- Regular awareness program on attitude change and working practice should be conducted for all working personnel.
- Suitable Motivation scheme have to be developed and implemented effectively.
- The safety and health of the working people should be prime concern of any industrial activities. Basic needs such as food, shelter, and clothing cannot be fulfilled by sick workers. Thus, Attitude of the working people can only be changed toward reduction of waste generation and pollution reduction, if the safety and health of the working people is considered at the same level to basic needs.

- According to management theory, 5Ms are applied in Production activities, my research in this field revealed that **M** for mentality of the worker plays a vital role in the production activities in waste minimization and creating safe and healthy working condition, controlling pollution and effects on human health, which is most important factor for sustainable industrialization.
- Production is not the indicator of the improvement of the industry. It gives the wrong impression to both management and workers. Overall productivity enhancement is the only best indicator of industrial development.
- Industries now cannot survive without considering the environment and human health.
- Waste treatment cost escalates the production cost making uncompetitive in the market. So, application of preventive approach reduces the cost of production making competitive in market. It also fulfils the social responsibility or ethic.

There is no argument that the industries fulfill the basic need of human beings. Still, the effective and efficient running of industries is the demand of the people for happy living. Sustainable production and consumption is the voice of the people of the present world.

Implication

a. For Government:

Government formulates the rules and regulation and enforce accordingly. There is no meaning of any regulations, if they are not enforced. Government has already formulated Environmental Protection Act 1997 and Environmental Protection Regulation 1997. Besides these, there are local governmental regulation and industrial policy and regulation regarding pollution control. But the enforcement of these regulations is very poor. Until and unless the regulations are enforced, pollution cannot be reduced. At the same time, it is also the responsibility of the government to promote the sustainable industries providing all required facilities. But present government of Nepal is not proactive in both matters. The Ministry of Environment,

Science and Technology (present Ministry of Science, Technology and Environment) is responsible for protection of the environment. To enforce any regulation needs the regular monitoring, analysis and action. To make such activities right and experienced personnel and infrastructures are required. But present ministry does not have both. So, it is very much necessary to create departments under this ministry with sufficient human resources to perform activities in reducing pollution generated from the industries.

Secondly, the Government has to play "give and take policy" and follow "carrot and stick approach". If only stick is applied, enforcement cannot be effective in compliance the regulation and reducing the pollution. So it is advisable to enforce the regulation introducing some incentive scheme. Incentive scheme may be tax exemption, custom exemption or even subsidy for purchasing awareness and training services and installation of pollution reduction technique or equipment.

Similarly, the government also has to initiate in the promotional activities for protection of the environment through compliance of the regulations. Pollution preventive concept and tools like Cleaner Production and Environmental Management System has to be promoted in the industries regularly and effectively.

b. Industries

Industrial development is the backbone of the country for sustainable development. Yes, industry fulfils our needs and creates employment opportunities. Major share of government revenue also comes from industries. Thus industries play a prominent role in overall economical development of the country. However, the industries also consume valuable resources and pollute the environment and effect on human health. Thus, industries have to run in such a way that it fulfils all our needs without any pollution to environment if possible. Otherwise, it has to minimize its adverse impact to environment through reduction of pollution. The government alone cannot develop the industrial activities in this line. Industries also have to be run considering all possible negative impact to environment seriously. For this, firstly industrialist himself has to understand the meaning of waste and its importance and at the same time he/she has to be committed for environmental ethic.

Production alone does not give any saving or benefit to anyone (Industrialist, Worker, and Government). Productivity is one of best indicators for industrial development. The implementation Cleaner Production concept gives overall productivity enhancement along with better working condition and less pollution to environment through waste minimization. It will be only possible if the working people have positive attitude toward waste generation. So, it is advisable that the industries adopt the Cleaner Production concept and awareness programs as a culture and implement it regularly and effectively. It will be more effective in changing attitude of the working people toward waste minimization leading to reduction of pollution, if motivational scheme is incorporated along with awareness program. The awareness program should be very practicable and easily convincing working people. So such program should be conducted by a competitive person having long years of experience in this field.

The industries should understand that the waste minimization gives the saving and benefits to industry itself and they have nothing to lose at all.

The benefits that industries get are as follows:

a. Monetary through resource saving
b. Respect from working people due to safe work place and giving more incentive to them
c. Appreciation from public and Government due to protection of environment and compliance of rules and regulations.

c. Working People

Working people are the pillars of the industries. Without strong and reliable work force no industry can survive. Even top management is committed to waste minimization, this commitment does not work without positive attitude of working people. Even atomization and modern technology is introduced, working people are always needed to handle these machine or plant or at least to support them. However, the industries of Nepal still use many manual processes, where work force play a vital role in controlling waste. Our industries are operating without any good

housekeeping planning, handling of chemicals and other hazardous materials without any safety measures. Spillage and leakage of Chemicals and other materials are usual phenomena inside the industry.

So, working people have to understand that safe work place is to minimize the risk of accident and health hazards. Chemical leakage and spillage are the sources of accident and health hazard. Risk of accident from running of plant machineries without safety measures (Guarding) is the same as suddenly meeting with a tiger in a forest. The working people have to understand this that safe work place gives them better living and happy family.

Secondly, they have to understand that waste is very valuable resource at the wrong place and in the hand of wrong person. So, they should not make any wastage and even though if waste has generated, it should be placed or collected in an appropriate container or condition and use accordingly without throwing out. The working people are responsible for waste generated from the industries and pollution caused from these waste accordingly. They have to understand that waste minimization is the saving of the resources including human resource, which gives additional benefits or bonus to working people.

But in our context,working people in general are uneducated. They may not understand the importance of industrialization and adverse impact of pollution caused from the waste generated by the industries. So, it is very much importance to aware them about these problems. And working people also have to demand for awareness program and exposure to training program on Cleaner Production. Generally present workers are politically motivated. They normally demand many other things except the educational knowledge and awareness program on safe working condition and waste minimization and it gives them positive environmental attitude.

The working people have to understand that the waste minimization gives them not only safe workplace and less pollution but also economic benefit through additional bonus and incentives. It is not so difficult too to handle the chemical/materials safely and carefully. It is also not difficult t to make less spillage and leakage and less waste to environment. The working people need only very competitive and practicable awareness program, which can change their attitude

towards waste minimization leading to reduction of pollution through changing their working practices and traditional own thinking practices.

d. Pressure Group/Public

Pressure group or neighbouring public are one of the main concerned stakeholders in reduction of pollution to environment. They are most and immediate sufferers too, from the pollution caused by the waste generated from the industries. It is general practice that everybody likes to have industry to be established but these industries should be far from the residential areas. Until now, there is no proper urbanization planning in Nepal. Few industrial area /zones are planned in urban areas. So, there are many cases where public are complaining about the pollution caused by industries. Their one and only one demand is to reduce the pollution. But the industries are not in position to set up the waste treatment plant, because of its high investment and additional operating expenses. So, there are always conflict between industries and public about the pollution.

It is now time to understand by the public also about the need of pollution prevention techniques rather than pollution treatment. Pollution treatment may be effective for short time when the pressure is severe, whereas Pollution Prevention is permanent and it will be more and more effective as the time goes. So, it is advisable that the pressure group/public has to ask the industrialist about the pollution prevention planning before the operation of the industry rather than after the pollution made by the industry. The public should also be honest toward their demand and interest. Their demand should be only for the protection of the environment and human health. If the public demand Pollution Prevention planning from the industries, then the industries have to think about it before the production starts and it will help them to allocate some resources for the pollution prevention activities. The industries also welcome such demand, because it will motivate them to plan for awareness and training program on waste minimization before the production starts. It will definitely help to keep the attitude of the working people positive toward waste minimization and pollution reduction.

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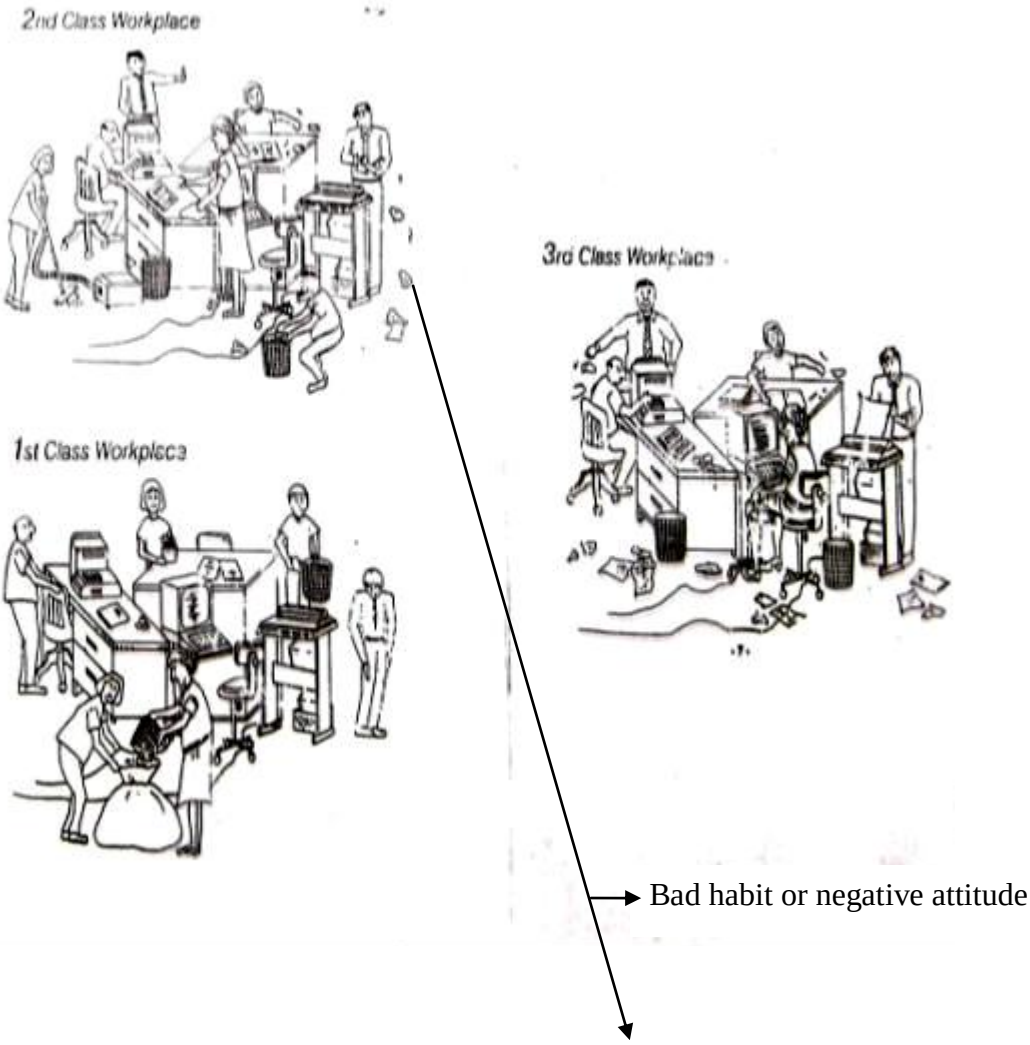
Annexes

Annex -1

What is Waste? Is it useful or useless thing?

This picture "waste in the street" shows that waste is a valuable resource at a wrong place

All these waste were generated by us and it means that all our valuable resources are thrown to the street polluting the environment and human health. It is the best awareness matter to convince the employees that the waste is a valuable resource at a wrong place


2nd Class Workplace
3rd Class Workplace
1st Class Workplace
Bad habit or negative attitude
Littering or waste generation does not make shopfloor clean

Plastic Shoping bag from dust bin

Pen stand from dust bin

Flower decoration from dust bin

Paper bag from dust bin

What is it? What you see here?

This picture shows that everything, every task and matter has at least two options "Positive or Negative, Right or Wrong, Yes or No. However, we have to be Positive and at the same time, we should not ignore the other's opinion, although it is different from own. We have to consider other's opinion too. To make any correct decision and get success in any task, we have to do positive work taking consideration of negative task too. Be always positive and do not neglect the other's opinions or comments.

What is it?

The example of cauliflower (Govi) was initiated to show that noting in the world is useless. Generally a question is asked to participants about the percentage of used part and throws out part. The answer was that the percentage of used part varies from 60% to 100%. On the basis of these answers, it was clear that the cauliflower can be used up to 100 percent. But it is not necessary that all are used as food. Some parts may be used as animal food or and it can be used for making organic fertilizer. Lastly employees were convinced that nothing is useless. Even we throw the thing that we did not use; that thrown thing may be useful to someone other who can make something useful thing from this. It means that very thing is useful. Nothing is useless in the world.

Fighting for nothing

I am only right. I am stronger.

We should perceive that we also should be wrong and other may be right and give respect to other and be respectable.

Need of good relation between labour and management to reduce the waste leading to less pollution

Inspiration from Lord Ganesh Jee

5 senses of Ganesh Jee is our inspiration. We have to know what is telling by Ganesh Jee. The followings 5 explanations have to be considered and work accordingly to be success in work and get reduction of waste keeping the environment less polluting and less health hazard.

1. **Big Head** – Every one of us has one head and brain inside the head. Nobody is big man from birth. Use the brain as far as possible so that we get success in the work. Big Head inspires us to think big and think positively to environment
2. **Big Ears** prompt us to listen patiently to new ideas and suggestions from others as far as possible.
3. **Narrow Eyes** see the thing that could not see by bigger eye. Narrow eyes point to deep concentration needed to find out the causes of problems and of course its solution then.
4. The **Long Nose** tells us to poke around inquisitively to learn more and find out the solution for solving the problem with new ideas to reduce the waste leading to less pollution.
5. The **Small Mouth** reminds us to speak less and listen more to others.

Annex-2

1. Cleaner Production Concept

Cleaner Production Concept

Durga B.Karanjit

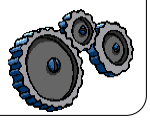
Effects of Industrial Development

Positive

- Fulfill needs
- Employment
- Increase Per capita income
- Comfortable living
- Economic Development

Negative

- Consume resources
- Create the Pollution
- Occupational disease and accident

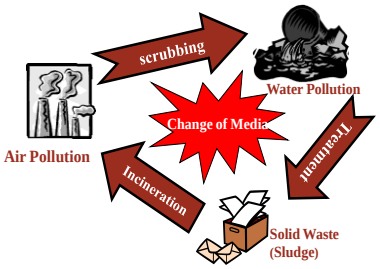


Response to Industrial Pollution

Historical Response

- ✓Ignore
- ✓Dilute
- ✓Treat

Treatment Process



Response to Industrial Pollution

Historical Response

- ✓Ignore
- ✓Dilute
- ✓Treat
- ✓Preventio

Definition of Cleaner production

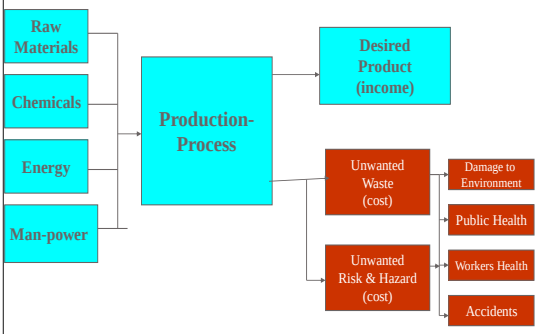
Cleaner Production is the continuous application of an integrated preventive environmental strategy to processes, products and services to increase overall efficiency and to reduce risk to human and to environment.

- **UNEP**

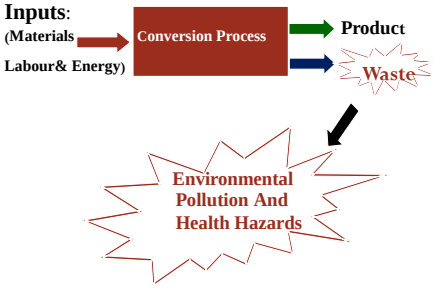
Terminologies

- ✓ Pollution Prevention - PP
- ✓ Source Reduction/Control - SR
- ✓ Waste Minimization - WM
- ✓ Eco-efficiency - EE
- ✓ Green Productivity - GP
- ✓ Cleaner Production - CP

The Production Process



Pollution from Industry



What is a pollutant ?

It is, in fact, a valuable resource at wrong place.

Effects of Cleaner Production

Cleaner Production →
- Higher Productivity
- Better Environment
- Better Working Condition

Example of Plastic Processing

Plastic granules, Master Batch, Electricity, Water Compressed air, Water, Labour

Conversion Process

Plastic Bottle

scrap, empty bag, fumes, rejection & other losses

Heat radiation, heavy load, risk to burn etc

Comparison of Two Approaches

Traditional Pollution Control (PC)

- Pollutants are controlled by treatment
- Pollution control is evaluated when product developed or problems arise
- Pollution Controls are always cost factor for the company

Cleaner Production : (C P)

- ✓ Pollutants are prevented at source itself. through integrated measures.
- ✓ Pollution Prevention is an integrated part of product & process development.
- ✓ Pollutants & waste are considered to be potential resources to make useful products and by- products.

Comparison of Two Approaches

Traditional Pollution Control (PC)

- Pollution control is concern of environmental experts only
- Environmental improvements are to be accomplished with techniques and technology
- Environmental improvement is only to fulfil discharge standards set by authorities

Cleaner Production : C P

- ✓ Environmental improvement challenges should be the responsibility of all people in the organization.
- ✓ Environmental improvement include non-technical approaches also.
- ✓ Environmental improvement measures is the continuous process to achieve higher and higher standards.

CP Benefits

- ✓ Reduction in input materials - productivity enhancement
- ✓ Improvement of quality
- ✓ Improvement in environment
- ✓ Improvement in working condition
- ✓ Better in corporate image

Myths about Cleaner Production (CP)

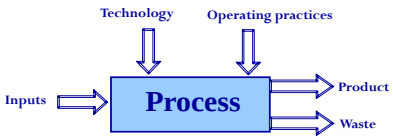
1. CP is costly and large sum of money will be necessary for financing it
2. Highly CP is possible with large scale and foreign owned or multinational industries
3. Qualified experts with long years of experience is necessary
4. Production will suffer while implementing CP
5. Requires modern technology
6. One time activity
7. CP has limited potential

- **Cleaner production Technique and Methodology**

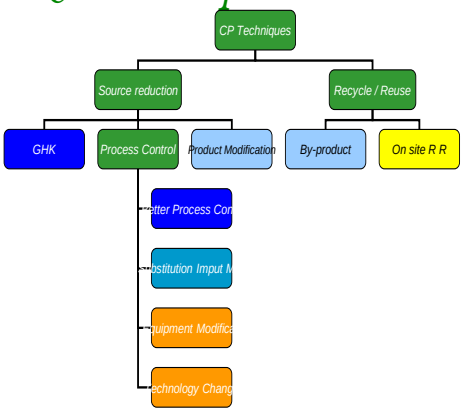
Cleaner Production Techniques and Methodology

Durga B. Karanjit

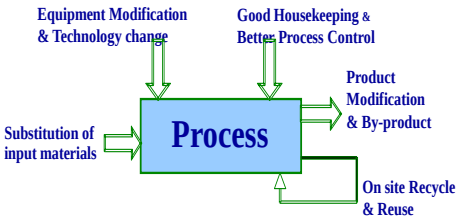
Five features of Process



CP Techniques



CP Techniques



Good Housekeeping and Process control

- Avoid or reduce loss due to leaks and spills
- Turn off water and electricity when not needed
- Reduce cleaning waste by appropriate batch size
- Minimize dragouts from process baths
- Optimize operating parameters - temp, pressure,

Good Housekeeping and Process control (Contd.)

- Reduce storage and transfer losses
- Improve maintenance to avoid shut down loss and defects
- Train operators
- Segregate different wastes

Equipment Modification and Technology change

- Modify equipment to improve efficiency
- Install measuring and process control instruments
- Install more efficient motors and speed controls
- Change equipment or layout to improve efficiency
- Use equipment with better process control

Change in Input Material

- ✓ Eliminate or reduce the use of hazardous raw materials - heavy metals, chlorinated solvents
- ✓ Use purer and higher quality materials
- ✓ Use of cleaner fuel
- ✓ Use of high absorption dyes

Product Reformulation

- ✈ Remove toxic substance from product component
- ✈ Eliminate or reduce unnecessary packaging
- ✈ Design products that can be readily dissembled
- ✈ Increase durability
- ✈ Use materials that can be recycled

Reuse, Recover and Recycle

- Recycle solvents, cooling water
- Recycling of rinse water
- Counter current washing
- Recover heat
- Recovery and Reuse of steam condensate

Methodology

- Management Commitment
- CP Team Formation
- Analysis of Existing Process
- Determination and Costing of wastes
- Cause Analysis
- Generation of CP Options
- Evaluation of the Options
- Implementation
- Monitoring
- Sustaining of CP

Methodology

UNEP - 5 Phase

- *Planning and Organizing Phase*
- *Pre-assessment Phase*
- *Assessment Phase*
- *Feasibility Phase*
- *Implementation Phase*

ESPS – 3 Phase

- ✓ *Pre-assessment Phase*
- ✓ *Assessment Phase*
- ✓ *Post-assessment*

I. Pre-assessment Phase

Step 1 - Management Commitment
Step 2 - Project Team Setup
Step 3 - Establish Goals
Step 4 - Barriers and Solutions
Step 5 - Development of Flow Charts
Step 6 - Evaluate Inputs and Outputs
Step 7 - Selection of areas to be investigated

II. Assessment Phase

III. Post-assessment Phase

I. Pre-assessment Phase

II. Assessment Phase

Step 8 - Material Balance
Step 9 - Cause Analysis
Step 10 - Generation of CP Options
Step 11 - Screening of Options

III. Post-assessment Phase

I. Pre-assessment Phase

II. Assessment Phase

III. Post-assessment Phase

Step 12 - Preliminary Evaluation
Step 13 - Technical Evaluation
Step 14 - Financial Evaluation
Step 15 - Environmental Evaluation
Step 16 - Select Option
Step 17 - Prepare a CP Implementation Plan
Step 18 - Implement CP Options
Step 19 - Monitoring and Evaluation
Step 20 - Sustain CP Activities

Annex-3

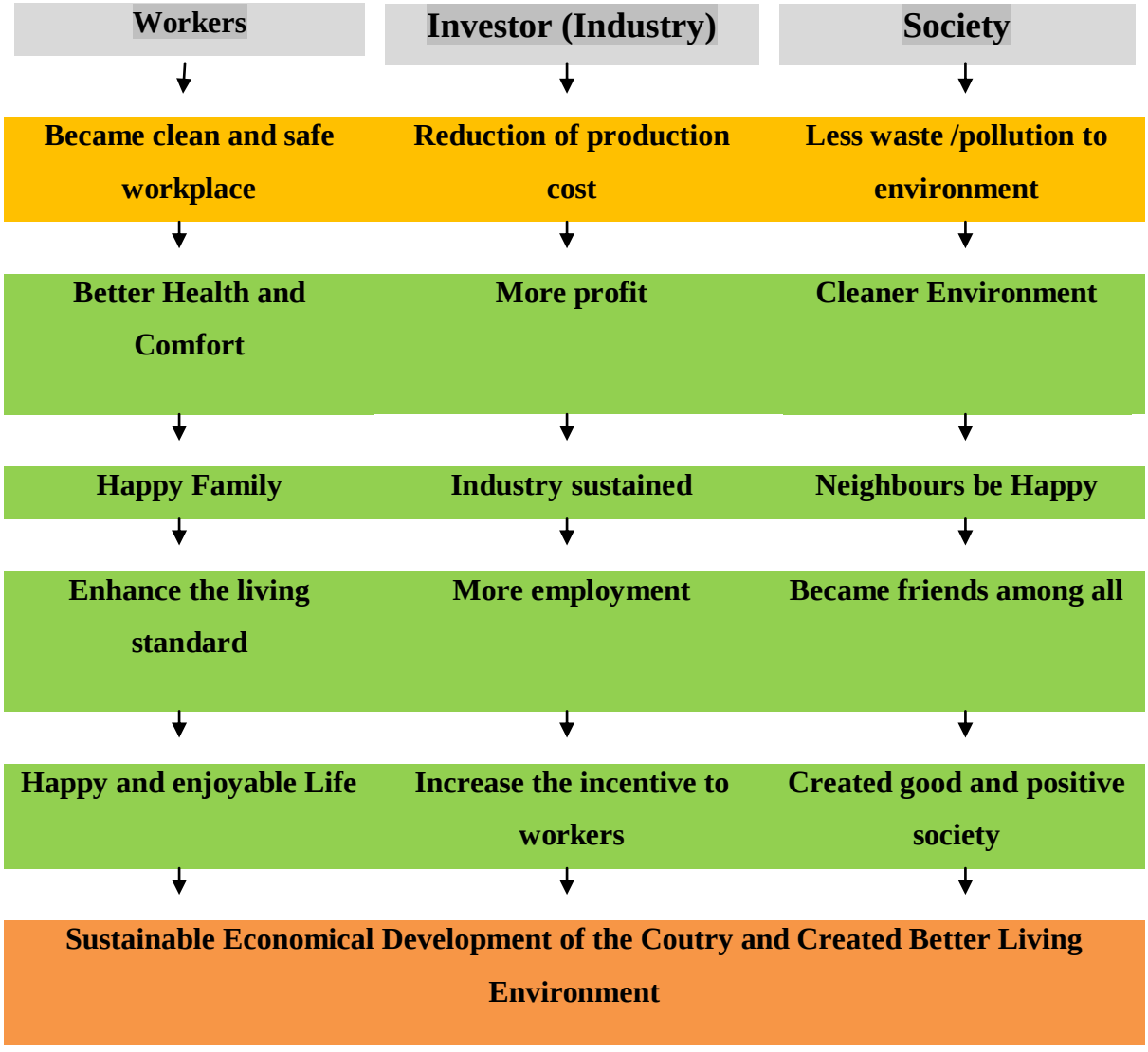
Benefit from implementation of the Cleaner Production through waste Minimization (Win- Win –Win situation)

(Nepali version)

Annex-3a

Benefits from implementation of Cleaner production through waste minimization (win-win –win situation)

(English Translation)



Five Cleaner Production Implementation Techniques can be represented in our Palm with five fingers. Thumb is most important finger for working people. So, Thumb is representing the Good House Keeping and Better Process Control Technique. This technique as our thumb is very important technique for solving the problem. It gave up to 30% saving to the industries without or low investment and 20% pollution reduction to environment and human health. Such option is called no cost low cost option. *Poster published by: ESPS, DANIDA project*

Annex-4a

Soil Test (P.) Limited
ENVIRONMENTAL ASSESSMENT & MATERIAL TESTING DIVISION

Battishputali.
Kathmandu,Nepal

Phone : 977-1-4470551
Fax : 977-1-4470551
Email : soiltest@wlink.com.np

ANALYSIS REPORT

Clent Name: Boudha Dyeing House
Sample Name: Effluent of wool dyeing
Entry No.: 2-069/2
Received Date: 1-2-069
Reporting Date: 17-1-069
Determination: Chemical Analysis

S.No.	Parameters	Unit	Sample Name		Method Used
			Straw Colour	Black Colour	
1	pH		7.1	8.6	pH meter
2	Total Chromium	mg/l	<0.04	<0.04	AAS
3	Sulphide	mg/l	0.004	0.004	Gravimetric
4	COD	mg/l	150.8	185.6	Titrimetric
5	TSS	mg/l	23.6	100	Gravimetric
6	Oil & Grease	mg/l	4.1	6.9	Gravimetric

Note:

1) Results are valid only for submitted samples.
2) Samples, such as water and food, will be destroyed after 7 days, other samples will securely be stored for a month only.

Ramika
Analyzed By

Rochana Joshi
Checked By

Authorised Signature

Annex-4b

Govt. Reg. 108/047/048
SWC Reg. 283/047/048

ENPHO
Creating Eco Societies

ENVIRONMENT AND PUBLIC HEALTH ORGANIZATION

ENPHO LABORATORY

WATER ANALYSIS REPORT

Lab Reg. No.1693/(068-069) **Code :WW**

Client : Boudha Dyeing House
Address : Dyeing Coloni, Mulpani
Sampled By : Client

Source of Sample : Industrial Effulent
Location/Area : Dyeing Coloni Mulpani
Received on : 28th March 2012
Date of Analysis :28th - 3rd April 2012

PHYSICO-CHEMICAL AND BACTERIOLOGICAL ANALYSIS

S.N.	Parameters	Unit	Sample ID 1693	NG/Std*	Test Method
1	pH (21° C)	-	8.5	5.5-9.0	pH meter
2	Total Suspended Solids (TSS)	mg/L	48	100	Gravimetric (filt°, weighing of residue)
3	Biochemical Oxygen Demand (BOD) for 5 days at 20 degree C	mg/L	185	100	5 days incubation at 20 degree C and tit° of initial and final dissolved oxygen
4	Chemical Oxygen Demand (COD)	mg/L	464	250	Dichromate oxidation and titration with ferrous ammonium sulphate
5	Phenolic Compound	mg/L	ND (<0.05)	5	Spectrophotometric (4 amino anti -pyrine)
6	Oil & Grease	mg/L	15.1	10	Partition Gravimetric method
7	Chromium (Cr)	mg/L	0.09	2.0	Atomic Absorption Spectrometer (AAS)
8	Sulphide	mg/L	<0.8	2	Iodometric Titration

NG/Std*- National Standard for Wool Processing Industries

Reference: Standard Method for the Examination of Water and Wastewater (APHA, AWWA & WEF) 19th Edition (1995)

** Nepal Government -Generic Standard ND- Not Detected*

ANALYZED BY CHECKED BY AUTHORIZED SIGNATURE

Note: (1) The results refer only to the parameters tested of the samples provided/collected for analysis. Endorsement of products is neither inferred nor implied.
(2) In order to ensure the confidentiality, the report will be released to the person who produces the registration slip.
(3) All the samples are disposed of 7 days after the report date unless the laboratory has received special request.
(4) Total liability of our organization is limited to the invoiced amount only.
(5) The reproduction of this report wholly or partly cannot be used as an evidence in the court of law and should not be used in any advertising media without prior written permission from ENPHO Lab.

P.O.Box: 4102, New Baneshwor, Kathmandu, Nepal
Tel: 977-1-4468641, 4493188, Fax: 977-1-4491376 E-mail: enpho@mail.com.np, http//www.enpho.org

Annex-5

Checklist for conducting interview
(For Workers and Operators, Supervisor)

At beginning, self introduction and purpose of interview was explained. Management are convinced that the matters of interview will be kept confidential it will be used only for my PhD purpose.

Industry: Boudha Dyeing House, Mulpani, Kathmandu

Name of Respondent: Mr.ChhabiLal Shrestha (after awareness)

Sex: Male Age: 39

Responsibility: To assist in sample dyeing in laboratory

Post: Lab Assistant

Number of years in this industry: 5 years

Q1 How you feel working environment here

Good and Satisfactory. I do not feel any health Problem till now.

Q2. What is the environment?

It is Surrounding like Air, water, Land etc

Q3. What is your attitude toward environment?

It is Positive. Environment should be free from dust and pollution

Q4.Are you responsible for protection of an environment, if yes how

Yes, I feel my responsibility to make clean shop-floor, no waste and no pollution

Q5. Do you know about the pollution? What is it?

Yes, Pollution is no good thing.

Q6. What are the sources of pollution in your industry?

Waste water from production,

smoke from boiler,

dust from boiler,

Yarn pieces in production and store

Q7. Do you know how much pollution is generating from the industry?

I do not know how much. At present not so much pollution, thikthikaichha (Normal)

Q8. Where the pollution goes? How it makes adverse impact to environment (river, land, Air and public Health, animal, plants etc)

-Directly to environment

-Adverse impact to river, land, atmosphere, animal, plant and public health, animal

Q9. Why the pollution is generated in the industry

Production generates pollution. No proper production generates more pollution. It is our compellation or unavoidable too.

Q10. How you understand the Waste

Waste generated after use of the thing. Waste is not useless thing. It is valuable.

Q11. Please tell me the relation between waste and pollution

It has direct relation. More waste more pollution. Less waste less pollution

Q12. Do you feel that you are also responsible for the waste and pollution generated?

Yes, I am also responsible for waste and pollution generated. I alone cannot stop the generation of waste. Others also should cooperate. It is responsibility of all together

Q13. What is the relation between generated waste and your working condition in the industry?

It has also direct relationship. More waste means worse working condition and it makes more risk of accident and health hazard

Q14. Do not you like to have safe working place without any risk of accident and health hazard. If yes, what you suggest for that.

Yes of course I like safe working condition. Nobody likes accident and bad health.

Keep clean in shop-floor

No spillage and leakage

Store the Product in right place and in right condition.

Keep lid of the chemical container closed

Q15. What is the relation between Pollution and your life, family, surrounding?

Pollution has direct link with our life.

Pollution makes the life unhealthy, weak and sad.

Q16. If you are affected negatively from waste and pollution generated by yourself, why do not you care about it?

I am taking the care of chemicals as no spillage and leakage. *Some time due to busy in performing task, I could not take care of the waste*.

Q17. Do you need money or other resources to minimize the waste (leakage, Spillage, aide running of plant, use of resources not efficiently? If no, why waste/pollution is generated so much?

It is not at all. We can reduce the waste generation without money also. We as workers need to be commitment to work with positive attitude. *Now I understand that I can reduce the waste and pollution*

Q18. Have you been ever participated in awareness and training program on attitude change (Cleaner Production)?

Yes may be 2 times in awareness programme. *I still remember you and your teaching matter*

Q19. Did you find any differences in the working people before and after the awareness/ training programme?

Yes. I am changed myself. Now I work carefully and less wastage is generated

Q20. Now do you think that awareness program for you and for your working people is essential for reducing waste leading to reduction of pollution*?*

Yes of course, we need regular awareness programme. Worker's turn out is high in our industry. They do not know about Cleaner Production. So awareness is very essential program to be conducted for them.

Q21. What are barriers for not doing pollution?

The main barrier is no knowledge about the waste and of course attitude. The following are specific barriers.

No awareness program for new workers on attitude
No regular awareness programmed
No team work

Q22. Do you blame to your friends, family, industry management and society as a whole for pollution generated by your industry. If yes why and if no why?

No, I blame myself. I do not blame to anyone. Because, I generate the waste, it is no any other thing. It is my responsible to take care of waste generation. However, all other production people including management also should be honest and serious.

Q23. What you need, or expect from whom for waste minimization and pollution reduction.

Firstly I have to be strong enough for not to doing any pollution. Then management should also be serious on monitoring of waste generation and in implementing motivation scheme

Q24. Do you like to be own safe only. Or you like to save society from being polluted?

I like to save all living and non living thing from pollution.

Q25. Do you know Cleaner Production Concept? If yes what is its meaning.

I remember a little bit. It is cleaning of the shop floor and mind. We should follow no spillage and no waste

Q26. Did you change your attitude toward no pollution from your industry?

Yes, but still I need to improve my knowledge toward environment for better attitude.

Q27. Can we reduce the pollution in some extend just changing our attitude.

May be there are many ways and methods to reduce the pollution. But Attitude of the working people is the prime concern. Yes, we can reduce pollution by changing the attitude of the working people. I already reduced the waste generation.

Q28. Now do you agree that you can save the environment from pollution generated by you? If agree, what you are now planning to do? Please give some options to reduce the pollution from the industry.

Yes I agree. I am always following or try to do the following things:

a. Good housekeeping

b. No negligence in work

c. No spillage, leakage, no waste

d. No idle running of plant

Thank You for your time taken

Checklist for conducting interview

(For Workers and Operators, Supervisor)

At beginning, self introduction and purpose of interview was explained. Management are convinced that the matters of interview will be kept confidential it will be used only for my PhD purpose.

Industry: Boudha Dyeing House, Mulpani, Kathmandu

Name of Respondent: Mr.DawaTamang (after awareness)

Sex: Male Age: 24

Responsibility: To operate the dyeing machine

Post: Operator

Number of years in this industry: 7 years

Q1 How you feel working environment here

Better than earlier, More clean and safe (House Keeping)

Q2. What is the environment?

So far I understand that environment is all things around us. Land, River, Mountain, Flora Fauna and others

Q3. What is your attitude toward environment?

Environment where we live should be free from pollution. If the air we breathe is contaminated, we will be sick. My Attitude is to make environment clean and safe

Q4.Are you responsible for protection of an environment, if yes how

Yes me too. Because I am directly involved in Production. I produce wastewater mixed with chemicals and it goes to environment. I can protect the environment by changing the working practices and handling the chemicals carefully.

Q5. Do you know about the pollution?, what it is ?

Yes, it is waste water, smoke, solid waste. All are bad to Environment. It makes us sick and unhealthy

Q6. What are the sources of pollution in your industry?

Chemical spillage from the store and production,

Waste water from the production and store

smoke, Ash and dust from boiler

Waste Yarn pieces from the dyeing machine and store

Q7. Do you know how much pollution is generating from the industry?

Correctly I do not know. I even do not know how to measure the pollution. But it is not big, and lesser than before.

Q8. Where the pollution goes? How it makes adverse impact to environment (river, land, Air and public Health, animal, plants etc)

-All our waste goes to Environment. It makes water of river not good for human consumption and irrigation purpose. The air we breathe became contaminated with dust particles. Pollution makes us unhealthy.

Q9. Why the pollution is generated in the industry

We have to operate machine and boiler, handle chemicals and water. Using all kinds of chemicals and dyes, we have to dye the yarn to make it colourful. Due to this operation pollution is generated.

Q10. How you understand the Waste

Although it looks like an unused thing, but actually we can use it, if we think so.

Q11. Please tell me the relation between waste and pollution

Pollution is generated from the waste. More waste is more pollution. If the waste generated is less, the pollution will be less and less. If we works without any waste, then pollution will be not at all.

Q12. Do you feel that you are also responsible for the waste and pollution generated?

Yes, I feel. We work as a worker. We handle all chemicals, dyes and water. We operate the machine and we produce the dyed yarn and at the same time a lot of chemical mixed waste water is discharged to environment. So, we of course responsible for waste generation and pollution.

Q13. Relation between generated waste and your working condition in the industry

Waste for example spillage of chemicals and dyes on the floor make risk of accident. No waste is any risk of accident.

Q14. Do not you like to have safe working place without any risk of accident and health hazard. If yes, what you suggest for that.

Yes, nobody likes accident and bad health. Everybody likes comfortable working and living condition. So I also like safe working condition. To keep safe working condition, we have to do:

Keep clean in shop-floor
No spillage and leakage
No negligence during work
Handle Chemicals carefully

Q15. What is the relation between Pollution and your life, family, surrounding?

It has direct relation. Pollution makes health hazard. Waste water contains toxic matters and acid which makes health hazard and uncomfortable living.

Q16. If you are affected negatively from waste and pollution generated by yourself, why do not you care about it?

Some time due to busy in working, I forget the thing that you taught us. I do not generate waste purposely. I generally take care so that no waste or spillage. I will try to improve still more.

Q17. Do you need money or other resources to minimize the waste (leakage, Spillage, aide running of plant, use of resources not efficiently? If no, why waste/pollution is generated so much?

No. It is not money needed. I have to develop positive attitude. I do not get any benefit from this waste or pollution. Then why I have to make waste. It is not good thing. Still we all do not have positive approach to work; we do not know also how to work. Then we do not have good working tools and equipment.

Q18. Have you been participated in awareness and training program on attitude change (Cleaner Production)?

Yes may be 2 times in awareness programme. I still remember thing that you taught us. It is equally useful for our household activities also. It was very interesting.

Q19. Did you find any differences in the working people before and after the awareness/ training programme.

Yes, there are many differences. After your awareness programme, the outlook and management system of our industry is already changed. We are also changed accordingly. Now we have better working condition and clean shopfloor and less wastage.

Q20. Now Do you think that awareness program for you and for your working people is essential for reducing waste leading to reduction of pollution*?*

Yes of course. We have been changed due to your awareness programme. Awareness program should be regularly for all working people.

Q21. What are barriers for not doing pollution?

No regular awareness classes in our industry

New worker without awareness program.

No good team work

No waste monitoring from management side.

Lot of own family problem.

Politically motivated people.

Q22. Do you blame to your friends, family, industry management and society as a whole for pollution generated by your industry. If yes why and if no why?

I blame myself. I am also responsible for waste and pollution generation from the industry. I use to blame to industry management also. They have to be strict on us for good job by monitoring our job and waste made by us.

Q23. What you need, or expect from whom for waste minimization and pollution reduction.

I like to have some strict monitoring of waste from management and regular awareness programme. I also like to have support from my co workers in pollution reduction activities.

Q24. Do you like to be own safe only. Or you like to save society from being polluted?

Yes, at first I like to have own safe and then only I can save to others. My intention is that we have to save our whole society and environment from being polluted.

Q25. Do you know Cleaner Production Concept? If yes what is its meaning.

I remember a little bit. It refers to no spillage and no waste and has good thinking and attitude toward the environment.

Q26. Did you change your attitude toward no pollution from your industry?

Yes, I am changed, but still I need to improve my knowledge toward good attitude.

Q27. Can we reduce the pollution in some extent just changing our attitude?

Yes, we can reduce through changing the attitude. I myself have felt this and I have already reduced the waste generation under my responsibility.

Q28. Now do you agree that you can save the environment from pollution generated by you? If agree, what your now planning to do? Please give some options to reduce the pollution from the industry.

Yes I am totally agreed. I am trying to do following things:

a. Loading of yarn into the machine without breaking

b. Store the chemicals in a container with tight lid

c. No negligence in work

d. No spillage, no waste

e. Handle the chemicals carefully

f. Team work

Thank you

Checklist for conducting interview

(For Workers and Operators, Supervisor)

At beginning, self introduction and purpose of interview was explained. Management are convinced that the matters of interview will be kept confidential it will be used only for my PhD purpose.

Industry: Boudha Dyeing House, Mulpani, Kathmandu

Name of Respondent: Mr.NaraNathPhunyal

Sex: Male Age: 35

Responsibility: To make sample dyeing, colour/shade matching

Post: Supervisor, Quality Controller

Number of years in this industry: 7 years

Q1 How you feel working environment here?

Good and Satisfactory. Here is now good working environment and working condition

Q2. What is the environment?

To keep shopfloor clean and to produce less pollution is the Environment

Q3. Your attitude toward environment

Environment should be clean and free from pollution. I have very positive attitude toward environment.

Q4.Are you responsible for protection of an environment, if yes how?

Yes, I am also responsible for waste and pollution generation from the industry. Because, I am working in the production and generating all kinds of waste.

Q5. Do you know about the pollution?, what it is?

Yes, Pollution is waste, noise, dust, wastewater and smoke etc. It is bad thing for environment and human health.

Q6. What are the sources of pollution in your industry?

Pollution is mainly from Production,

smoke and dust from boiler,

Q7. Do you know how much pollution is generating from the industry?

I do not know how much. However, I know that now the pollution is reduced in great extent. Previously we generated more waste and pollution.

Q8. Where the pollution goes? How it makes adverse impact to environment (river, land, Air and public Health, animal, plants etc)

Our pollution goes directly to environment of course

It makes adverse impact to all of us including land, river, flora and fauna. It makes all not usable for human consumption.

Q9. Why the pollution is generated in the industry

It is not our intention to produce waste. It is unavoidable. No production without waste. However waste can be reduced. And now we are reducing waste.

Q10. How you understand the Waste

Waste can be useful product. It can be used. It is resource

Q11. Please tell me the relation between waste and pollution

It has direct relation. More waste is more Pollution

Q12. Do you feel that you are also responsible for the waste and pollution generated?

Yes, I am also responsible for waste generated in our industry and for pollution caused from this waste.

Q13. What is the relation between generated waste and your working condition in the industry?

It has direct relation. Waste makes unsafe work place. There will be risk of accident and health hazard

Q14. Do not you like to have safe working place without any risk of accident and health hazard. If yes, what you suggest for that.

Yes of course I love my life. Who do not like to have safe working condition? Nobody likes accident and bad health. We have to keep clean shopfloor, no spillage and leakage during work. We have to handle the thing carefully.

Q15. What is the relation between Pollution and your life, family, surrounding).

Pollution makes us sick and creates a lot of health problems. So I collect all waste generated from my activities and reuse them immediately.

Q16. If you are affected negatively from waste and pollution generated by yourself, why do not you care about it?

I know now how to reduce pollution. So I try to generate less waste and pollution. Still I have to learn how to improve the working condition. I am alone not enough to reduce the pollution in great extent. I have to tell to my friends also for cooperation and team work.

Q17. Do you need money or other resources to minimize the waste (leakage, Spillage, aide running of plant, use of resources not efficiently? If no, why waste/pollution is generated so much?

No, need of money. We need only positive attitude of the working people. Pollution is generated due to our negligence to working style and approach.

Q18. Have you been participated in awareness and training program on attitude change (Cleaner Production)?

Yes many times, may be 2 times in awareness program and one time in Training on Cleaner Production and 2-3 times in just meeting with you. I still remember what you taught me.

Q19. Did you find any differences in the working people before and after the awareness/ training programme?

Yes. I am myself changed totally. My working approach is also changed. Now I do not make any waste. If happened, I reuse the waste as far as possible. So there are big differences in working behavior before and after awareness programme.

Q20. Now do you think that awareness program for you and for your working people is essential for reducing waste leading to reduction of pollution*?*

Yes, Now I know what we have to do and how to work. So we need such awareness program regularly. I request you to conduct such program for us again.

Q21. What are barriers for not doing pollution?

No awareness programe for new workers
No regular awareness programme
No regular monitoring of the people and their work performance.

Q22. Do you blame to your friends, family, industry management and society as a whole for pollution generated by your industry. If yes why and if no why?

At First, I blame myself. I do not blame to my friends, Family, Industry management. We need first self motivation. We should have morale

Q23. What you need, or expect from whom for waste minimization and pollution reduction.

I expect strong positive attitude and appropriate working posture from all my colleagues and team work. I expect good motivational scheme from our management and provide us regular awareness program on attitude toward waste.

Q24. Do you like to be own safe only. Or you like to save society from being polluted?

Pollution makes adverse impact to all equally. *So we have to save all from being polluted.*

Q25. Do you know Cleaner Production Concept? If yes what is its meaning.

Yes, Cleaner Production can be understood as "no spillage and no waste", and maximum utilization of all resources.

Q26. Did you change your attitude toward no pollution from your industry?

Yes, my attitude is totally changed. I still like to learn more on waste minimization and pollution reduction

Q27. Can we reduce the pollution in some extent just changing our attitude?

Yes. I have very good cases and examples. Upton 70% waste was reduced in some cases only through changing working practices and good housekeeping.

Q28. Now do you agree that you can save the environment from pollution generated by you? If agree, what your now planning to do? Please give some options to reduce the pollution from the industry.

a. No spillage, No waste if possible, otherwise minimize the waste

b.Handle the chemicals and dyes carefully

c.Collect all waste yarn pieces so that they can be reused in another purpose.

d.Regular awareness program for all workers.

e, Safe staircase in the machine for safe dyes and chemical feeding and dosing

f. Arrange appropriate containers for chemical storing and handling.

Thank you.

Checklist for conducting interview

(For Workers and Operators, Supervisor)

At beginning, self introduction and purpose of interview was explained. Management are convinced that the matters of interview will be kept confidential it will be used only for my PhD purpose.

Industry: Boudha Dyeing House, Mulpani, Kathmandu

Name of Respondent: Mr.Nawa Raj Sapkota (No awareness)

Sex: Male Age: 32

Responsibility: To assist in production

Post: Helper

Number of years in this industry: 1 year only

Q1 How you feel working environment here

This is new experience for me. I have to work in hot condition with chemicals and dyes.

Q2. What is the environment?

Surrounding is Environment

Q3. What is your attitude toward environment?

Environment should be clean.

Q4.Are you responsible for protection of an environment, if yes how

Yes, I should not send the wastewater to river and smoke to air.

Q5. Do you know about the pollution?, what it is?

Pollution is foul smell and black water. Pollution makes us sick. I do not know more about pollution.

Q6. What are the sources of pollution in your industry?

Waste water, smoke and dust from boiler, waste yarn pieces

Q7. Do you know how much pollution is generating from the industry?

I do not know how much. But it pollutes the environment,

Q8. Where the pollution goes? How it makes adverse impact to environment (river, land, Air and public Health, animal, plants etc)

Pollution makes us sick and creates many problems.

Q9. Why the pollution is generated in the industry?

I do not know correctly. However, Production generates the pollution.

Q10. How you understand the Waste

Waste is useless, thrown thing.

Q11. Please tell me the relation between waste and pollution

Waste is pollution.

Q12. Do you feel that you are also responsible for the waste and pollution generated?

I am also responsible for pollution caused by this industry.

Q13. Relation between generated waste and your working condition in the industry

Waste makes uncomfortable working condition and risk of accident.

Q14. Do not you like to have safe working place without any risk of accident and health hazard. If yes, what you suggest for that.

Of course I like to work in safe working condition.

No spillage and leakage in the shopfloor

Keep clean surrounding

Q15. Relation between Pollution and your (life, family, surrounding).

Pollution makes us unhealthy and uncomfortable life.

Q16. If you are affected negatively from waste and pollution generated by yourself, why do not you care about it?

What I can do? Management should arrange everything.

Q17. Do you need money or other resources to minimize the waste (leakage, Spillage, idle running of plant, use of resources not efficiently? If no, why waste/pollution is generated so much?

We need money to run the plant and container to keep the chemicals. We also should not work haphazardly. More waste is generated when we do not work carefully.

Q18. Have you been participated in awareness and training program on attitude change (Cleaner Production)?

No, I do not know anything about Cleaner production.

Q19. Did you find any differences in the working people before and after the awareness/ training programme.

I am new in this industry. So I do not know what it was before.

Q20. Do you think that awareness program for you and for your working people is essential for reducing waste leading to reduction of pollution*?*

I do not know more. I do not know about the awareness program conducted before. I am low educated person. However, if we are convinced, and aware, we can reduce the waste

Q21. What are barriers for not doing pollution?

Nobody told me about this

No awareness program for new workers

No knowledge about health hazard

No knowledge about waste

Nobody cares of waste.

Q22. Do you blame to your friends, family, industry management and society as a whole for pollution generated by your industry. If yes why and if no why?

At first I blame myself. Then I blame to my senior friends. Because I just follow them. If they guide me positively, I also became good worker.

Q23. What you need, or expect from whom for waste minimization and pollution reduction.

Firstly I have to convince myself that pollution is not good thing and I should not do any pollution. Then I expect some awareness program from management and good guidance from my senior friends.

Q24. Do you like to be own safe only. Or you like to save society from being polluted?

It is not at all. We all like to have to live in unpolluted environment. So, if I can I will not generate any pollution so that all we live in good environment.

Q25. Do you know Cleaner Production Concept? If yes what is its meaning.

No. But I like to learn some good thing from you sir

Q26. Did you change your attitude toward no pollution from your industry?

After listen you, now my mind is changing. I started to think that I have to change my attitude toward no waste generation and no pollution from my work.

Q27. Can we reduce the pollution in some extent just changing our attitude?

After listening you and your matter, I think that we can reduce the waste and pollution just by changing the attitude

Q28. Now do you agree that you can save the environment from pollution generated by you? If agree, what your now planning to do? Please give some options to reduce the pollution from the industry.

a. Good housekeeping

b. No negligence in work

c. No spillage, no waste

Thank You.

Checklist for conducting interview

(For Workers and Operators, Supervisor)

At beginning, self introduction and purpose of interview was explained. Management are convinced that the matters of interview will be kept confidential it will be used only for my PhD purpose.

Industry: Boudha Dyeing House, Mulpani, Kathmandu

Name of Respondent: Ms. Shova Shrestha (after awareness programme)

Sex: Female Age: 31

Responsibility: To assist in production and loading of yarn into the machine

Post: Helper

Number of years in this industry: 8 year

Q1 How you feel working environment here

Now better, clean and safe

Q2. What is the environment?

Things around us are an environment. Environment should be clean and fresh

Q3. What is your attitude toward environment?

Environment should be protected

Q4.Are you responsible for protection of an environment, if yes how

Yes, we all are responsible for better environment. I should not generate waste which makes pollution to environment and human health

Q5. Do you know about the pollution?, what it is?

I do not know correctly. But I think it is adverse impact to human health. For example, smoke, dust, wastewater are pollution.

Q6. What are the sources of pollution in your industry?

Boiler –Dust, Smoke and ash

Dyeing Machine- Waste water and yarn pieces

Store – Spilled chemical, yarn pieces

Q7. Do you know how much pollution is generating from the industry?

I do not know how much. But I know that now it is less than it was before

Q8. Where the pollution goes? How it makes adverse impact to environment (river, land, Air and public Health, animal, plants etc)

All go to outside in surrounding. Waste water from out industry goes to nearby rive called Manohara. Smoke from our boiler goes to fresh air.

Q9. Why the pollution is generated in the industry

In detail I do not know. However I think that Production generates the pollution. Unmanaged production produces more pollution. Wrong working process and carelessness of workers also produces more pollution.

Q10. How you understand the Waste?

Generally waste is considered as useless thing. But it can be reused if we like. Waste is valuable thing.

Q11. Please tell me the relation between waste and pollution

Waste makes pollution to us. More waste produces more pollution

Q12. Do you feel that you are also responsible for the waste and pollution generated?

Yes I am also responsible but not me alone. Our management is more responsible. They have to control us. If we all think positively, pollution can be reduced in great extent.

Q13. Relation between generated waste and your working condition in the industry

Waste makes us risk of accident. Spilled chemicals make me head aching every day. Waste makes working condition unsafe and dirty.

Q14. Do not you like to have safe working place without any risk of accident and health hazard. If yes, what you suggest for that.

Yes, I love my life. Of course I like to work in safe working condition.

No spillage and leakage in the shopfloor

No open chemical container

Good housekeeping

Q15. Relation between Pollution and your (life, family, surrounding).

Pollution makes us unhealthy living condition. Pollution makes us sick and weak.

Q16. If you are affected negatively from waste and pollution generated by yourself, why do not you care about it?

I am always aware of pollution. I take care of things. But still we make pollution and discharge waste water and smoke but now much less that it was before. I am proud of it

Q17. Do you need money or other resources to minimize the waste (leakage, Spillage, idle running of plant, use of resources not efficiently? If no, why waste/pollution is generated so much?

We do not need money. We need very good working attitude and honesty in the work. Without good attitude and honesty in the work, pollution cannot be reduced. At the same time we need encouragement and motivation from the management too. .

Q18. Have you ever been participated in awareness and training program on attitude change (Cleaner Production)?

Yes I have participated 2-3 times in awareness and training program on Cleaner Production. It was very good and useful program for workers like us.

Q19. Did you find any differences in the working people before and after the awareness/ training programme?

Yes, it found many differences before and after awareness programme. Now after awareness programme, we have better working condition and less waste and pollution. I fell very happy.

Q20. Now do you think that awareness program for you and for your working people is essential for reducing waste leading to reduction of pollution?

Yes, only awareness program can change the attitude of the working people like us. But if working people are convinced, and aware, waste can be minimized and pollution will be reduced accordingly.

Q21. What are barriers for not doing pollution?

We have some barriers as follows:

No awareness program regularly

No team work

Frequent changing of labour force

No strict monitoring from the management

No impressive motivation scheme

Q22. Do you blame to your friends, family, industry management and society as a whole for pollution generated by your industry. If yes why and if no why?

Firstly I blame myself. Then I blame to our management also for not doing any waste monitoring and not controlling us in waste minimization activities.

Q23. What you need, or expect from whom for waste minimization and pollution reduction.

Awareness program for all workers regularly

Monitoring of waste from management regularly

Appreciation for best workers

Incentives for every drop of pollution reduction.

Q24. Do you like to be own safe only. Or you like to save society from being polluted?

I do not like to give trouble to anyone. If I can, I like to give better environment and good health from being polluted.

Q25. Do you know Cleaner Production Concept? If yes what is its meaning.

I got training on Cleaner production. Although I still do not understand well, I know that no spillage and no waste is the Cleaner production, which we can do very easily.

Q26. Did you change your attitude toward no pollution from your industry?

Yes, I have changed my attitude toward no pollution. Now I always try not to do any waste, spillage and leakage. I work honestly and handle the materials carefully

Q27. Can we reduce the pollution in some extent just changing our attitude?

Yes of course, I did it.

Q28. Now do you agree that you can save the environment from pollution generated by you? If agree, what your now planning to do? Please give some options to reduce the pollution from the industry.

Yes, if we, working people are aware of waste minimization, we can reduce the pollution. For this firstly we should change our working attitude toward:

a. Be Honest in work

b. Careful working practices

c. No spillage, no waste

d. Handling of yarn carefully without damage

Checklist for conducting interview

(For Managers and Directors)

beginning, self introduction and purpose of interview has been explained. Management is convinced that the matters of interview will be kept confidential and it will be used only for my PhD purpose.

Industry: *Dantakali Dyeing Industries Pvt. Ltd, Jorpati, Kathmandu*

Name of Respondent: *Mr. Jeevan Shrestha* (Not participate in awareness programme)

Sex: *M* Age: *52*

Responsibility: *To manage the Production and delivery and overall management*

Post: *Director*

Number of years in this industry: *7 years*

Q1. How the industry is running?

The industry is running satisfactory. Although there is no problem of pollution, the industry could not make good business.

Q2. In an average, how much yarn is dyed daily?

The production capacity of the industry = 2MT/day

But at present Production = 800kg/day

New Zealand woolen yarn 300kgs

Tibetan woolen yarn = 500 kg

The all yarn is used for carpet production only.

Q3. What is consumption of water, fuel (name of fuel used) and chemicals in general daily

Water consumption= 25,000 lits/day

Chemicals (Acetic acid, Formic acid, SMK etc) = 16 kg

Fuel for boiler (wooden chips) = 1500kgs/day

Dyes (colour) = 30 kg/day

Q4. Is Production going up or going down? How much?

At this time, the production is going down. The business is not so smooth now.

Last year the production was 1500 kg/day

and expected production in this year is 800 kg/day

Q5. What losses are in your industry? how much they are? (Water, Fuel, Labour, Chemicals, Woolen yarn)

Losses are mainly due to re-dyeing. It is about 10% (not confirmed and may be more). We have no record keeping system for losses. We never calculate losses. I do not know how much they are.

However, the tentative losses are: (production process losses)

Yarn losses = 1 %

Water = 12%

Fuel = 7 %

Dyes =2 %

Chemicals = 12%

Electricity = 15 %

Labour = 20%

But these losses may be more, because our business is now not good enough

Q6. Why so much losses?

We have no good system and have many problems in production management. Yet some causes of loss are:

a. *Mistake in weighing*
b. *Mistake in matching of sample*
c. *Error in shade in sample dyeing*
d. *Error in dosing of chemicals and other materials.*

e. *Rough handling of chemicals*
f. *Leakage and spillages of chemicals and dyes*
g. *Improper loading of yarn in the machine*
h. *Improper handling of water*
i. *Manual feeding of fuel into boiler*
j. *Condition of machine and equipment is not good (Repair and maintenance)*
k. *Miscommunication from the customer(Causes of production loss)*

Q7. Where the losses go?

Waste water goes to nearby River and drain
Smoke discharges to atmosphere. All wastes are directly discharged to environment without any treatment.

Q8. Do you know what the waste is?

Waste is our loss. Waste is useless product for us.

Q9. Do you know what the pollution is?

Yes, Pollution is disease. Foul smell, waste water, and adverse impact to environment and human health.

Q10. How often you are getting complaint from the neighbors, civil societies, pressure group etc

Previously we had many complaints from neighbours but now we do not have any complaints from neighbors. We had improved in smoke emission through chimney.

Q11. Are you penalized by government for non compliance of wastewater discharged and emission?

It was never. The government has never come for monitoring as well as for promotional work.

Q12. What is the relation between waste generated by you and pollution given to others?

Waste from our industry is polluting the environment very little. Waste and pollution has direct link. More waste is more pollution.

Q13. Are you polluting the environment and public health? If yes how and why

Yes, our production generates wastewater, smoke and solid waste. We produced dyed yarn from grey yarn. Wastewater, smoke, solid waste is

generated in the process of dyeing. If honestly speaking, yes I am polluting the environment. However it is unavoidable. Production without waste is not possible

Q14. Do you know how and why waste and pollution are generated? If yes, please tell me.

Yes, Production generates waste. No waste is possible only if production is stopped. Some waste is generated due to negligence or mistake from the working people. At the same time it is not easy to control the working people.

Q15. In your opinion, who is responsible in your industry for the pollution generated from your industry?

Yes, we all working people are responsible for pollution caused by our industry. As a director, I have to take more responsible. .

Q16. Do you think that you can reduce the pollution? If yes how?

May be it can be reduced. It all depends on our working condition, and working people and plant and machineries (waste reduction approach)

Q17. What is the attitude of working people toward the pollution in your industry?

They purposely do not generate waste. But some time we have some problem from the working people. We depend on them. Of course they do not like to have pollution. However, they are not serious on waste minimization and handle the materials a little bit haphazardly without taking care of spillage and leakage.

Q18. Do you think that money is the prime concern for pollution reduction?

No. Although money plays important role in motivation of working people, it is not prime important in reduction of pollution. Money can change working method of the working people for short term only, which does not make any changing in the working attitude of the working people.

Q18a. If no, what is the prime cause of pollution?

Working people and their working method are the prime concerned on minimization of waste. Prime concern is the attitude of the working people. Pollution totally depends on how they behave in handling the chemicals and production process. Thus the prime cause of pollution in our industry is not positive attitude of the working people.

Q18b. Are you not able to convince workers? If not, why? If you can, then why do not work accordingly?

I never try to convince them. I am always busy in other activities. It is now not easy too to convince the working people against their attitude. They are so rigid that they do not listen us. Just on contrary, I have to follow them.

Q19. Have you been participated in awareness and training program on attitude change (Cleaner Production)?

Yes, I remember that I have participated one time in awareness program on Cleaner Production. We had meeting on this subject many times. Although, I do not remember many things about Cleaner Production, it was good program to aware the working people toward waste minimization and pollution reduction. And I do not know how to aware to workers about the waste and pollution.

Q20. Did you find any differences in the working people before and after the awareness/ training programme?

We did not conduct any awareness program on attitude change for our working people. So I do not have any observation on this.

Note: Then I started to say something about Cleaner Production. I told him about some successful cases on waste reduction. I gave him some example of well running dyeing industries and show him some simple demonstration. After this I asked some more additional questions:

Q20a. Now do you think that awareness program for you and for your working people is essential for reducing waste leading to reduction of pollution*?*

Yes, Now I know what I have to do for waste minimization and pollution reduction. I will follow your advice and teaching. I totally agreed that attitude of the working people should be changed positively for reducing the waste. I like to request you to conduct one awareness program in the industry.

Q21. Did you reduce the pollution? If yes, how much?

Yes, I made some improvement in boiler so that it reduces the emission. But I did it with money expenses. Now, I knew that such improvement can be made through just proper feeding of fuel and controlling the air input, which does not cost me. For this I have to aware the working people.

Q22.Do you think that external factor can also influence on the positive attitude of the working people. And due to which, workers, even with positive attitude toward pollution reduction, could not work as they like. Is it so?

Yes, we got a lot of problem due to external pressure to our workers. Even good workers hesitate to work as required. So I have to develop strong positive attitude to workers.

Q23. Do you agree on my opinion that Attitude is the prime factor to reduce the pollution?

Yes of course I agreed. From to-day, I will try to implement your suggestion and run the industry according to your opinion.

Thank You

Checklist for conducting interview
(For Managers and Directors)

At beginning, self introduction and purpose of interview has been explained. Management is convinced that the matters of interview will be kept confidential and it will be used only for my PhD purpose.

Industry: *Dantakali Dyeing Industries Pvt. Ltd, Jorpati, Kathmandu*

Name of Respondent: *Mr. Krishna Ghimire*

Sex: *M* Age: *45*

Responsibility: *To look after Production and delivery of products*

Post: *Manager*

Number of years in this industry: *7 years*

Q1. How the industry is running?

I think it is all right. Production is going on as usual but at lower capacity. At this time, the production is not high as it was before.

Q2. In an average how much yarn is dyed daily?

The production capacity of the industry is 2MT/day

But at present Production is 800kg/day

The consumption of materials is as follows:

New Zealand woolen yarn 300kgs

Tibetan woolen yarn = 500 kg

The dyed yarn is used for Nepali Hand Knotted carpet making.

Q3. What is consumption of water, fuel (name of fuel used) and chemicals in general daily

Water consumption is about 25,000 lits/day

Chemicals (Acetic acid, Formic acid, SMK etc) = 16 kg

Fuel for boiler (wooden chips) = 1500kgs/day

Dyes (colour) = 30 kg/day

Q4. Is Production going up or going down? How much?

At present not so good as before. Production is going down due to higher production cost and lower quality of the product due to competitive market

Q5. What are losses in your industry? And how much they are? (Water, Fuel, Labour, Chemicals, Woolen yarn)

I think we do not have any losses. All inputs are as per requirement for production. However, we never calculate the inputs and output and waste. We do not have any recording system. May be we are losing.

Q5a. Do you have any re-dyeing?

Yes, the industry cannot run without re-dyeing. It is our normal process. Of course re-dyeing is our losses. But I do not know how to reduce or how to run the production without re-dyeing?

Q5b.Is extra input for re-dyeing not loss of the industry?

Yes that is extra expenses. In some extent it is also loss of the industry. However, we adjust this extra expense in the cost of service. At the same time due to re-dyeing, we discharge more waste water to environment too.

Q5c. Then if so, how much losses are in the industry?

We do not have any record of such losses. We do not have even how much re-dyeing are. However, it is conformed that we have some losses. Overall losses may be up to 15% due to re-dyeing only.

Q6. At the beginning, you told me that you do not have any losses. Now I said that there are many losses in the production. Tell me why so much losses (re dyeing)?

There are many sources and causes of losses. More sources generate more losses. More losses are mainly due to following causes.

a. *Weighing error*
b. *No correct Sample dyeing*
c. *Spillage in dosing of chemicals*
d. *Break down of dyeing cabinet*
e. *Old machine*

f. Mistake in order taking and so on

Q7. Where the losses go?

All losses go to environment.

Waste water goes to outside nearby river

Smoke to atmosphere

Yarn to Kawadi

Q8. Do you know what the waste is?

Waste is useless product for industry. It is pollution too.

Q9. Do you know what the pollution is?

Pollution is discarded product, smoke and waste water

Q10. How often you are getting complaint from the neighbors, civil societies, pressure group etc

No complaint from Government. Previously, we had many complaints from neighbors. They tried even to close down the industry. The complaint was mainly due to black smoke from chimney.

Q11. Are you penalized by government for non compliance of wastewater discharged and emission?

Not yet. Enforcement is very poor. No monitoring of pollution from the government. We neither get punishment and nor positive support from the government. Government is silence.

Q12. What is the relation between waste generated by you and pollution given to others?

Pollution from our industry is not severe. Waste makes pollution. And Pollution makes us sick.

Q13. Are you polluting the environment and public health? If yes how and why

Yes, production needs water, chemicals and dyes. We have to throw this waste water to somewhere and smoke as well. We cannot produce dyed yarn without waste water and smoke from the boiler.

Q14. Do you know how and why waste and pollution are generated? If yes, please tell us.

Our industry is not automatic running. Technology used is old and traditional and we have to do everything manually. Spillage and leakage occurred automatically. Production generates the waste and waste generates the pollution

Q15. In your opinion, who is responsible in your industry for the pollution generated from your industry?

We are responsible. We, working people and management are responsible for pollution discharged by our industry

Q16. Do you think that you can reduce the pollution? if yes how ?

May be it is possible. But I do not know how? You have to teach me.

Note: Then I started to teach him about Cleaner Production. I explained him about what waste is and how it is generated and told him about some successful cases on waste reduction and better working condition with less risk of accident and health hazard. I gave him some example of well running dyeing industries and show some simple demonstration on working practice. After this I asked some more additional questions:

Q17. What is the attitude of working people toward the pollution in your industry?

The attitude of the working people in our industry is not bad. They are sincere. But they consider pollution is still not serious. But they know that the pollution is not good for health and Pollution should not be generated. Now I understand that the pollution is to be considered very seriously and we have to minimize the waste generation to reduce the pollution by applying good working practices.

Q18. Do you think that money is the prime concern for pollution reduction?

No. Money alone cannot do anything. We need attitude, good behavior, strength and positive thinking is needed to reduce the waste generation leading to pollution reduction.

Q18a. If no, what is the prime cause of pollution?

Prime cause of pollution is wrong attitude and behaviors of the working people. Making spillage and leakage habit is the main source of pollution. Wrong working practices and not strong positive attitude of the working people is another cause of pollution. The other causes of waste generation are no regular awareness program to workers, no team work sprit. Management also does not control us.

Q18b. Are you not able to convince workers? If not, why? If you can, then why do not work accordingly?

It is not easy to convince the workers, I never try to convince to them also. They are not under my control.

Q19. Have you ever been participated in awareness and training program on attitude change (Cleaner Production)?

I have never participated in the awareness and training program on Cleaner Production. But after listing your matters and advices, now I understand that we have to work honestly and we should have positive attitude to reduce the waste minimization leading pollution reduction.

Q20. Did you find any differences in the working people before and after the awareness/ training programme.

I did not listen your training before. Still I could not notice the condition before and after the awareness programme. However, after discussion and interaction with you, I suppose that there should be great differences in the working practice before and after awareness program on attitude change. Your awareness program definitely can change the attitude of the working people leading to reduction of pollution.

Q20a. Now do you think that awareness program for you and for your working people is essential for reducing waste leading to reduction of pollution*?*

Yes, Now I know what we have to do such awareness program regularly. I request you to conduct such program for us too.

Q21. Did you reduce the pollution? How much

Now from today I will change my working attitude and hope the waste will be reduced by at least 10 %.

Q22.Do you think that external factor can also influence on the positive attitude of the working people. So due to which, workers with positive attitude toward pollution reduction could not work as they like. Is it so?

Yes, we have some problem from external pressure. So we have to develop strong attitude toward working practice.

Q23. Do you agree on my opinion that Attitude is the prime factor to reduce the pollution?

Yes of course we agreed 100%.Now I know how to reduce pollution to make better working environment reducing the pollution to human health

Thank You

Checklist for conducting interview

(For Managers and Directors)

At beginning, self introduction and purpose of interview has been explained. Management is convinced that the matters of interview will be kept confidential and it will be used only for my PhD purpose

Industry: *Rajan Dyeing Industries, Mulpani, Kathmandu*

Name of Respondent: *Mr. Som Raj Pandey*

Sex: *Male* Age: 42

Responsibility: *To look after overall management of whole industry (Production, Selling and purchasing)*

Post: *Director*

Number of years in this industry: *11 years*

Q1. How the industry is running?

Not bad. We are managing our business to keep it at profitable level.

Q2. In an average how much yarn is dyed daily?

It is true that at this time carpet business is not good. The business is going down. Although the production capacity of the industry is 2.5MT/day, we are able to have business of 900 kgs/day. We are dyeing not only yarn for carpet, but also felt and yarn used for sweater. The tentative production range is as follow:

Yarn for carpet = 30% and

Yarn for sweater = 15 %

Felt = 55 %

Q3. What is consumption of water, fuel (name of fuel used) and chemicals in general daily

The tentative the consumption of water, fuel and chemicals are as follows:

Water consumption= 30,000 lits/day

Chemicals (Acetic acid, Formic acid, SMK etc) = 21 kg

Fuel for boiler (Rice Husk) = 1920kgs/day

Dyes (colour) = 27 kg/day

Q4. Is Production going up or going down? How much up/down?

Generally, we are maintaining business at the same level. Some time more and some time less. This year our business is little bit going down.

Q5. What losses are in your industry? And how much they are? (Water, Fuel, Labour, Chemicals, Woolen yarn)

We have many kinds of loses from various sources. Al though we do not have any correct recording system, the tentative loses are as follow

Water = 20%

Fuel(saw dust/rice husk) = 10 %

Dyes =7 %

Chemicals = 20%

Electricity = 10 %

Labour = 15 %

Q6. Why so much losses?

Comparatively now we have lesser wastes. Previously we had more. But still we have to improve our working practices. We have the working people still with negative attitude toward waste. They think the waste is usual and it is unavoidable. They said that no production is possible without waste

Q7. Where the losses go?

We do not have any waste treatment facility except primary treatment of waste water. The waste is directly goes to environment.

Q8. Do you know what the waste is?

You taught me that the waste is valuable resource at wrong place. I think that it is correct. I have very good attitude on it

Q9. Do you know what the pollution is?

Yes, Pollution is not good thing. It makes adverse impact to our health and environment. It is outcome of the waste that we generated.

Q10. How often you are getting complaint from the neighbors, civil societies, pressure group etc

At present we do not have any complaint from no one. Previously we had complaint from the local people about waste water and air pollution. We had already made wastewater treatment plant for primary treatment and we installed fluidized bed boiler, which discharge smoke or flue gas with insignificant air pollution.

Q11. Are you penalized by government for non compliance of wastewater discharged and emission?

We are never penalized by the government. At present no enforcement and no monitoring from the government side. Government never takes any interest on development of carpet yarn dyeing industries. They are neither monitoring the industry nor providing any technical or managerial support to the industries.

Q12. What is the relation between waste generated by you and pollution given to others?

It has direct relation. Waste is our pollution which makes environment not fit for living and health hazard to human being

Q13. Are you polluting the environment and public health? If yes how and why

Yes, we are still polluting to environment and human health. We are still producing waste and pollution. We are polluting the environment, because we still many problems. One of the main reasons of pollution is unstable government and work force. They are changing the

Q14. Do you know how and why waste and pollution are generated? If yes, please tell us.

There is no doubt that production is not possible without pollution. However production can be done with minimum waste. We have to just be careful in handling the resources and working with chemicals and dyes. We should work always with positive attitude.

Q15. In your opinion, who is responsible in your industry for the pollution generated from your industry?

Of course, all working people are responsible. I, as a director am more responsible.

Q16. Do you think that you can reduce the pollution? if yes how

Yes, we can reduce the pollution without any investment and low expenses. The main cause of pollution is waste generated during production in the course of material handling, carrying and dosing. So we have to learn to work without any waste or at minimum waste. For this we have to develop good attitude to working people toward work through awareness programme. One time, we organized awareness program for our employees. But unfortunately, I could not continue it. I participated many time in awareness and training program on Cleaner Production and Environmental Management System organized by you. So I am convinced that waste can be reduced through attitude changing to working people.

Q17.What is the attitude of working people toward the pollution in your industry?

It is not easy to change the attitude of working people. All working people did not get training /awareness programme. The only working people having already awareness program are working with positive attitude toward waste generation. We need more awareness classes for working people.

Q18. Do you think that money is the prime concern for pollution reduction?

Not, at all. We need first good attitude supported by proper motivation.

Q18a.What kinds of motivation you think to be best?

Money alone is not perfect solution. Every year we give bonus to all working people. Still we could not get better result from all workers. We also have to appreciate good work providing appreciation certificate, token of love or showing the interest to their good work or making good friendly relationship with workers.

Q19. Have you been participated in awareness and training program on attitude change (Cleaner Production)?

Yes, many times I have participated since last 10 years. I have participated even in the training program on Environmental Management System. It is very useful training program for reducing wastes. It gave me big thrust on reducing the waste generation.

.Q20. Did you find any differences in the working people before and after the awareness/ training programme.

Yes, I myself am the example of this. I changed my attitude and way of thinking and way of working practices after training program on Cleaner Production. So I got success to reduce waste and pollution of course.

Q21. Did you reduce the pollution? If yes, how much for example

Yes, we reduced the first waste generation and then ultimately it reduced pollution. We not only reduced the pollution but also saved money through waste minimization and better resources utilization. We are able to reduce the pollution minimum by 30%. Air Pollution in the form of smoke and dust is reduced more than this in emission.

Q22.Do you think that external factor can also influence on the positive attitude of the working people. So due to which, workers even with positive attitude toward pollution reduction, could not work as they like. Is it so?

Yes you are right. Some time I felt difficult to get work done even from the good worker. May be it was due to some external pressure or political intervention.

Q23. Do you agree on my opinion that Attitude is the prime factor to reduce the pollution?

Yes, I agreed 100% and I experienced it that the workers with changed attitude reduce the pollution.

Thank you

Checklist for conducting interview

(For Managers and Directors)

At beginning, self introduction and purpose of interview has been explained. Management is convinced that the matters of interview will be kept confidential and it will be used only for my PhD purpose

Industry: *Rajan Dyeing Industries, Mulpani, Kathmandu*

Name of Respondent: *Mr. Ram HariPanta*

Sex: *Male* Age: 42

Responsibility: *To look after overall management of whole industry (Production, Selling and purchasing)*

Post: *Director*

Number of years in this industry: *11 years*

Q1. How the industry is running?

The industry is running well. Sale is also normal. The industry is giving profit .But a little problem was from neighbors regarding waste water and smoke. We installed wastewater treatment plant and now problem is already solved.

Q2. In an average how much yarn is dyed daily?

The production capacity of the industry = 2.5MT/day

But at present Production = 900 kgs/day.

Yarn for carpet = 30% and

Yarn for sweater = 15 %

Felt = 55 %

Q3. What is consumption of water, fuel (name of fuel used) and chemicals in general daily

Water consumption= 30,000 lits/day

Chemicals (Acetic acid, Formic acid, SMK etc) = 21 kg

Fuel for boiler (Rice Husk) = 1920kgs/day

Dyes (colour) = 27 kg/day

Q4. Is Production going up or going down? How much?

Generally it is at same level. Now going down a little bit

Last year =1200 kg/day and Expected this year = 900 kg/day

Q5. What losses are in your industry? And how much they are? (Water, Fuel, Labour, Chemicals, Woolen yarn)

The main cause of waste /loss is due to re-dyeing (Repeat the dyeing). The re-dyeing is about 10%. We do not have the record of the losses. However tentative losses are as follows:

Water = 20%

Fuel = 10 %

Dyes =7 %

Chemicals = 20%

Electricity = 10 %

Labour = 15 %

Q6. Why so much losses?

There are many causes. The main cause is our working attitude and system. The causes of losses are:

i. *Mistake in weighing and dosing of chemicals due to negligence of the workers*
j. *Leakage and spillages of Water, chemicals and dyes*
k. *Improper loading of yarn in the machine*
l. *Wrong handling of water, chemicals*
m. *Feeding of fuel in boiler not as per instruction, more air*
n. *Condition of machine and equipment (Repair and maintenance)*
o. *Mismatching of sample*
p. *Miscommunication from the customer*

Q7. Where the losses go?

All losses go to environment. For example wastewater goes to nearby River, smoke to atmosphere and solid wastes are sold out to kawadi.

Q8. Do you know what the waste is?

Waste is loss. If cannot use, waste is useless. Waste can also be reused. But we are not reusing waste water and other wastes.

Q9. Do you know what the pollution is?

Yes, Pollution is waste, smoke, dust and wastewater. It gives adverse impact to environment and human health.

Q10. How often you are getting complaint from the neighbors, civil societies, pressure group etc

Previously, we are in great trouble due to complain from neighbours regarding wastewater and smoke from the chimney. Now we solved the problem by improving pollution caused from wastewater, so we do not have any complain now.

Q11. Are you penalized by government for non compliance of wastewater discharged and emission?

It was never. Now- a –day, Government is very silent. Enforcement is very weak. They never monitor our production and waste.

Q12. What is the relation between waste generated by you and pollution given to others?

It has direct relation. Pollution is caused from the waste generated by us. More the waste is more the pollution.

Q13. Are you polluting the environment and public health? If yes how and why

Yes, we are polluting environment in some extent. We have to operate machine and boiler, which produce pollution. It is unavoidable. However, the production can be managed with low waste and low pollution. We have reduced the pollution. We are still trying to reduce more. It is very good that we now know what the waste is and how to reduce it.

Q14. Do you know how and why waste and pollution are generated? If yes, please tell me.

Waste is generated from the production in the form of wastewater, smoke and solid waste (small pieces of woolen yarn. When waste goes to environment, it creates the pollution. Mainly waste is generated in our industry due to Re-dyeing and re-dyeing is mainly due to wrong working practices and working attitude of the working people..

Q15. In your opinion, who is responsible for the pollution generated from your industry?

Of course, we are responsible. As I am looking for production, I am responsible in first place. However, I alone could not reduce the pollution.

Q16. Do you think that you can reduce the pollution? if yes how

Yes, I know now how to reduce the waste and then pollution. However, due to busy in other production activities fulfilling the requirement of the customers, I could not give more attention in this activity. I confessed that minimization of waste gives us more profit and competitiveness in market. I have to manage it. I alone could not reduce the waste. So, I need regular awareness program for all working person. I will definitely reduce the waste and ultimately reduction of pollution through conducting awareness program and introducing effective motivation scheme.

Q17. What is the attitude of working people toward the pollution in your industry?

The attitude of the working person in our industry is mixed. We have both workers trained and untrained on Cleaner Production. The workers having awareness program are more positive toward the pollution. They care about the waste. They produce less waste and work more seriously and they have discipline also.

Q18. Do you think that money is the prime concern for pollution reduction?

No, I do not think that money is the prime concern for pollution reduction. Motivation and awareness program on Cleaner Production focusing more on safety and health hazard is needed. However, we need money too. Money can buy everything but some time it encourages them for black mail

Q18a.What kinds of motivation you think to be best?

Every year we have system of giving bonus to all employees. We give monetary award twosome best workers. From this year we are thinking to give some non monetary award also.

Q19. Have you been participated in awareness and training program on attitude change (Cleaner Production)?

Yes. You taught us. You always make us aware about waste and pollution. I always get something new knowledge and advice from you during your visit to our industry. I am grateful to you.

Q20. Did you find any differences in the working people before and after the awareness/ training programme.

Yes, worker after awareness program are more serious about the waste. They generally take care of waste and they spill less.

Q21. Did you reduce the pollution? If yes how much for example

Yes, we reduced the pollution and saved money too. I think pollution is reduced in great extent especially in smoke and dust emission. The reduction of pollution in smoke and dust emission may be more than 50%.

Q22.Do you think that external factor can also influence on the positive attitude of the working people. So due to which, workers with positive attitude toward pollution reduction could not work as they like. Is it so?

Yes, if external factor influence to working people having even positive attitude, they stop to work positively. So we have to develop them strong positive attitude. Our one of the main problems is political motivated working people, who are not easily motivated to work positively.

Q23. Do you agree on my opinion that Attitude is the prime factor to reduce the pollution?

Yes, I agreed 100 %. Attitude is the main factor, which can reduce the pollution through minimization of waste generation.

Thank you

Checklist for conducting interview

(For Managers and Directors)

At beginning, self introduction and purpose of interview has been explained. Management is convinced that the matters of interview will be kept confidential and it will be used only for my PhD purpose

Industry: *Boudha Dyeing House, Mulpani, Kathmandu*

Name of Respondent: *Mrs. Ratee Shrestha*

Sex: *Female* Age: 46

Responsibility: *To look after overall management of whole industry (Production, Selling and purchasing)*

Post: *Director*

Number of years in this industry: *8 years*

Q1. How the industry is running?

The industry is running well. No problem from the side of market demand and production. But a little problem was from neighbours regarding waste water and smoke. But now it is solved already.

Q2. In an average how much yarn is dyed daily?

The production capacity of the industry is 3MT/day. However, the actual production is lesser. It is only 1.5MT/day. We normally dyed the woolen yarn used for carpet making. However, w e dyed about 10% woolen yarn used for sweater

Q3. What is consumption of water, fuel (name of fuel used) and chemicals in general daily

The daily consumption of input materials depends on the production. However, tentative the consumption of materials is as follows:

Water consumption= 55,000 lits/day

Chemicals (Acetic acid, Formic acid, SMK etc) = 30 kg

Fuel for boiler (Rice Husk) = 2250 kgs/day

Dyes (colour) = 60 kg/day

Q4. Is Production going up or going down? If possible how much?

Generally it is at same level. Now going up a little bit

Last year, the production was average 1200 kg/day and expected production this year is average 1500 kg/day

Q5. What losses are in your industry? And how much they are? (Water, Fuel, Labour, Chemicals, Woolen yarn)

The main cause of waste /loss is due to re-dyeing (Repeat the dyeing). The re-dyeing is about 18%. So, the tentative losses are:

Water = 25%

Fuel = 7 %

Dyes =2 %

Chemicals = 25%

Electricity = 18 %

Labour = 25 %

Q6. Why so much losses?

There are many causes. The main cause is our working attitude and practices. The main causes are:

a. improper weighing and dosing of chemicals due to negligence of the workers
b. Leakage and spillages of chemicals and dyes
c. Improper loading of yarn in the machine
d. Improper handling of water
e. Feeding of fuel in boiler not as per instruction
f. Condition of machine and equipment (Repair and maintenance)
g. Mismatching of sample
h. Miscommunication from the customer

Q7. Where the losses go?

Of course they all go to environment (River, Land, Air etc) and it pollutes us also.

Q8. Do you know what the waste is?

Yes, I have participated in the training on Cleaner Production. Durga Sir has taught me about waste and how to keep shopfloor clean and safe. So, Now, I know that Waste is useful resource; just we have to keep it at right place and hand of the right man. Nothing is useless product in the world.

Q9. Do you know what the pollution is?

Yes, Pollution is contamination to environment. It makes adverse impact to environment and human health. It creates the disease and makes us sick and weak.

Q10. How often you are getting complaint from the neighbors, civil societies, pressure group etc

Previously we received some complain from neighbours regarding waste water and smoke from the chimney. Now we improved the emission and discharged the waste water only after treatment, so we do not now have any complain.

Q11. Are you penalized by government for non compliance of wastewater discharged and emission?

No. Nepal government is weak now. Although we have Environmental Protection Act and Regulation, Enforcement of Environmental regulation is very poor. Government never makes any monitoring of the industries. So we are never penalized for non compliance of discharged standards.

Q12. What is the relation between waste generated by you and pollution given to others?

It has direct relation. Pollution is created from the waste generated by us. However waste is considered as our loss and so we consider it as valuable resource. And pollution is considered as unwanted and very harmful to environment and human health.

Q13. Are you polluting the environment and public health? If yes how and why

Yes, we are polluting environment in some extent. We now improved our production and reduced waste and started to work carefully with better operating practices. So now, pollution is less from our side.

Q14. Do you know how and why waste and pollution are generated? If yes, please tell us.

Yes, waste is generated from the production we did. No production is any waste. Pollution is created from the waste generated from the production. Then the working attitude of the workers is another cause of waste generation. Easily availability of underground water without cost is also the cause of water losses

Q15. In your opinion, who is responsible for the pollution generated from your industry?

Of course, we are responsible. Our management is responsible in the first place.

Q16. Do you think that you can reduce the pollution? If yes how for example?

Yes we can reduce the pollution still. I like to have awareness program regularly in my industry. Awareness and training program on working attitude to all working people can reduce the pollution. But we have to give to workers job security (permanent) also. Frequent changing of the employees is also not good for waste reduction. Considering all these circumstances, if the production is managed, waste will be minimized leading to low pollution.

Q17. What is the attitude of working people toward the pollution in your industry?

Previously they have not good attitude. After training and in house awareness program on Cleaner Production, they became aware of waste generation. But due to frequent changing of working people, (they usually left the job for overseas job), we have to appoint new workers. Some new employees still have negative attitude. We have to train them also on positive attitude toward waste reduction.

Q18. Do you think that money is the prime concern for pollution reduction?

It is not at all. We can reduce the pollution without money also. But we have to motivate working people so that they work more efficiently leading to reduction of pollution.

Q18a.What kinds of motivation you think to be best?

Every year during the Dasain, we provide to all working people regular bonus as per rule. At the same time we give some incentive to the best workers. From this year I am thinking that best workers to be awarded with Letter of Appreciation too.

Q19. Have you been participated in awareness and training program on attitude change (Cleaner Production)?

Yes, I have participated both in training and awareness program on Cleaner Production focusing on attitude change. Besides this, when I meet Durga sir in our industry, he started to tell us something about waste reduction and suggest us some good options for improvement. However, I always expect some more awareness program from Durga sir.

Q20. Did you find any differences in the working people before and after the awareness/ training programme.

Yes, there are many differences before and after training /awareness programme. We improved a lot. We improved not only on pollution reduction but also in resource saving and creating safe work place for workers.

Q21. Did you reduce the pollution? If yes how much for example

Yes, we reduced the pollution through reduction of spillage and creating good housekeeping. We reduced 25-30% both in waste water and smoke emission.

Q22.Do you think that external factor can also influence on the positive attitude of the working people. So due to which, workers with positive attitude toward pollution reduction could not work as they like. Is it so?

Yes, some time I got difficult to get positive response from the some workers even they are very good workers. Later I felt they were influenced by some external pressure. So I think we have to aware the working people regularly about the pollution and risk of health hazard. I have to develop strong attitude to them considering external factors.

Q23. Do you agree on my opinion that Attitude is the prime factor to reduce the pollution?

Yes of course I agreed. I am getting the good result due to this.Thanks god

Thank you

Checklist for conducting interview

(For Managers and Directors)

At beginning, self introduction and purpose of interview has been explained. Management is convinced that the matters of interview will be kept confidential and it will be used only for my PhD purpose

Organization: Woolen Yarn Dyeing Industry Association

Name of Respondent: Bishnu P. Sharma

Sex: Male

Responsibility: To coordinate with all members and provide advices and suggestion

Post: President

Director: Indira Dyeing Industries.

Q1. Please tell me the situation of industries in Nepal in general

Industries are now just surviving. As all other industries, Carpet and Dyeing industries are also going down.

Q2. In an average how the industries are running?

The industries are running from Hand to Mouth. There are many problems: problem of reliable power supply, problem of labour, problem of banda and strike.

Q3. The contribution of manufacturing industries to GDP is going down, why it is so?

Yes. The industries are running at very low capacities. Many industries are even closed down. Our wool dyeing industries are also running at low capacities. More than 50% are already closed down. It is mainly due to unstable political situation, load shedding and labour problem.

Q4. What are their causes, who are responsible? To whom you like to blame?

Main problem is political leaders. I blame to government policy and industrial policy and Act. Trade union is another source of problem.

Q5. Do you have any information or complaints about the pollution made by industries, if yes please tell me about the pollution and complaints.

We do not have many complaints. Previously we had many complaints from local people and pressure group. Now we improved our production and operating practices so that pollution is reduced. So now we have less complaint about pollution

Q6. How is responsible for such pollution?

Industries are polluting the environment. Rivers of Kathmandu Valley are already polluted not only because of industries but it is also due to pollution from households. So we all people are responsible for the pollution. The main responsible is government. Government does not have any streamline for monitoring of industries.

Q7. Do you organize some interaction program about the reduction of pollution or on solving the complains

We among the industries organize interaction program more on problem solving than in pollution reduction. However, I participated in many interaction programs on pollution reduction organized by other organizations.

Q8. How you think whether the pollution is loss/benefit to industry?

Pollution is good for no one. Industries are also not polluting the environment purposely. Dyeing industries are considered as polluting sector. We are losing a lot of resources and money due to this pollution. Pollution is definitely loss to industry.

Q9. Industry produces the waste. The industry cannot run without generating waste. Do you agree on this statement?

Yes, in some extent. But we can reduce the waste generation if we have positive attitude toward safe work place, environment and sustainability of industries.

Q10. Waste generation from the industry shows inefficient of the industry or it is just their compulsion. How you judge it?

Waste is not compulsion neither is unavoidable. More waste means more inefficient production and weakness of the management in organizing good operating practices in production.

Q11. Are there any relation between waste generated by the industry and pollution to environment?

Yes, Waste makes the pollution and health hazard. It has direct relation to pollution. More waste produces more pollution and more loss of resources including unsafe work place to workers.

Q12. Do you think that industry should run efficiently i.e with high overall productivity?

Of course, we do the business for profit making. If we run the industries at low productivity, we lose the money and we have to close our industries. So we have to run the industries efficiently and effectively.

Q13. How about Cleaner Production Implementation? Do you think that it is one of the best solutions for enhancement of productivity and reduction of pollution?

I have participated in the training program organized by Ministry of Industry on Cleaner Production. Yes, Cleaner Production helps to run the industries minimizing the waste leading to less pollution. At the same time, it makes shopfloor without risk of accident and health hazard. Cleaner production is very practicable concept for small industries like ours.

Q14. Main factor for efficient running of industry and reduction of pollution through waste minimization is the attitude of the working people. Do you agree on this statement?

I agreed 100%. Attitude of the working people plays the main role in generating waste and pollution. Production will be safe and efficient with less pollution and safe working condition only if the attitude of the working people is positive toward waste and pollution.

Q15. If yes, how to change the attitude of the working people toward the waste minimization?

Of course it is not easy task to change the attitude of the working people. However, there is nothing impossible too. I myself together with other working people have participated in the awareness program organized by you (Durga sir). It was so convincing that most of us changed our attitude toward waste minimization. So we need regular such awareness programme.

Q16. The working people even with positive attitude can be influenced by external factor/forces compelling to do non productive work. Is it right?

Yes, you are right. External force can influence if you have weak positive attitude.

Q17. So we have to develop the work force with strong positive attitude toward the waste minimization, which cannot be influenced by external factor. Is it so?

Yes, we need to develop strong positive attitude, which cannot be influenced by external factor.

Q18. If yes, how to develop strong attitude

Strong positive attitude can be developed through regular effective awareness program along with effective motivational scheme.

Q19. What is the relation between waste generated and Occupational health and safety?

Waste makes unsafe working condition and risk of accident. More waste means more unsafe shopfloor and risk of accident.

Q20. Can we influence to working people through motivational activities

Motivation helps to develop strong positive attitude in the working people. Motivation together with awareness program can influence to working people toward waste minimization.

Q21. If yes, what they are:

Our working people are mostly from poor family. They need money too. Worker strength is their health. So awareness program focusing on health and safety along with motivation scheme will help to reduce waste and pollution. Motivation scheme may also include certificate of appreciation for best job.

Q22. One more last concluding question is. How you think is it possible to reduce the pollution through changing the attitude of the working people?

I already experienced and even got the result that the best way to reduce the pollution from the industries is the Changing of Attitude of the working people toward waste minimization. It is less expenses and sustained forever.

Thank you.

Checklist for conducting interview

(For Managers and Directors)

At beginning, self introduction and purpose of interview has been explained. Management is convinced that the matters of interview will be kept confidential and it will be used only for my PhD purpose.

Organization: Woolen Yarn Dyeing Industry Association

Name of Respondent: Suman Shrestha

Sex: Male

Responsibility: To coordinate with all members and provide advices and suggestion

Post: Past President

Q1. Please tell me the situation of industries in Nepal in general

Overall the situation of industries in Nepal is not good. Specifically the position of carpet industries is under satisfactory level. Export market is going down and down, which effect negatively in our business too.

Q2. In an average how the industries are running?

Many carpet industries are already closed due to declined market. Carpet industries are our clients. Once their business is not good enough, our business automatically is going down.

Q3. The contribution of manufacturing industries to GDP is going down, why it is so?

Overall contribution of manufacturing industries to GDP is declined in great extent. The capacity utilization of established industries is now very low less than 50%.The condition of industries in Nepal now is no good.

Q4. What are their causes, who are responsible? To whom you like to blame?

There are many reasons. Load shedding, trade unions and attitude of the working people are the main reasons for down the industries. Of course firstly I like to blame to our political leaders and secondly to our business attitude.

Q5. Do you have any information or complaints about the pollution made by industries .If yes please tell me about the pollution and complaints?

Presently the industries do not care of pollution so much. Although we have environmental law and acts, their enforcement is very poor. Due to poor enforcement, Industries are not taking pollution seriously. It is true that the industries are polluting the environment and they are facing the complaints too. So far as wool dyeing industries are concerned, these are polluting industries. Most of the management and some working people of these sectors are trained in Cleaner Production. So now they got success in reducing the pollution.

Q6. How is responsible for such pollution?

Management of the industries themselves are main responsible. Secondly, our political system and enforcement of legislation are also responsible for pollution.

Q7. Do you organize some interaction program about the reduction of pollution or on solving the complains

Our industries in general do not organize any interaction program among the staffs and management. But the industries participated in the training program and awareness program on waste minimization and Cleaner Production conducted by ministries and other organizations.

Q8. How you think whether the pollution is loss/benefit to industry?

I have participated in many training, awareness program and interaction program conducted by various organizations. Now I know waste is valuable resource, just we have to put it properly and re use accordingly. So pollution is great loss of the industry. If we reduce the waste, ultimately pollution is also reduced accordingly and it gives saving to industry, good working condition to workers and safe environment. It creates win -win -win situation.

Q9. Industry produces the waste. The industry cannot run without generating waste. Do you agree on this statement?

No, waste is not generated automatically. We produce the waste. We pollute the environment. Of course, there is no possible to make zero pollution. However, we can run the industries with less waste and less pollution.

Q10.Waste generation from the industry shows inefficient of the industry or it is just their compulsion. How you judge it?

Waste is valuable resource. We have to minimize it. Waste generation shows inefficient of the industry rather than compulsion.

Q11. Are there any relation between waste generated by the industry and pollution to environment?

Yes of course, pollution to environment is due to waste produced by the industry. It has direct relation. More waste generation gives more pollution to environment.

Q12. Do you think that industry should run efficiently i.e with high overall productivity?

The main objective of business is to get monetary profit. Profit will be more if you can produce the product efficiently with low cost of production. It is possible only if you minimize the waste in production. Otherwise industry cannot survive in such competitive market.

Q13. How about Cleaner Production Implementation? Do you think that it is one of the best solutions for enhancement of productivity and reduction of pollution?

Low cost of production alone cannot get good business. We have to maintain quality and safe working condition and should consider the ethic of the society. Cleaner Production considers all these aspects. The implementation of the Cleaner Production gives best solution for enhancement of the productivity, better working condition to workers and pollution free environment to society.

Q14. Main factor for efficient running of industry and reduction of pollution through waste minimization is the attitude of the working people. Do you agree on this statement?

Yes, I agreed on this statement. Previously we produced more production and got less profit and also a lot of complain from the local people. Now although production is lower, profit is not changed so much and no complains as well. It is mainly due to waste minimization of resources and better working condition which we got due to good attitude of the working people.

Q15. If yes, how to change the attitude of the working people toward the waste minimization?

Of course, awareness program and training on Cleaner Production should be conducted for working people. Although it is not easy to change the attitude of the working people, but your (Durga Sir) awareness program changed their attitude toward the waste minimization.

Q16. The working people even with positive attitude can be influenced by external factor compelling to do non productive work. Is it right?

Yes, you are right. Now a day, the external force is activating. The working people can be influenced from such force.

Q17. So we have to develop the work force with strong positive attitude toward the waste minimization, which cannot be influenced by external factor. Is it so?

Yes, so we have to give strong positive attitude to the workers by conducting awareness program regularly and effectively.

Q18. If yes, how to develop strong attitude

Some time only awareness program cannot develop very strong positive attitude. We need to provide motivation scheme and appreciation for best job.

Q19. What is the relation between waste generated and Occupational health & safety?

I think that most important thing for happy living is health. Nobody likes to have accident and bad health from the job. The one of the most effective tools for motivation to workers is to create safe working condition and no health hazard. Waste creates the bad working condition. No waste means better working condition.

Q20. Can we influence to working people through motivational activities

Yes, everybody likes to have importance and appreciation. Motivation means importance giving. Motivation helps to create positive attitude. Motivation is not necessarily be Money.

Q21. If yes, what they are:

Monetary benefit alone is not motivational scheme. Along with monetary benefit, some other motivational scheme can be implemented for example to appreciate in mass just giving small effective THANKs. Certificate of Appreciation, token of love (souvenir)

Q22. One more last concluding question is. How you think is it possible to reduce the pollution through changing the attitude of the working people?

I have participated in awareness and training program on attitude change many times before relocating here. Since then, I followed the working people who had participated in the awareness program. I got a lot of difference in their working practices and talking behaviors. Now I am confirmed that the pollution can be reduced in great extent and sustained forever only if the attitude of the working people is changed toward waste minimization, which can be done through effective awareness program along with motivational scheme conducted regularly.Thank you

Annex-6

Employee Attitude toward Pollution Control through application of Cleaner Production

Questionnaires for workers

I. Introduction

a. Name: b. Gender: Male ☐ Female ☐

c. Qualification: d. Age:

e. Name of Company: f. how long you are in this company:

g. Your address i. Permanent

ii. Present:

II. Please tell us how much you agree or disagree with each of the following statements

a. Waste is unused thing

1. *Strongly Agree* ☐
2. *Agree* ☐
3. *Undecided* ☐
4. *Disagree* ☐
5. *Strongly disagree* ☐

b. Waste is valuable resources at wrong place and in wrong hand of a person

1. *Strongly Agree* ☐
2. *Agree* ☐
3. *Undecided* ☐
4. *Disagree* ☐
5. *Strongly disagree* ☐

c. Pollution caused negative impact to workers themselves first

1. *Strongly Agree* ☐
2. *Agree* ☐
3. *Undecided* ☐
4. *Disagree* ☐
5. *Strongly disagree* ☐

d. Pollution gives very good impact to our surrounding (Environment)

1. *Strongly Agree* ☐
2. *Agree* ☐
3. *Undecided* ☐
4. *Disagree* ☐
5. *Strongly disagree* ☐

e. Pollution is a natural phenomenon

1. *Strongly Agree* ☐
2. *Agree* ☐
3. *Undecided* ☐
4. *Disagree* ☐
5. *Strongly disagree* ☐

f. Pollution gives more profit to industry

1. *Strongly Agree* ☐
2. *Agree* ☐
3. *Undecided* ☐
4. *Disagree* ☐
5. *Strongly disagree* ☐

g. Pollution adds the cost of production

1. *Strongly Agree* ☐
2. *Agree* ☐

☐

3. *Undecided*
4. *Disagree* ☐
5. *Strongly disagree* ☐

h. Pollution should be reduced

1. *Strongly Agree* ☐
2. *Agree* ☐
3. *Undecided* ☐
4. *Disagree* ☐
5. *Strongly disagree* ☐

i. Pollution can be reduced

1. *Strongly Agree* ☐
2. *Agree* ☐
3. *Undecided* ☐
4. *Disagree* ☐
5. *Strongly disagree* ☐

j. Reduction of Pollution is possible only if workers wand

1. *Strongly Agree* ☐
2. *Agree* ☐
3. *Undecided* ☐
4. *Disagree* ☐
5. *Strongly disagree* ☐

k. I do not know how to reduce pollution

1. *Strongly Agree* ☐
2. *Agree* ☐
3. *Undecided* ☐
4. *Disagree* ☐
5. *Strongly disagree* ☐

l. Awareness and training on pollution reduction is necessary

1. *Strongly Agree* ☐
2. *Agree* ☐
3. *Undecided* ☐
4. *Disagree* ☐
5. *Strongly disagree* ☐

m. To keep shopfloor clean after work is one of the main jobs of the workers

1. *Strongly Agree* ☐
2. *Agree* ☐
3. *Undecided* ☐
4. *Disagree* ☐
5. *Strongly disagree* ☐

n. Cleaning is necessary to keep always clean

1. *Strongly Agree* ☐
2. *Agree* ☐
3. *Undecided* ☐
4. *Disagree* ☐
5. *Strongly disagree* ☐

o. Cleaning does not keep shopfloor always clean. Not spill makes shopfloor always clean

1. *Strongly Agree* ☐
2. *Agree* ☐
3. *Undecided* ☐
4. *Disagree* ☐
5. *Strongly disagree* ☐

p. Health and safety is first, but not money

1. *Strongly Agree* ☐
2. *Agree* ☐

☐

3. *Undecided*
4. *Disagree* ☐
5. *Strongly disagree* ☐

q. Haphazard working practice and spill make unhealthy and unsafe working environment

1. *Strongly Agree* ☐
2. *Agree* ☐
3. *Undecided* ☐
4. *Disagree* ☐
5. *Strongly disagree* ☐

r. We ourselves make our workplace unhealthy and danger

1. *Strongly Agree* ☐
2. *Agree* ☐
3. *Undecided* ☐
4. *Disagree* ☐
5. *Strongly disagree* ☐

s. Is it good attitude to make spill and be unhealthy and unsafe workplace

1. *Strongly Agree* ☐
2. *Agree* ☐
3. *Undecided* ☐
4. *Disagree* ☐
5. *Strongly disagree* ☐

t. It is the responsibility of management to keep healthy and safe workplace

1. *Strongly Agree* ☐
2. *Agree* ☐
3. *Undecided* ☐
4. *Disagree* ☐

5. *Strongly disagree* ☐

u. I am just low level worker; it is not my responsibility to keep safe workplace

1. *Strongly Agree* ☐
2. *Agree* ☐
3. *Undecided* ☐
4. *Disagree* ☐
5. *Strongly disagree* ☐

v. It is the responsibility of all workers to keep safe workplace free of pollution

1. *Strongly Agree* ☐
2. *Agree* ☐
3. *Undecided* ☐
4. *Disagree* ☐
5. *Strongly disagree* ☐

w. I know my work very well

1. *Strongly Agree* ☐
2. *Agree* ☐
3. *Undecided* ☐
4. *Disagree* ☐
5. *Strongly disagree* ☐

x. I have to improve my working practice, knowledge and skill

1. *Strongly Agree* ☐
2. *Agree* ☐
3. *Undecided* ☐
4. *Disagree* ☐
5. *Strongly disagree* ☐

y. I like to learn, I like to get training on waste, pollution control person

1. *Strongly Agree* ☐
2. *Agree* ☐
3. *Undecided* ☐
4. *Disagree* ☐
5. *Strongly disagree* ☐

z. You know about Cleaner Production very well

1. *Strongly Agree* ☐
2. *Agree* ☐
3. *Undecided* ☐
4. *Disagree* ☐
5. *Strongly disagree* ☐

Annex-7


Awareness Programme


Training Programme


Interaction with management of industries


Observation during field visit