Determinants of Green Practice Adoption by Pakistani Manufacturing Firms

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Abstract

Green manufacturing is a way of fulfilling corporate social responsibility (CSR) and preserving environmental degradation. Unfortunately, Pakistani manufacturing units are not practicing it due to multiple reasons. This study focuses on identifying the issues which hinder Pakistani units from going green and find out determinants that motivate industrial units to adopt green practices. Our findings can assist managers to develop their future strategy of competitive advantage and policy makers to frame new industrial rules and regulations for fulfilment of CSR and preserving the environment.

Results show that corporate environmental ethics, quality of human resource and competitive advantage are the most significant factors contributing to adopting greener technologies and practices. On the other hand, the role of government pressure on industrial units do not play a vital role in motivating industries to change traditional manufacturing towards greener and eco-friendly manufacturing.

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Dedication

“This Research work is dedicated to the

Allah Almighty for his love and care”

" فَإِن تَنَازَعْتُمْ فِي شَيْءٍ فَرُدُّوهُ إِلَى اللَّـهِ وَالرَّسُولِ إِن كُنتُمْ تُؤْمِنُونَ بِاللَّـهِ وَالْيَوْمِ الْآخِرِ"

“And if you have a dispute concerning any matter, refer it to Allah and the messenger if you are (in truth) believers in Allah and the Last Day” .An-Nisa - 4:59

Also dedicated to my Mother (for her love and care)!

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CHAPTER I

INTRODUCTION

1.1 Overview

Population growth and increase in demand of daily commodities results in mega installation of production and manufacturing units. A production/manufacturing unit can be classified as big enterprise or a small and medium sized enterprise (SME), depending on its size (human resource) and production capacity.

These firm's intake raw materials, process them and present a final commodity in market. During raw material processing numerous solids, chemicals and gases are used to remove waste from raw material or to enhance the quality/look of the final product.

Waste which is removed from the final product can be in solid, liquid or gas form. Since it's a waste it is no more useful for the natural environment, humans or any other living organism. Population is growing and so is the waste. The more the demand of a specific product in market the more waste is associated with its manufacturing.

Industrial solid waste when handled improperly can destroy the land. The land to which solid waste is exposed can no longer be used for crop cultivation and vegetation. This solid waste not only destroys land it also effects humans. Dust from the solid waste can cause breathing problems. Mosquitoes and other dangerous flies can breed on this waste. Which alternatively can cause malaria, typhoid, hepatitis, cholera and dengue fever. Eye infection and skin diseases are common in people living around the industrial solid waste.

A common practice in industries is to dump the liquid waste in nearby streams, rivers and oceans. This destroys all the aquatic life fish, plants etc. The contaminated water could not be used for crop water needs and it cannot be utilized in everyday needs by humans and animals. The toxic industrial liquid waste destroys every organism coming in its way. Oxygen in water is necessary for life in water. Dissolved oxygen level in water is tremendously consumed by liquid industrial waste which directly kills all living organism in water.

Smoke from the chimneys of industries at large scale causes air pollution. Smoke and toxic gases in it can spread over nearby residential areas. Which could cause breathing problems. Lungs and throat are affected on large scale by the toxic gases in smoke. These gases can weaken humans and animal's respiratory system. The hazardous gases in industrial smoke

could bring about changes in the weather patterns. It could result in less rain more barometric pressure and smog in winter.

Liquid and solid industrial waste toxicity can reach the ground water and inserts heavy metals in it. Which could turn ground water not fit for consumption and use. Rivers and streams are already exposed to industrial waste. Gases industrial waste can bring about acid rain which can destroy corps. Solid, liquid and gases are already causing skin and breathing problems. Destroying our immune system. We are attacked on every front by this industrial waste.

The industrial waste is directly responsible for environmental degradation.

1.2 Growing Importance of the field of inquiry

In 1970s countries started to realize the devastating impact of industrial pollution on environment. Legislation's, environmental rules and regulations are made to be imposed on the industries polluting the environment[1][1]. Industries are bound legally to take environmental measures and reduce the impact of industrial waste on environment.

With the passage of time new and greener technologies are introduced in manufacturing industries which drastically reduced the waste generated during manufacturing. Today industries are working on green innovations which could lead to better environment, economy and provides competitive advantage [2]. Environmental management is an important field of interest that is explored today in academia and among industrialists. Corporate social responsibility (CSR) is taken as integral part of business in developed nations.

1.3 Statement of the Problem

In the developing country like Pakistan the adoption of green practices, innovations in cleaner environment and technologies by industries is far behind the developed countries. Environmental management is not seen ethically a field of concern for better environment nor do Pakistani industries pay attention and fulfil CSR[3]. Though the environmental rules and regulations are charted by the government, but they have no impact on the industries to take green environment measures and reduce the impact of waste on environment[4].

[1] http://www.deq.state.ok.us/lpdnew/wastehistory/wastehistory.htm

1.4 Objectives

Multiple factors play their role in not adopting the green measures by Pakistani industries. This study first highlights the main barriers that do not allow industries to take green environment measures. A bench mark was first carried out in first phase to investigate the scope and strength of the barriers. In the second phase a conceptual model was constructed to figure out determinates and pressures that motivates Pakistani industries to adopt green environment measures.

1.5 Application of the research

Determinates to adopt green practices and fulfilling CSR can be utilized by mangers to construct the future strategy of the firm. Government can use it for future legislations which could enhance the willingness of industries to take environmental measures against pollution they are generating.

CHAPTER II

LITERATURE REVIEW

Rapid urbanization and increase in population growth negatively effects the environment in Pakistan. [5].

24% of Pakistan GDP is constituted by industrial sector. Major industrial units are textile, tanners, cement, sugar, steel, tobacco, food processing and steel etc. Cotton processing and textile is the major industry in Pakistan constituting 8.5% of GDP. Textile sector employs about 45% of total labour force in the country second after the government. 38% of the manufacturing work force in country is employed in this sector. 57% of Pakistan exports revenue comes from textile products [6] . Roughly 2000 industrial units belong to this industry. The amount of small scale manufacturing enterprises (SMEs) are not know but it's evident that they are also in numerous numbers.

Major industrial units are situated in the cities of Karachi, Lahore, Kasur, Sialkot, Faisalabad, Multan, Peshawar and Sheikhupra. All the industries are located nearby sea, rivers and river link canals. Karachi industrial effluent waste is directly dumped in to the Arabian Sea. Lahore and Sheikhupra effluent waste, directly or through link canals is dumped in to river ravi. Kasur industrial effluent waste is dumped in to river Satluj. Sialkot industrial effluent goes through Nullah Aik and drops in river Chenab. Peshawar small and medium size units dump their effluent in river Kabul. Not only the effluent but also solid waste by manufacturing units also goes to rivers. Municipal effluent and solid waste is also disposed in the same rivers. This continuous dumping already destroyed much of the farming land and is busy in doing so.

2.1 Water Pollution by Pakistani industries

Drinking water contamination accounts for 20 to 40% of all diseases in the country. Surface and ground water in Pakistan is contaminated with coliforms, pesticides, toxic and heavy metals throughout Pakistan. Improper disposal of industrial, municipal waste and Indiscriminate applications of agrochemicals in agriculture are the main factors contributing to the deterioration of water quality [4]. 90% of industrial and municipal waste water is dumped in to nearby open drains which from their made their way to ground aquifers. By 2030, experts expect that Pakistan will become water stressed to water scare country. [7].

2.1.1 Industrial waste water effect on aquatic life

Aquatic life in Pakistani rivers, canals and at the belt of Arabian Sea border with Pakistan is highly effected by continuous dumping of industrial effluent waste in them. A recent study in Sialkot on the open drains located near tanning industry examined the effects of high concentration of heavy metals on two frog species. The frogs species living in the drain to which effluent from the tanners are exposed are found to be weak discoloured and contains heavy metals in body [8]. Huge concentration of heavy metals were found in the soil and ground water of Kasur, a major industrial city processing raw hides for leather industry [9]. The effluent from Pakistani industries without treatment cannot be used for irrigation and fish farming purposes [10].

2.1.2 Industrial waste water effect on vegetation

The main industries located at various industrial zones of Pakistan dump the heavy metals effluent in open streams. These streams are used for irrigation purposes. The elevated concentrations of heavy metals are continuously entering into the food chain through agriculture leading to serious health hazards and a threat to the sustainability of local ecosystem [11]. In Hayatabad, Peshawar Pakistan heavy metals were found in the vegetables grown by using the water contaminated with industrial effluent [12].

2.2 Soil pollution by Pakistani Industries

Soil pollution is also on vast majority on Pakistani urban and rural land scape. Almost every town located near industrial hubs is affected by solid waste. No proper dumping ground make the fertile land vulnerable to industrial solid waste disposal. Industries dump their solid waste on lands they found are empty or no one is its guardian. One can easily see the solid waste dumped improperly while visiting the major industrial hubs. Most practiced solid waste dumping is to drop it in the nearby rivers. Soil of Sialkot contains heavy metals beyond the permissible limit. All due to tanners and pharmaceutical industry [13].

2.2.1 Soil pollution impact on vegetation

Continuous wastewater irrigation has changed the soil physicochemical properties and has led to heavy metal uptake by food crops, predominantly vegetables. In Lahore it is found that metal concentration was greater in the vegetables grown in wastewater, than those grown in ground water [14].

2.2.2 E-waste Pollution – Current Hot Topic

E-waste is a hot topic discussed today in international environmental circles. Under developed countries like Pakistan is much effected by it. Under developed countries are dumping ground of this E-waste. E-waste is termed as world's fastest growing waste stream. The e-waste is recycled in Pakistan using crude processes (e.g. manual dismantling, burning, dumping and dipping in acids to extract gold and other precious metals)[15].

All the processes in recycling are not eco-friendly and are causing biggest damages to environment and human health.

Major e-waste recycling sites are located in Karachi. There is no big industrial unit that recycles this e-waste. Small scale business are busy in recycling it with manual methods. Which exposed them to dangerous gases and radiation. Future research in this field is necessary to quantify its damage to the environment and humans [16].

2.3 Air pollution by Pakistani Industries

Industrial smoke and vehicle emissions are major source of air pollution in Pakistan. Rapid urbanization and industrialization results in increase in various air pollutants in Pakistan. Little is done on the ground and the matter needs to be paid urgent attention [17].

Nearly every district in Pakistan has brick kiln small scale units operating in their vicinity. It is found that the old methods and techniques used in Brick Kiln industry has resulted an increase in gaseous pollutants in the atmosphere [18]. Industrial boilers in Sheikhupra are major source of air pollution in the district.

Yearly pollution growth in Lahore a major industrial hub and second populous city of Pakistan is 4%. The air quality of Lahore is heavily polluted and it did not meet the ambient air quality standards of world health organization (WHO). It’s all due to industrial and transport smoke emission [19].

In Islamabad the capital of Pakistan research was carried out to found the concentration of heavy particles in soil and dust near the main Islamabad high way. It was found that the soil and particularly the dust across the high way is polluted on medium level. It was concluded that rapid urbanization will increase the air pollution across the road[20].

2.3.1 Air Pollution Impact on respiratory system

Air pollutants from industries can affect the respiratory and immune system of humans on a disastrous level. People living near sugar mill in Jhang district of Pakistan fell stress in breathing and they face hurdles in their everyday social life due to smoke emitted by the factory [21].

Pollution generated by the vehicles in Pakistan is also raising on immense level. It is estimated that 45% of overall pollution in Pakistan is because of the vehicles black smoke. Developed nations are continuously working on building technologies for vehicles to consume green gas and emit green smoke. Green gas limits the use of fossil flue. In this way we not only save the environment from degradation but also saved the natural resource (oil, diesel) from burning.

From the above references it's obvious that mush is needed to be done on the ground. There for its necessary to find out determinants that motivates the Pakistani industrial units to adopt green technologies and save the environment from degradation.

Green Practice Adoption Determinants Factors

Many researches in the field of cleaner environment emphasis on the role of green practice adoption and its productive results. [22] list down the determinants which influences Chinese's logistics companies to adopt green practices. Another study in Taiwan restaurant industry studied the behavioural and attitudinal decisions by owners in adopting green practices [23]. Rapid urbanization results in mega construction. Construction sites are major source of noise, soil and air pollution. Determinants to adopt green practices in building industry is studied by [24] and found major pressures which influence the construction firms to operate greener and cleaner. Green supply chain management (GSCM) is another hot topic in cleaner environment studied widely across the globe. GSCM includes firms activities like purchasing raw material, its shipment to factory location and final product distribution[25]. [26] list down the current practices and pressures influencing Chinese firms to go green in GSCM sector. Some of the major pressures and factors which influence green practice adoption across multiple domains of social life are listed below.

Role of Environmental Ethics in adopting green practices

Corporate environmental ethics is driving force of competitive advantage. It is directly linked to innovation. Multiple studies proved that corporate environment ethics is positively linked to green process innovation and green product innovation[27]. It directly affects the competitive advantage and influence indirectly to green innovation[2]. Ethical leaderships when strong has positive effect on firms reputation through CSR [28]. Ethics plays an important role in constructing the behaviour of a person. A person possessing high code of ethics take positive decisions whereas the person on lower level of ethics take arbitrary and unclear decisions[29].

Role of Government support in adopting green practices

Government support is a dominant factor in adopting green practices and it is found that incentives from government results in cleaner productions [24]. Government can play an important role in motivating the suppliers for adopting GSCM practices [30].

Government support is usually taken as a benefit in terms of economic and growth. It is also considered that the government support in different forms provides benefits in national security. High social return rate is generally neglected in this case which authors argues[31]. The same government support principle is present in case of south Asian countries like Pakistan and India. In multiple sectors government support yield positive result[32]. But in many cases the same variable didn't performed well and end result is loss of money[4].

Role of Individual Knowledge in adopting green practice

A study on employees reveals that environmental knowledge, environmental concern and environmental awareness builds up the ecological behaviour of employees and ecological behaviour is positively linked to employees intentions to implement green practices [33]. Managers with environmental knowledge and value are more willing to respond to environmental issues [34]. When it comes to foods it is found that greener restaurants have higher customer retention rate [35].

Knowledge plays a vital role to wards change and innovation[36]. It is universally now accepted that knowledge when properly utilized results in the form of innovations. Innovations are in the field in which the one is trained in and the particular one practiced it. Fitting new information in some one head is a hard task, especially when he is not prepared for it. Research

in this field concluded that knowledge building plays and important role in bringing about conceptual change in one's mind[37]. Adopting green practices in manufacturing processes is found to be hard. Managers are not willing to go green. All because of the fear and perception of running out of money. Knowledge building can play an important role here.

Role of Pressures in adopting green practices

Customers environmental requirements and support are positively linked to supplier supply chain initiative [30]. Environmental awareness in Chinese firms is increased due to three pressures regularity, marketing and competitive advantage [26]. By manipulating ecological variable firms can gain completive advantage [38].

Larger firms tend to purchase raw materials from firms which full fills CSR responsibility, are eco-friendly and comply with the international standards. Developed nations firms like American firms are more willing to purchase raw material from firms/suppliers which properly treat their generated waste and according to regularity compliance [39]

Role of organizational size in adopting green Technologies

Organization size plays an important role in adopting the green practices. Researcher in different countries tried to drive the relationship between organizational size and adopting green practices. [40] found that in china small and medium size organizations had some advantage in adopting green practices when compared with their small-scale unit's counter parts. Small scale firms shows shallow ecology ethics [41].

Benchmarking and highlighting the Roles of factors discussed above in perspective of Pakistani industry by presenting the real industry examples

The real worlds examples below show the managers and government behaviour towards cleaner production and technologies. What's the role of competitive advantage in adopting cleaner technologies? Do the pressures (regulatory, customer) motivates industrial units to adopt greener productions? Does government support is enough for industries to save environment from degradation.

The examples below reflect the image and ground realities of private, government and semi government industry to wards green technologies. What measures they adopted to preserver environment from degradation and how successful they are in saving the environment.

Roughly 10% of manufacturing and production units in Punjab province of Pakistan installed effluent treatment plants. These 10% are big industrial units, employing more than 800 peoples. 4% of them properly treat effluent and follow the NEQS (National environmental quality standards). Rest 6% do not operate the plants due to high running costs. During inspections they run the plant to show government authorities that they are fulfilling the NEQS and CSR. 90% of the industry comprised of medium sized units (Medium size mean that the unit employs 100-200 people.) and small-scale manufacturing units (Quantitative figures are given by Punjab environmental protection department).

2.4 Real World Examples

- Royal Tanners – Private sector
- Combined effluent treatment plants (CETPS) – Semi government
- Islamabad I-9 Waste water treatment facility – Government run

2.4.1 Royal Tanners

Royal Tanners is a private goat skin and hides processing unit located at 31 km Lahore Sheikhupra road. It processes about 100000 to 120000 Kg /month raw hides and skins. Established in 1986, Royal lather industries limited is a vertical unit producing finished leather for shoes, garments, hand bags and furniture. It comprises of leather tannery and stitching factories for garments and furniture articles. The tannery is equipped with the most modern imported machinery from Italy, France, Germany and Netherlands. There are about 600 people working in tannery and 400 in stitching factories. Royal tanners is one of the top renowned unit in Sheikhupra which fulfils CSR and practice green manufacturing.

Royal tanners took decision to install waste water treatment plant at their facility in year 2000. It took 5 years to complete the project 2001-2005. Plant become operational in 2005. Total capital cost of the project was 70 million rupees. Plant was installed on an area of 4 kanal. Total effluent waste water treatment capacity of the plant is 1500m3/day. Effluent treatment method is Biological (Activated Sludge Process).

First chromium is removed from the effluent with a separate process. Than the effluent is treated biologically in waste water treatment plant. 100% of the effluent generated by the royal

tanners goes through the treatment process. Around 2% of the total effluent is waste from kitchen and toilets of royal tanner's rest is the water used from soaking and washing the hides.

Currently 300 to 800 m3/day waste water is generated by the royal tanners. Average daily waste water generated by the royal tanners is 550m3/day. Production unit runs 24 hours a day and so is the waste water treatment plant. 8 person's works at plant in four shifts. A backup up generator is also installed at the facility in case of power failure. 9 pumps and motors are installed at plant for water pumping etc purposes.

Coagulant 25kg/1000 litres and Flocculent Polymer 1.25kg/1000 litres is used for sludge generation. 2mg/litre of oxygen is maintained in the waste water to stop bacteria from decaying. After treatment the water ph level is between 7-9. Treated water is drained or sometimes it is reused for washing purposes.

2.4.1.1 Year 2016 operational cost of the royal tanner's waste water treatment facility

Operational cost is divided in to 5 major costs. Labour, electricity, laboratory, chemical and maintenance costs. The table below shows per month and yearly expenditure. Cost per cubic meter is also entitled in the table. Chromium plant capital and operational cost is not included in the table it will be discuss separately.

Table 1 Operational cost of Royal Tanners year 2016

Description	**Total year**	**Per Month Exp.**	**Cost/Cu m**
Labour Cost	1,707600.00	142,300.00	14.06
Electricity Cost	2,179737.60	181,644.80	17.95
Laboratory Tests	415,823.00	34,651.92	3.42
Repair and Maintenance	274,911.00	22909.25	2.26
Chemical Consumption	495,238.00	41,269.83	4.08

Bar view of the operation expense is below. Electricity and labour cost has greater share in the total expense.

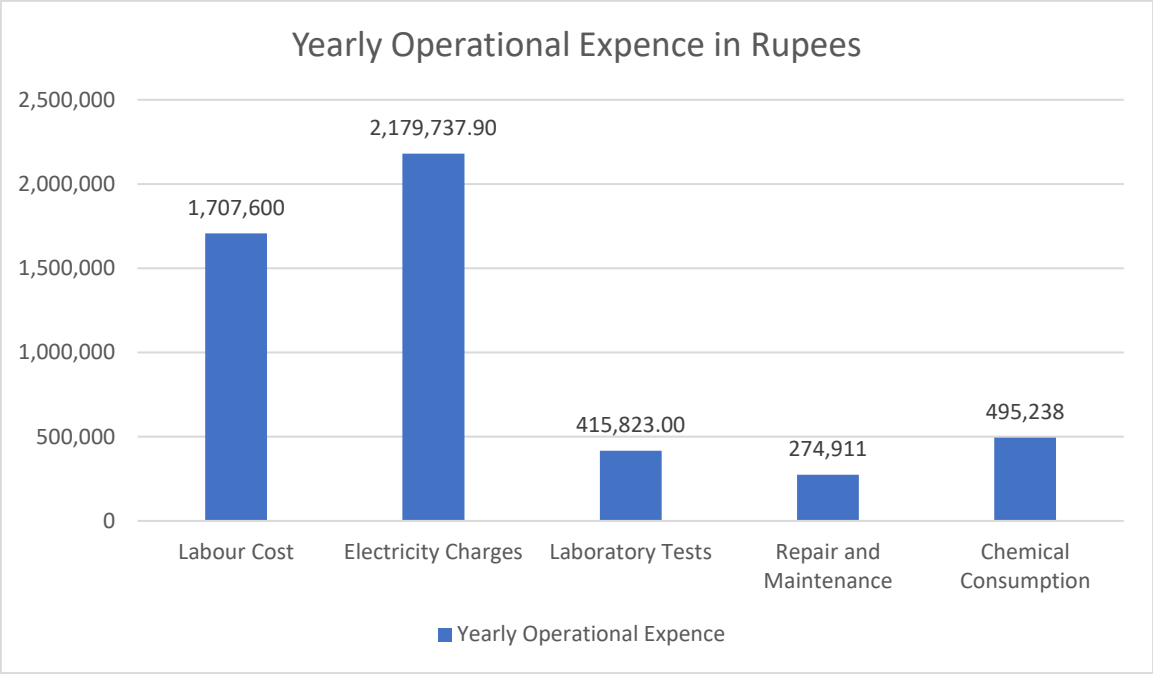


Figure 1 Royal Tanners Yearly Operational expense

2.4.1.2 Percentile view of operational cost

Electricity charges are 43% of the operational cost. 34% is consisted of labour cost, 10% is occupied by chemical. 8% by laboratory tests and 5% by repair and maintenance. Per unit electricity charges for industry is greater than that of average house hold. Pakistan is also going through major energy crises. Heavy power blackouts are made on industries which halts the production and ultimate loss in business. Customers deadlines are not meet which results in loss of customers. During power short outs effluent and production plants are run on generates. Which consumes diesel. A big burden on running cost. Not only generator's increases running costs, it's also burn diesel which results in air pollution and noise pollution. To control water pollution by generators' results in air and noise pollution. Second big cost is chemicals. Poor quality of chemicals made locally do not produce good results in treating effluents. Due to which chemicals are also imported from other counters which includes extra cost of shipment. It's hard to operate the effluent plants in the above conditions. An extra load and resource is required for the tackle the above tasks.

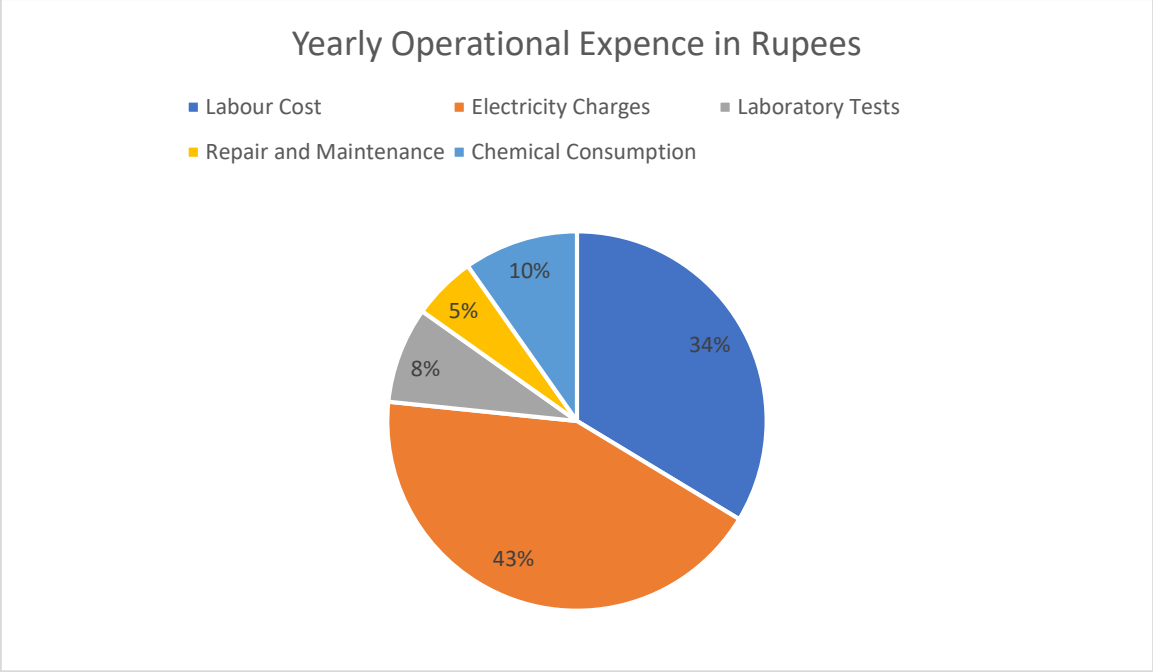


Figure 2 Pie chart distribution of yearly expense (Royal Tanners)

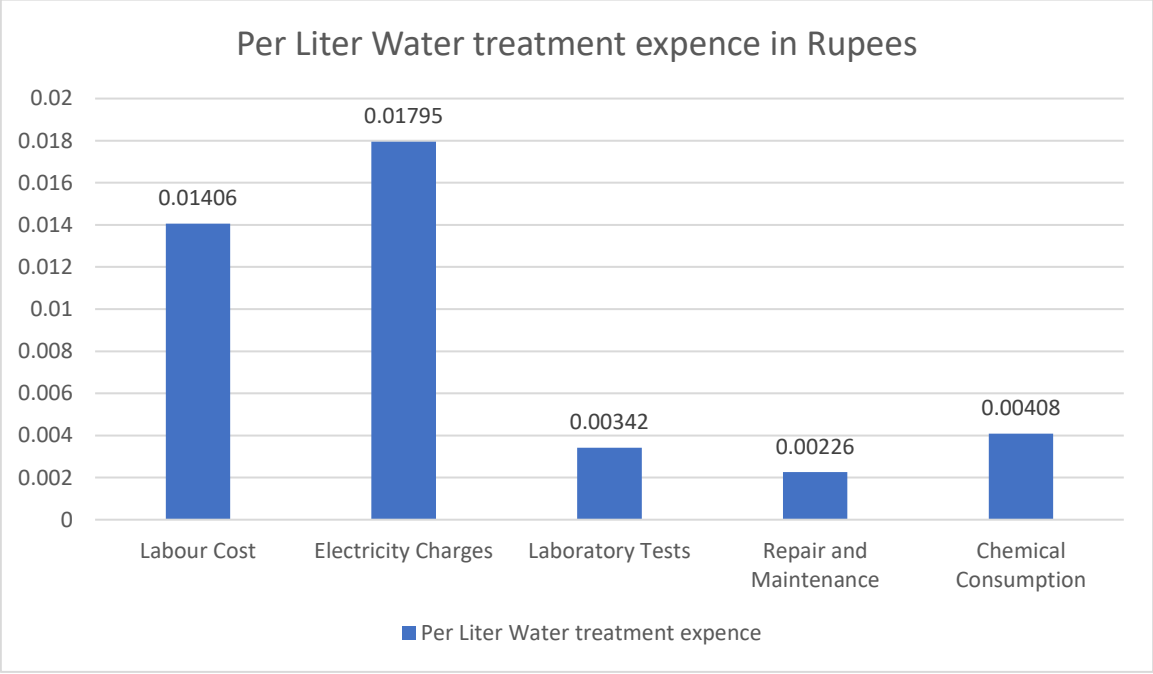


Figure 3 Per Liter water treatment cost (Royal Tanners)

Total operational cost of year 2016 Rupee's: 5,073,309.60 Rupees

Total effluent treated in the year 2016: 121,444.80 Cu m

Per month effluent treated in year 2016: 10,120.40 Cu m

Effluent treatment Cost per cubic meter: 41.77 Rupees

Cost per litre : $\frac{Cost\ per\ cubic\ meter}{1000}$ = 0.04177 rupees

2.4.1.3 Finance barriers analysis with royal tanners' example

Pakistani industry consists of medium size manufacturing units and big production firms. Medium sized production units out numbers big units in quantity and production. Official statistics of medium sized production units are not available rather no research is done on this field so it's hard to predict a quantitative quantity of the medium sized manufacturing and production units. But it's clear from the ground study that medium size industrial units in Pakistan are in greater quantity than big units.

2.4.1.4 Capital cost Investment

Initial capital cost of taking green measures and fulfilling CSR is very high. Like for the royal tanners investing in the waste water treatment plant is a hard pill. 70 million rupees is a huge amount today and one can imagine what 70 million worth in years 2001-2005. Pakistan medium sized enterprises start their business with the investment of 20 to 50 million rupees. It's hard for these businesses to invest in green measures.

2.4.1.5 Operational cost investment

Operational cost is also a big burden like 5,073,309.60 Rupees per year for royal tanners to invest in treating effluent is a huge amount. Medium sized enterprises could not afford to invest that much amount in green practices.

From the above points it's clear that Pakistani medium sized enterprises hesitate to invest in green practices due to high costs.

2.4.1.6 Long run advantages

Royal tanners invested in green practice which today brought them the award of one of the best tanners in Pakistan. It's all due to quality of leather and green practice adoption. Today they advertise their green practice adoption which brought them international customers and ultimate increase in sales and revenue. So in long run green practice adoption can increase sales and revenue. It also helps to improve environment.

2.4.2 Combined Effluent treatment plants (CETP) (Government, public and NGOs initiative)

Major tanner's clusters in Pakistan are located at Karachi and Kasur. The pollution they were generating was on huge scale. Not even a single manufacturing unit has effluent treatment plant in the vicinity. The idea of installing combined effluent treatment plant for a cluster of tanners was floated in year 1993. Two CETPs were built in Pakistan one in Kasur for Kasur cluster of tanners and other in Karachi for Korangi tanner cluster.

2.4.2.1 Karachi Korangi tanners CETP

Total capital cost of the project was 492 million rupees. Project was funded by Trade Development Authority of Pakistan (TDAP), Ministry of Commerce, Govt. of Pakistan, Pakistan Tanners Association (Southern Zone), Govt. of Netherlands, Govt. of Sindh and City District Government, Karachi. Plant has a capacity of treating 42,000 cubic meters per day of effluent from tanners. Among 42,000 cubic meter, tanners waste water quantity is 16,500 cubic meter and 26,000 cubic meter of domestic waste water from main land Karachi is treated at the facility. The domestic waste water plays an important role in treating the effluent. Plant works on Dutch Up-Flow Anaerobic Sludge Blanket (UASB) technology. 12km of pipe lines brought effluent from the tanners to waste water treatment plant. Plant occupies 15 acres of land. Total staff administrative and technical employed at korangi tanners waste water treatment plant is 75. 150 to 180 small and big tanners can take advantage of the waste water treatment facility.

Capital cost of 492 million divided in to major sub task costs.

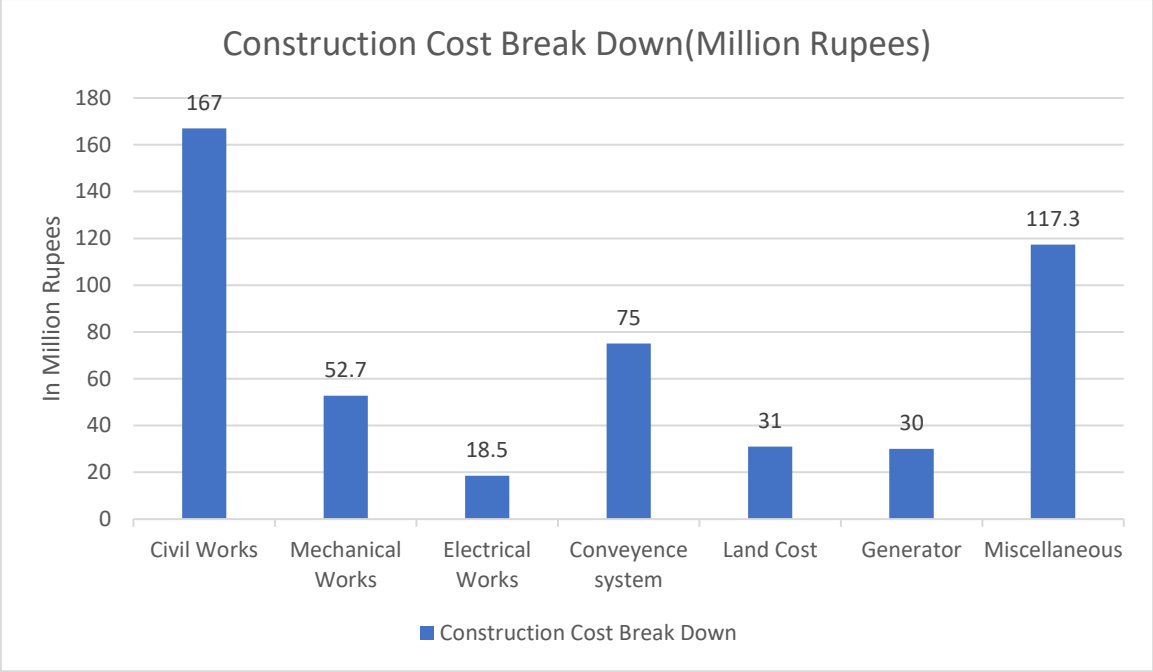


Figure 4 Karachi Korangi CETP cost distributions

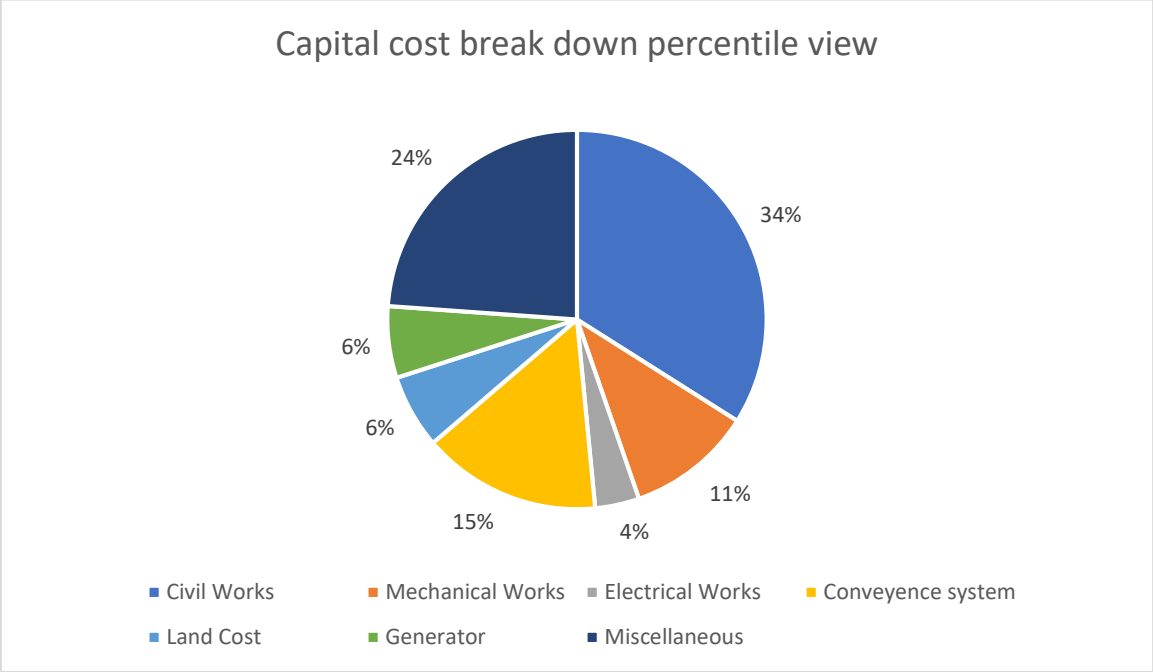


Figure 5 Karachi Korangi capital cost pie chart distribution

Pilot scale study was conducted out in 1998-1999. Plant construction started in 2001 and completed in 2006. Plant became operational in 2007. Finance was the major issue in plant delayed construction. Construction halted many times during construction due to lack of finance and delayed donation by donors.

2.4.2.1.1 Operational cost of Korangi tanners waste water treatment facility

Operational cost of the plant legally has to be bearded by the beneficiaries, the tanner's units. Each tanner has to pay 7.5 rupees per cubic meter of waste water he is discharging. It was estimated that operational and maintenance cost of korangi CETP is 45 million per anum. But soon after the operationalization of the plant the individual tanners showed resistance in paying the price to CETP for their share of waste water discharge.

Per litre treatment cost = $\frac{Tanners\ liable\ to\ pay\ per\ cubic\ meter}{1000} = \frac{7.5}{1000}$ = 0.0075 rupees

2.4.2.2 Kasur tanners CETP

One of the big raw hides and skin processing tanning cluster is situated in kasur city adjoining Lahore a major industrial hub. A CETP was also set up here for tanning cluster. Capital cost of the project was 497.24 million rupees. 298 million rupees were from United Nations development program (UNDP). 199 million is local bodies share namely Punjab government, federal government and Pakistan tanner's association. The project intends to upgrade an already existing simple waste water treatment plant. Technical and managerial support, procurement and construction, training and awareness of local people is essential part of the project being carried out by the united nation industrial development program (UNIDO). UNIDO is an implementation branch on UNDP. Installation of pilot chrome recovery plant is also carried out. Plant treatment capacity is 13,000 cubic meter per day.

Figure 6 CETP Kasur

Construction of solid tanner's industrial waste dumping site is also part of the project. Before that solid waste is disposed on nearby open lands. This solid waste covers about 327 acres of land. In moon soon 311 acres of fertile land is affected by this tanning solid waste due to flow of hazardous metals from waste towards streams which are used for irrigation purposes.

In June 2002 Kasur CETP became operational. 230 tanners were expected to take advantage of the Kasur CETP. The operational cost of the plant here is also legally must be bearded by the beneficiaries, the tanners.

2.4.2.3 Operations problems of CETP Karachi and Kasur

The construction of both CETPS were heavily dependent on government and foreign donors. In many phases of construction, the work halts due to shortage of financial resources and delayed donations by the donors. Technical assistance is also provided by the foreigners. Since the equipment of CETP was also imported extensive training sessions of local employs were also conducted.

- Soon after the completion of the project the individual tanners refused to pay their share of money to CETP[42].

- Significant technical and plant operational issues pooped at both CETPs[42]. Due to which randomly CETPs stopped working for months.
- Kasur tanners CETP only pre-treats effluent and discharged water containing chromium in it. The pilot scale chromium recovery plant at Kasur CETP only captures 10% of chromium. Rest is discharged in river Satluj. It did not fulfils NEQS[43].
- Korangi CETP also have limited chrome recovery ability. Individual tanners are advised to install chrome recovery plants at their units. But despite repeated notices many tanners refused to install plants at their sites. Due to which Pakistan tanners association (PTA) have to report non-compliance with NEQS tanners names to Sindh provincial government. Out of 80 only 9 installed chrome recovery plants at their sites. Which account 35% of the total chrome used by Korangi tanner's cluster [42].
- Kasur tanners CETP did not cover the whole tanners located near Kasur. Many tanners are discharging effluent without any treatment.
- Many tanners in Kasur are even paying less than their due share to CETP Kasur.

Both CETPs today did not work properly due to above issues. Nothing is done for the up gradation of the plants. The plants are now decade old. The news of upgrading and tackling the issues related to CETPs publish every year in newspaper but little is done on the ground.

In 2004 it was estimated that the secondary plant to recover chrome at Kasur tanners would cost 800 million rupees. Approximately double the cost of CETPs. The capacity of Kasur CETP is 18,000 cubic meter per day but it is treating 8000 to 13,000 cubic meter per day. It is also in pipe line to repair the faults and bring it back to 18,000 capacity. But still in 2017 nothing is done. In 2009 a grant of 142 million rupees was passed by federal government but it was never released[2].

In 2014 the conditions remain same only the tanners increased from 180 to 300. 150 tons of solid industrial waste and 9000 cubic meter effluent is daily dumped in open drains and river Satluj[3].

[2] https://tribune.com.pk/story/527947/pollution-by-tanneries-kasur-to-get-a-secondary-treatment-plant/
[3] https://www.pakistantoday.com.pk/2014/05/12/pollution-in-kasur-crying-for-attention/

2.4.3 Why Combined Effluent Treatment Plants (CETPs)?

To tackle high construction, operation and maintenance cost of effluent treatment by industries CETPs idea was floated. CETPs minimizes the cash outflow. Through use of CETP no significant cash outflow is required like in case of IWTP (Individual waste water treatment plant). Management will be free from stress of operation and maintenance issues. Initially it was estimated that

Capital cost of CETP: IWTP = 1:10

Operational and maintenance cost (CETP: IWTP) = 1:5

The results showed that though the construction cost is low. But operation and maintenance cost varied significantly due to poor management and technical staff. CETPs can perform better with proper trained employees. R&D locally in this sector is also a dire need today.

2.4.3.1 Government Domestic-industrial effluent treatment plant I-9 Islamabad

The government of Pakistan decided to build first, advanced and biggest waste water treatment plant in its capital Islamabad. Project capital cost was estimated to be rupees 2.72 billion. Construction of the plant completed in three years. Plant became operational in 2009. The plant was built with foreign assistance, French engineers took part in the construction and training programs. Equipment was procured from foreign companies. Total treatment capacity of the plant is 17 million gallons per day. It was estimated initially that the operational cost of the plant will be approximately 3 million rupees monthly. Treated water will be dropped in nullah Lai and solid waste will be further treated to make fertilizer for green belts and parks located in the vicinity.

Figure 7 Islamabad I-9 Waste water treatment plant

From the day one the project was not welcomed by the locals and serious issues were highlighted from different bodies.

An article published in The Nation Pakistan a few days before inauguration of the project (18 February 2009) highlights the main issues that were not significantly addressed. The existing sewage network could not carry 17 million gallons of sewage water to plant. Sewage lines are not wide enough to carry that much effluent[4].

- Engineering wing of capital development authority also highlights the same issue and entitled it a useless project. According to them first it needs to rehabilitate the existing sewage network that has been broken from many locations.

20 July 2013 Pakistan Today article states that the residents of nearby effluent plant complains about foul smell emitting from the waste water treatment plant. According to the resident's children are mostly affected by the smell. Plant is breeding ground for mosquitoes and other harmful flies. Plant is acting as a major source of pollution to stop water pollution it is generating air pollution[5].

In 2015 the performance of plant is still poor. Poor management and technical staff is costing Pakistani government millions of rupees per month to float the sinking boat[6].

[4] http://nation.com.pk/18-Feb-2009/Sewerage-treatment-plant-at-I9-to-cost-Rs-2727b
[5] https://www.pakistantoday.com.pk/2013/07/20/not-a-good-treatment/
[6] http://www.dawn.com/news/1216077

In December 2016 plant has been shut down after seven years. Faulty equipment and insufficient flow made the authorities to shut it down. Plant was receiving only 2 million gallons per day over the total treatment capacity of 17 million gallons per day. Official also said that plant never received the 17 million gallons in his entire life[7].

In 2017 government bodies accepted that the project is failure and cause millions of rupees loss. The reason is poor planning, lack of technical and management problems and a bonus of corruption. It was also acknowledged that the treated water is not fulfilling NEQS[8].

Generating electricity with methane gas produced during sewage treatment is also part of the project and a special methane chamber was built for this purpose. But it never became operational in his entire life. Only few experiments were performed and due to complexity and no technical resource to handle the process no electricity was produced.

Currently 104 people are employed at the facility and per gallon treated water cost is 1.5 rupees. The cost is never calculated by the authorities only an approximation is made and forwarded by authorities during interview.

Per Litre treatment cost = $\frac{Cost\ Per\ gallons}{3.78541}$ =$\frac{1.5}{3.78541}$ = 0.396 rupees

Government failed to operate the biggest effluent treatment plant due to complexity and lack of technical staff. If government is failed how could it motive the private sector to invest in the green practice adoption and fulfilling CSR.

2.5 Government failure

Pakistan government formulated the environmental laws in 1997. But they were unable to implement it properly. Stakeholders and politics play an important role in not implementing the environmental laws. Nearly every researcher in the field of environment pollution highlighted this point.

> Weak implementation of environmental laws in the country are responsible for the industrial pollution. No clear strategy is made to implement these laws. National

[7] https://epaper.dawn.com/DetailImage.php?StoryImage=12_10_2016_151_008
[8] https://www.dawn.com/news/1355747

environmental quality standards (NEQS) for municipal and industrial effluents were formulated in 1993 but could not be strictly implemented until now[4].

Industries should be forced to properly treat their waste waters before discharging and follow the NEQS for waste effluents [4].

Government is also not willing to construct more CETP plants. Due to the behaviour of the industries and the performance of previous projects.

Several reasons explain why the government did not agree to the loan for more CETPs. A major reason was the failure to come to an agreement upon a rate of interest that the government should charge the industrial associations for the borrowed capital for construction of the CETPs. Another reason was the failure to resolve whether the government or the industrial association should cover the costs of the land on which the CETPs would be built[42].

2.6 Future proposed projects- The case of Ravi treatment plants

Two waste water treatment plants were proposed to be built by government near river Ravi. River Ravi flows adjacent to Lahore city. Lahore is the second biggest populated city of Pakistan it is also capital of Punjab province. Total population of Lahore is 11.13 million (2017). River ravi is the most effected river in Pakistan by the water and solid waste. Approximately 40% of fish in the river is vanished. The same river is used to irrigate the most fertile lands of subcontinent. It flows from Indian province of Punjab to Pakistan province of Punjab. Indian state of Punjab also contains major industrial hubs which dump their waste in the same river. IT then enters into Pakistani Punjab region near Narowal. With its entry in Pakistan it is welcomed with industrial and domestic effluent and solid waste. Along its way in Pakistan nearly every major city, town and village dump their waste in it. IT then drops in to river Indus and finally paved its way to Arabian ocean.

Lahore and Sheikhupra are most populated cities and major industrial hubs. Lahore is located on east and Sheikhupra on west of the river Ravi. In 2009 Punjab environmental department highlighted that in order preserve environment from degradation there is an urgent need of treating waste that is directly dumped in river Ravi without treatment. In context to the issue 2 plants were approved to be built near Ravi in 2011.

Daily tribune article July 2011 states that it's possible that work on construction of first plant may start this year in December. 540,000 cubic meter of waste water is dropped in river Ravi on daily basis. Nearly all the waste water of Lahore is dropped in to it. It was expected that first plant will be built in three years and could treat 250,000 cubic meters of water per day. 750,000 tonnes of solid waste is also dropped in the Ravi per year. 70% of the project cost will be given as loan by the French government and the rest by provincial government. But the project halts due to do funding agencies[9].

Dawn July 2012 reports. A meeting of senior environmental officials was held and it was decided to take some practical steps and deal with environmental degradation of Ravi[10].

Pakistan Today august 2013 states. It was decided to conduct a feasibility study for the construction of plants proposed in 2011. Emphasis was to start construction without feasibility, because it's too late now[11].

According to Dawn May 2016. New theory is presented to construct 7 plants except 2[12].

2.7 Raw domestic water treatment from dams

In order to compare raw water treatment cost with effluent treatment cost a benchmark study on raw water treatment plants is also conducted. Two raw water treatment plants located near the capital Islamabad are selected for this purpose. Many managerial and technical flaws were found at both plants but this study only focuses on the treatment cost of raw water.

2.7.1 Khanpur dam- Sinjani water treatment plant

Khanpur dam supplies water to Islamabad and Rawalpindi. Sinjani water treatment plant located at the facility treats 23 million gallons per day. 8 million gallons is supplied to Islamabad and 15 million gallons to Rawalpindi.

[9] https://tribune.com.pk/story/218831/ravi-burning-sewage-treatment-plant-work-can-start-this-year/
[10] http://www.dawn.com/news/738539
[11] https://www.pakistantoday.com.pk/2013/08/02/two-waste-water-treatment-plants-on-ravi-approved/
[12] http://www.dawn.com/news/1258647

Figure 8 Khanpur dam Sinjani raw water treatment plant

January 2016 Operational cost

Electricity bill is = 24521700 rupees

Chemical cost is = 0.525 million rupees

Raw water Purchased from Wapda = 2339272 rupees

Chlorine + management + other costs = 2819028 rupees

January total water treated = 704 million gallons

Per day treated water = 22.7 million gallons

Cost per million gallons = $\frac{Total\ Cost}{MG\ Treated}$ = 42868.74 rupees

Cost per gallon = $\frac{Cost\ per\ million\ gallons}{One\ million}$ = 0.04286874 rupees

Cost per Litre = $\frac{Cost\ Per\ gallons}{3.78541}$ = 0.0113 rupees

2.7.2 Simly dam- Simply water treatment plant

Simly is the main water source which supplies water to Islamabad. 24 million gallons daily is now treated and supplied to Islamabad urban residents. At simly water treatment plant 45 people work in three shifts.

Figure 9 Simly dam raw water treatment plant

January 2017 Operational Cost

Electricity bill is = 727557 rupees

Chemical cost is = 39 million rupees

Chlorine cost = 27 million rupees

January total water treated = 744 million gallons

Per day treated water = 24 million gallons

Cost per million gallons = $\frac{Total\ Cost}{MG\ Treated}$ = 89687.57 rupees

Cost per gallon = $\frac{Cost\ per\ million\ gallons}{One\ million}$ = 0.089687 rupees

Cost per Litre = $\frac{Cost\ Per\ gallons}{3.78541}$ = 0.0236 rupees

In the above cost no management and human resource cost is included.

August 2016 Operational Cost

Electricity bill = 241198 rupees

Chemical cost = 39 million rupees

Chlorine = 27 million rupees

Total water treated = 1080 million gallons

Cost per million gallons = $\frac{Total\ Cost}{MG\ Treated}$ = 61334.433

Cost per gallon = $\frac{Cost\ per\ million\ gallons}{One\ million}$ = 0.061334433 rupees

Cost per Litre = $\frac{Cost\ Per\ gallons}{3.78541}$ = 0.0162 rupees

In the above cost no management and human resource cost is included.

2.8 Treatment Cost Analysis:

2.8.1 Waste water treatment from Private, Government and Semi Government Sector cost comparison

All the below mentioned costs are calculated above in the description of each sector.

- Royal tanner's effluent treatment per litre cost = 0.04177 rupees (Calculated per year basis of 2016)
- Koranig tanners CETP effluent treatment per litre cost = 0.0075 rupees (Fixed)
- Islamabad I-9 waste water treatment cost per litre = 0.396 rupees (Never calculated by authorities only floated)

Islamabad I-9 Cost > Royal Tanners > Korangi CETP

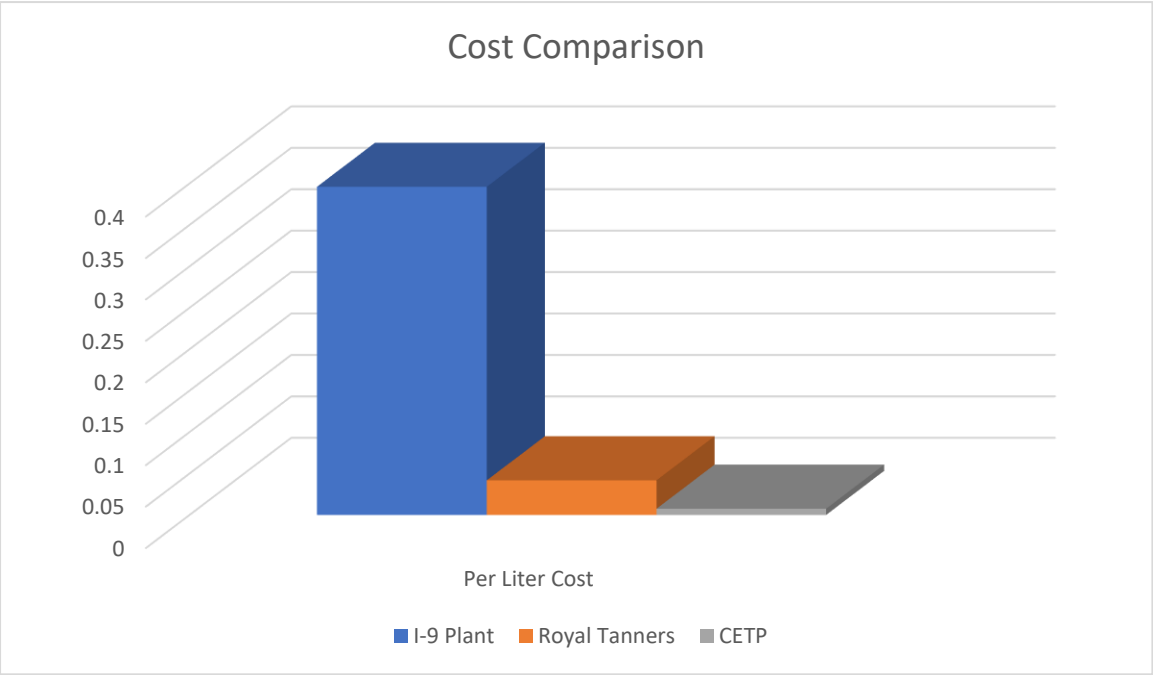


Figure 10 Cost Comparison (Royal tanners, I-9 and CETP plants)

The cost of CETP is significantly lower than the other two. Treatment cost of same amount of water by royal tanners is 5.5 times higher than CETP. But royal tanners is performing better than CETP in treating effluent and generating business. Since royal tanner is a private firm so the processes are more oriented towards achieving business goals. CETP can also perform better with government support and if qualified resource is deployed in it.

(Note in Royal tanners and Karachi Korangi CETP cost chromium recovery plant cost is not included. The above costs are after chrome recovery primary and secondary biological treatment)

The cost of government I-9 domestic and industrial effluent treatment plant is 9.4 times higher than royal tanners and 52.8 times higher than CETP. It's a big difference may be due to corruption. The cost must be lowest than other two but why its high is an unresolved matter.

(Note: The I-9 treatment plant per litre treatment cost is never calculated by authorities. This cost is floated and conveyed by manging authorities of I-9 waste water treatment facility.)

2.8.2 Comparison with Raw water treatment of dams to be used in homes

- Raw water simly water treatment plant cost per litre = 0.0236 rupees (January 2017)
- Raw water khanpur water treatment plant cost per litre = 0.0113 rupees (January 2016)

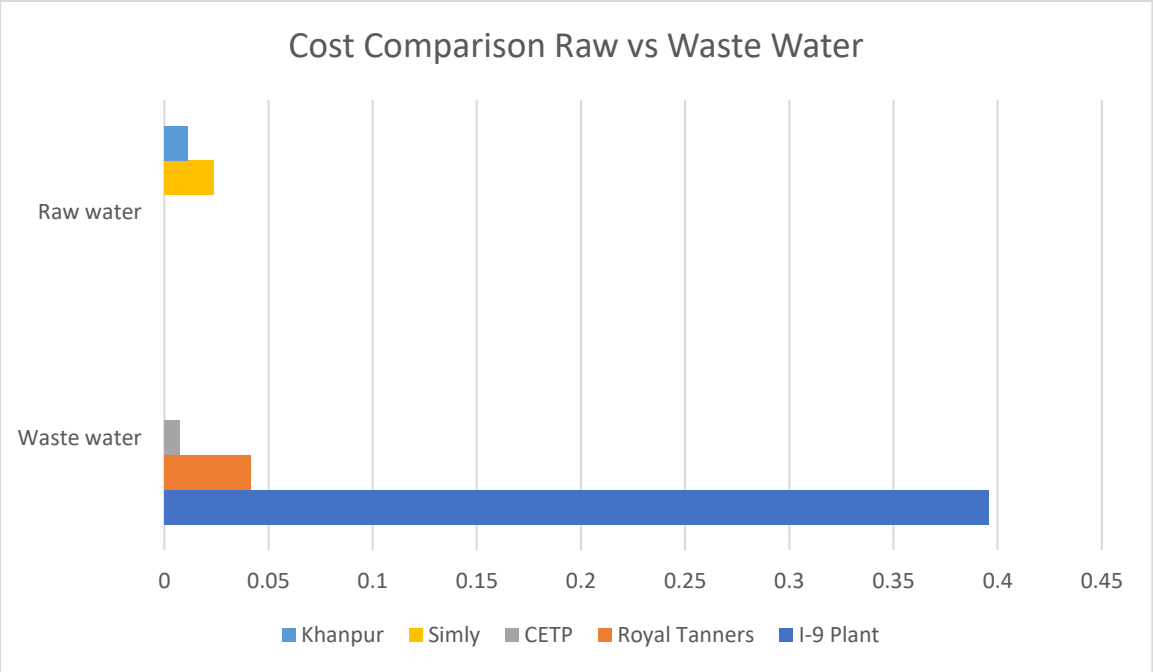


Figure 11 Raw and Waste water Treatment cost comparison

The cost of CETP is still low than raw dam water treatment to be used in homes. The raw water treatment costs are of January 2016 and 2017. The cost of I-9 plant is way high.

2.9 Summation Literature Review

Finance is the back bone of operations of any industry. Pakistani industry comprises of big and small-scale manufacturing enterprises. Financial instability increases environmental degradation [44]. Finance is not a strength of Pakistani SMEs and medium size enterprises, but still they can afford to take environment measures to reduce impact of pollution on natural environment. Government failure is also an issue it can also be overcome with the matter of time. Continuous writings, seminars and articles on environment can bring about change in government perception to deal with the issue of environmental degradation.

It's there for essential to find out the determinates that motivate the industries to take environmental measures, adopt green practices and fulfil CSR.

CHAPTER III

METHODOLOGY

This chapter starts with type of study. Then moves on to explain about the scope of research, data collection method, data sources, sample size and population. Further it discusses about the constructs their reliability and the constructs scale of measurement.

3.1 Type of study

The research in this thesis is no-experimental and is based on a survey questionnaire. Quantitative research approach is applied to gather information from the respondents on a numbered scale. A range of variables are tried to be measure in the study. The study focuses on determining the correlation among different variables. Hence, we can say that the study design is relational and correlational.

A real-world example presented in the literature review is based on comparative study between raw and waste water treatment plants by private, semi government and government operated plants.

3.2 Scope of research

Research is carried out on Pakistan manufacturing/production industry. All scales (small scale, medium scale, large scale) of manufacturing industries are part of the research. Manufacturing units ranging from (tanners, paper and pulp, textile, plastic and fabric, tiles and ceramic, tyres and tubes, resins producers etc) are all part of the study.

Domestic sewage and industrial effluents are the major contributors of water pollution[45]. A little is carried out on the ground to deal with the growing pollution threat. This study took the initiative to determine the determinants which encourage the Pakistani manufacturing units to reduce pollution and adopt green practices.

The study touches the research areas of corporate social responsibility (CSR), business ethics, environment reporting and pollution control.

3.3 Data collection method

The study is quantitative and is based on a survey questionnaire. After a pilot study the questionnaire is finalized. Data is gathered by visiting the manufacturing firms located in the different cities of the province of Punjab Pakistan.

Cities are further divided in to industrial clusters/divisions. Four clusters/divisions are part of the study. Cluster/divisions are

1. Lahore-Sheikhupora-Muridke
2. Sialkot
3. Hafizabad-Gujranwala
4. Kasur

3.4 Data Sources

Data is collected from senior managers and CEO's of manufacturing units. Data from Sialkot, Kasur and Lahore-Sheikhupora-Muridke cluster/division is gathered by visiting the respective units of clusters and filling the questionnaire on the spot by respondents. Data from the Hafizabad-Gujranwala division is taken by emailing the online questionnaire to the respondents.

3.5 Sample size and population

A total of 300 questionnaires were distributed among managers and CEO's of Pakistani manufacturing units. 223 were received back. Among 223 questionnaire 47 were completely un filled. 32 were partially unfilled. 12 of fully filled questionnaire were found to be highly biased. Those 12 were removed from the sample.

Final results were calculated on the sample of 132. Each cluster/division responses in total sample is below.

Cluster responses in final sample

Clusters/division	N
Kasur	44
Hafizabad-Gujranwala	18
Sialkot	17
Lahore-Sheikhupora-Muridke	53
Total	**132**

Table 2 Industrial Clusters/Divisions

The above 132 respondents break down in to individual sector is below.

Industry	N
Tanners	67
Textile	35
Paper and Pulp	13
Plastic and Fabric	8
Ceramic/Pharmaceutical	5
Tyre and Tube	4

Table 3 Break down total respondents' industry

3.6 Research framework

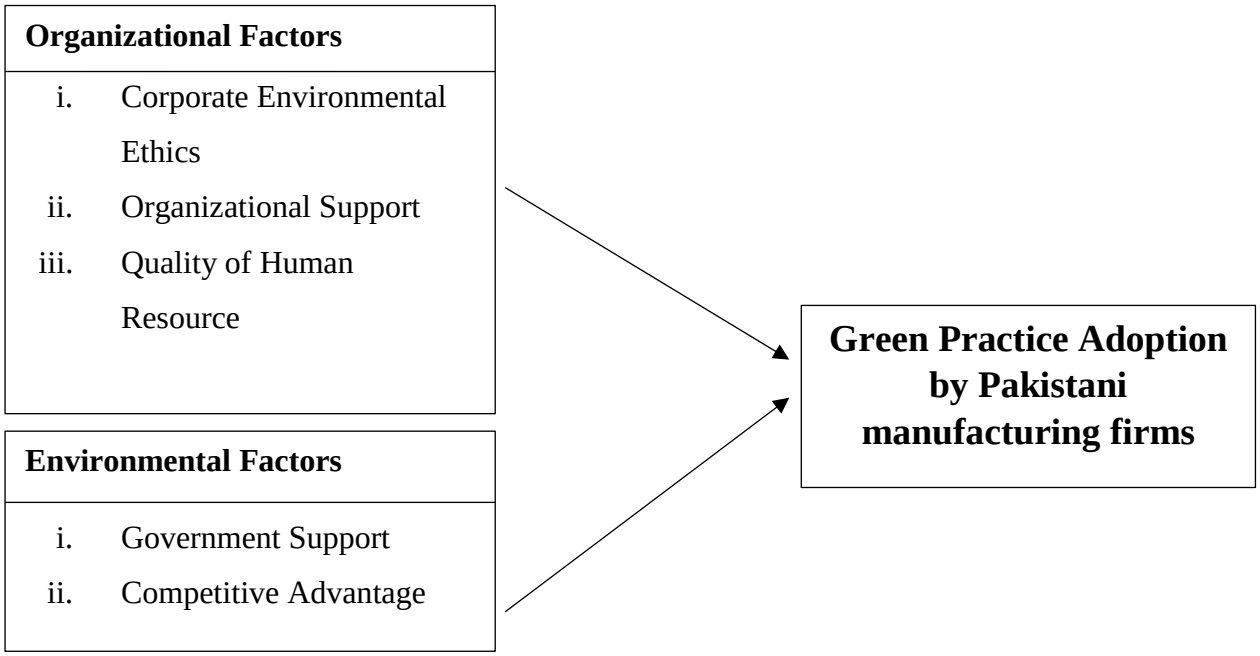


Figure 12 Research Frame work

3.7 Variables

Eight major variables are part of the study. The dependent variable in the study is "green practice adoption". Green practice adoption is the decision/willingness of manufacturing firms to respond to the environment issue. The independent variables are categorized in to two factors which influence an organization decision. Organizational factors and environmental factors. Four variables are part of each factor. Corporate environmental ethics, organizational support,

quality of human resource are part of organizational factor. Government support and competitive advantage are part of environmental factors.

3.8 Measure of Variables

Corporate Environmental Ethics – Four items are part of corporate environmental ethics (1) the company has clear and concrete environmental policies; (2) the company's budget planning includes the concerns of environmental investment or procurement; (3) the company has integrated its environmental plan, vision, or mission to its marketing events; and (4) the company has integrated its environmental plan, vision, or mission to company's culture[46].

Organizational support was measured according to the degrees of the company's resource supports and leaders' attitudes toward environment issues [47].

Quality of human resources was measured according to employees' learning and innovative capabilities [48].

Governmental support was measured according to the degree of financial and technical supports provided by the government for adopting green practices [48].

Competitive Advantage – Six items are part of competitive advantage variable (1) the quality of the products or services that the company offers is better than that of the competitor's products or services; (2) the company is more capable of R&D than the competitors; (3) the company has better managerial capability than the competitors; (4) the company's profitability is better; (5) the corporate image of the company is better than that of the competitors; and (6) the competitors are difficult to take the place of the company's competitive advantage [49] [50].

Independent variable 'Corporate Environmental Ethics' and 'Competitive Advantage' were measured using five-point Likert scale anchored by "Strongly disagree" to "Strongly agree". All the remaining dimensions are measured using seven-point Likert scales anchored by ''strongly disagree'' and ''strongly agree,''.

Two variables measured on five-point Likert scale are then transformed to seven-point Likert scale using the conversion formula $Y = (B - A) * (x - a) / (b - a) + A$ [51]. Standardising the

questionnaire on the same likert scale helps in data analysis. If the scales are not changed then during data analysis we have to standardise the variables. The most common way of standardising the variables is finding new z scores of variables. A z score represents how many standard deviations we are away from mean where mean is 0.

Another variable **company size** was also part of the study and it was included in organizational factors. But due to low response rate on particular variable and huge biasness find in answers and unwillingness of the huge number of respondents to disclose the size of their firm the variable was removed from the study.

The dependent variable in the questionnaire contains five items and is measured on a seven-point Likert scale anchored by ‘’not at all’’ and ‘’to a great extent’’. Respondents were measured on (1) green machinery purchase (2) treating waste (smoke, water, solid) (3) reducing waste during production (4) employees health and safety (5) eco-friendly supply chain process.

3.9 Hypothesis

H1: Corporate Environmental Ethics positively influences Pakistani manufacturing firms to adopt green practices.

H2: Organizational support positively influences Pakistani manufacturing firms to adopt green practices.

H3: Quality of Human Resource positively influences Pakistani manufacturing firms to adopt green practices.

H4: Government support positively influences Pakistani manufacturing firms to adopt green practices.

H5: Competitive Advantage positively influences Pakistani manufacturing firms to adopt green practices.

CHAPTER IV

DATA ANALYSIS & RESULTS

After data gathering its time to analyse the gathered data and find results to prove null hypothesis or go with the alternative one. For analysing the data, I used SPSS software tool to perform different tests on data. The tests which I carried out on data are "Psychometric test" to check the reliability and validity of data. Descriptive statistics and normality to check the normal distribution of data. Correlation to measure association and its strength between two normally distributed variables. Further to estimate the relationship between variables regression test in performed. At the end ANOVA (Analysis of variance) is run to check if statistically there is some difference between cluster/divisions of manufacturing units.

4.1 Reliability test

Reliability test is performed to check the internal consistency of the items and variables. It shows us if the scale for measuring a variable is reliable or not. Cronbach's Alpha is a value which determines the reliability of the scale. If Cronbach's Alpha value for each variable comes out to be greater than 0.70 then the scale is good to go with and the results are said to be satisfactory. I performed reliability test one by one on each variable included in our theoretical frame work. The Cronbach's Alpha value for each variable is greater than 0.70. Hence our results are satisfactory.

Variables	Cronbach's Alpha	"N" No of Items
Corporate Environmental Ethics	.864	4
Organizational support	.868	4
Quality of human resources	.840	4
Governmental support	. 818	3
Green marketing competitive advantage	. 836	6
Green Practice Adoption	. 864	5

Table 4 Reliability Test individual variables Cronbach alpha

4.2 Descriptive Statistics

Descriptive statistics shows us the mean, standard deviation, variance and minimum and maximum value of a variable after analysing the gathered data. The number of respondents are equal for each variable (N=132). Mean of Corporate Environmental Ethics and Competitive Advantage are nearly equal. Government support has the least mean value.

Descriptive Statistics

	N	Mean	Std. Deviation
Corporate Environmental Ethics	132	3.8598	1.29711
Green Practice Adoption	132	4.1727	1.07853
Organizational Support	132	3.9205	1.25526
Quality human resource	132	4.7027	1.11124
Competitive advantage	132	3.8965	1.01479
Government Support	132	2.9823	1.24198
Valid N (listwise)	132		

Table 5 Descriptive statistics

Another way to check the descriptive statistics of data is by performing "Kurtosis & Skewness" test. The output value of skewness divided by the value of kurtosis, must be in range of -1.96 to 1.96. If it's in this range we can say our data is normal[52].

Descriptive Statistics

	N	Mean	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Corporate Environmental Ethics	132	3.8598	.029	.211	-.924	.419
Green Practice Adoption	132	4.1727	-.040	.211	-.165	.419
Organizational Support	132	3.9205	.277	.211	-.345	.419
Quality human resource	132	4.7027	-.445	.211	-.007	.419
Competitive advantage	132	3.8965	-.243	.211	-.665	.419
Government Support	132	2.9823	.789	.211	.323	.419
Valid N (listwise)	132					

In our case quality of human resource and government support normality values are not lying in between -1.96 to 1.96. It's hard to find out the problem using kurtosis and skewness test for this we have to move to proper normality test like Kolmogorov-Smirnov and Shapiro-Wilk.

4.3 Testing for Normality

Normality test is perquisite to performing other correlation and regression tests. Normality of data can be found using numerically and graphically. I performed both tests. First comes the numerical test.

4.3.1 Kolmogorov-Smirnov and Shapiro-Wilk

Kolmogorov-Smirnov and Shapiro-Wilk are two popular tests to check the normality of the data. Shapiro-Wilk test best performs when our sample size is less than 50. It can also handle samples >50 but it's better to use it for sample size below 50.

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	df	Sig.
Corporate Environmental Ethics	.108	132	.001	.967	132	.003
Green Practice Adoption	.078	132	.046	.988	132	.320
Organizational Support	.086	132	.019	.975	132	.015
Quality human resource	.098	132	.003	.973	132	.011
Competitive advantage	.118	132	.000	.966	132	.002
Government Support	.124	132	.000	.940	132	.000

a. Lilliefors Significance Correction

Table 6 Kolmogorov-Smirnov and Shapiro-Wilk

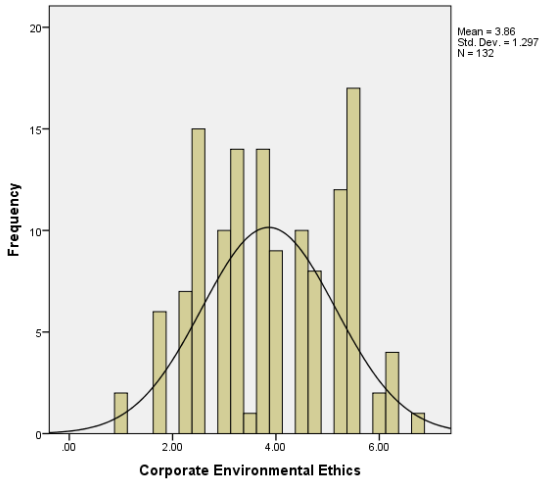
The results are normally distributed according to the tests. Only Green Practice Adoption variable Shapiro-Wilk test significant value is greater than 0.05 due to sample greater than 50. But according to **Kolmogorov-Smirnov** test the data is normally distributed and each variable is significant ($p<0.05$). Hence, we can say our data is normally distributed.

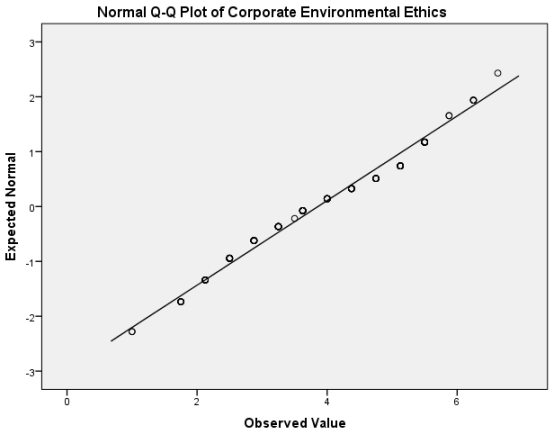
4.3.2 Q-Q probability plots

In order to check the normal distribution of variable graphically, plots are very helpful. Each variable distribution plot is shown below. All the plots are showing a curve shape. Some shapes

are not perfect but it doesn't mean that data is not normally distributed. The chance of error in graphical representation of data exists due to small sample size.

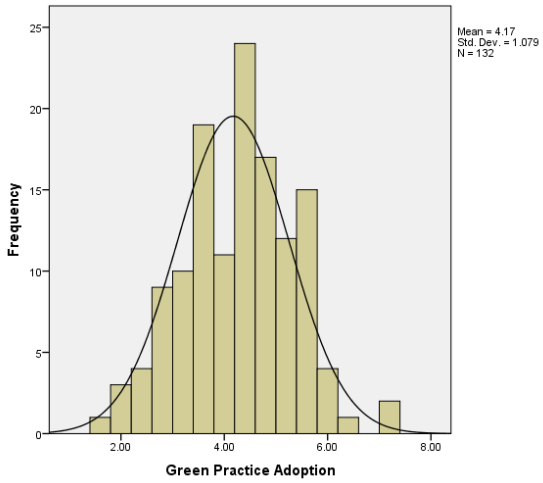
4.3.2.1 Corporate Environmental Ethics

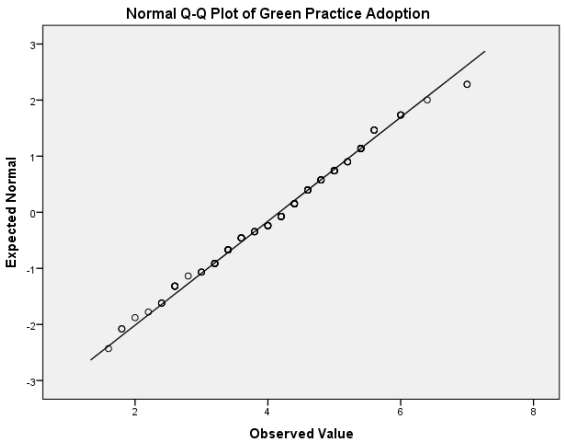




Graphical normality test of Corporate Environmental Ethics.

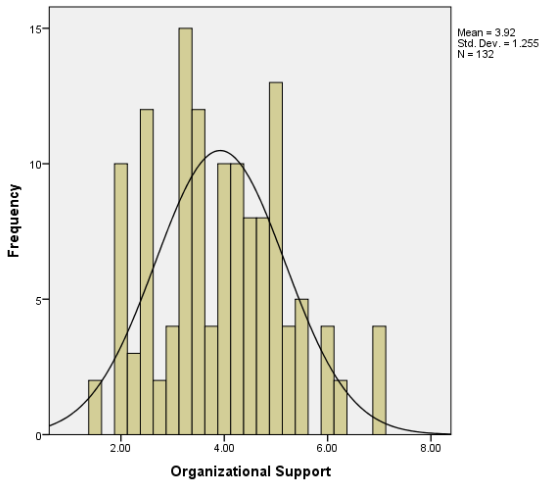
4.3.2.2 Green Practice Adoption

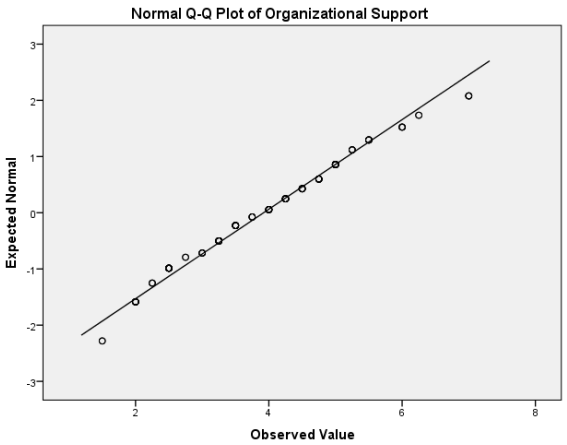




Graphical normality test of Green Practice Adoption.

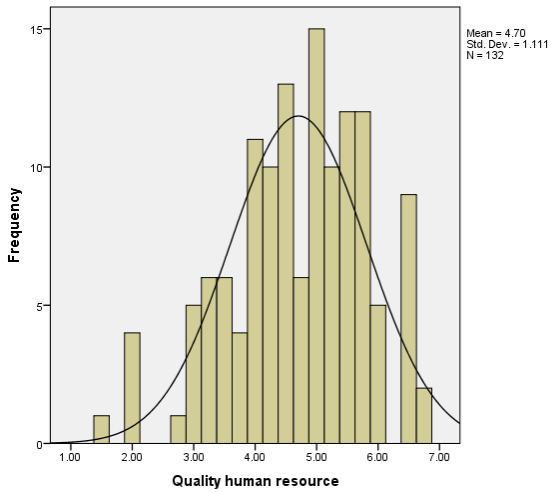
4.3.2.5 Organizational Support

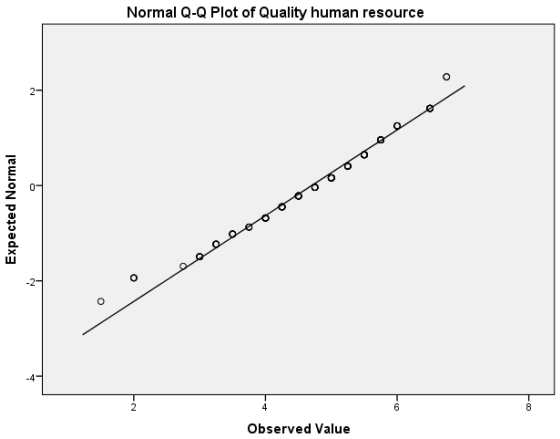




Graphical normality test of Organizational Support.

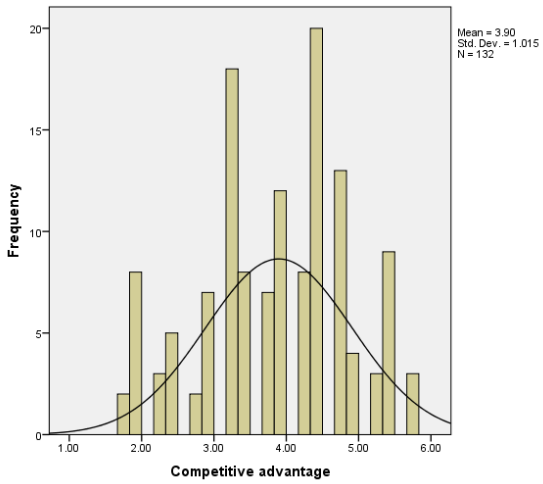
4.3.2.6 Quality human resource

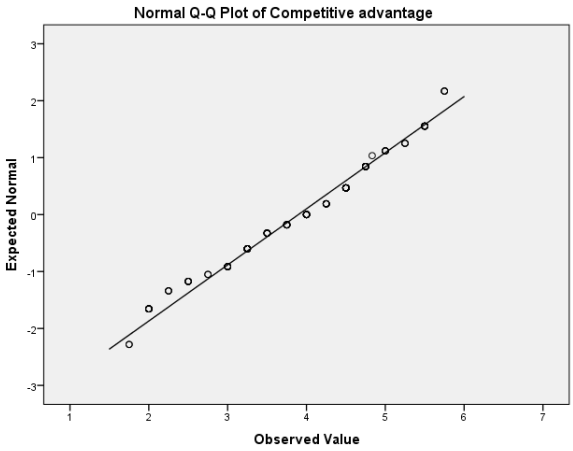




Graphical normality test of Quality human resource

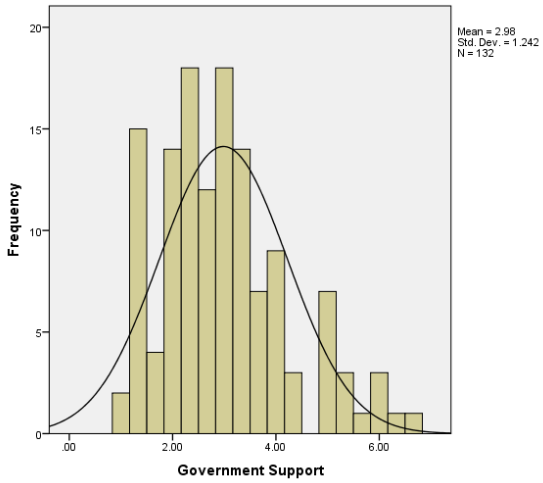
4.3.2.7 Competitive advantage

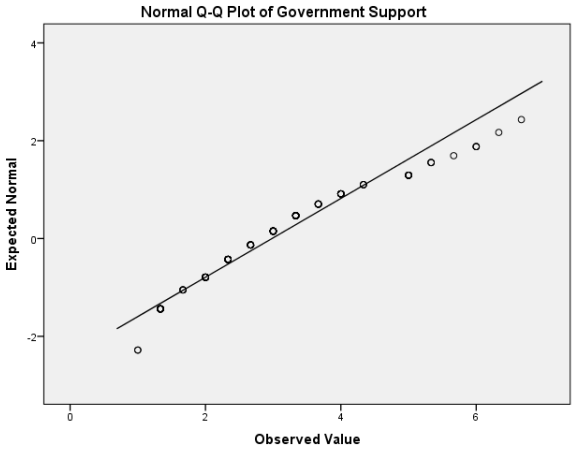




Graphical normality test of Competitive advantage.

4.3.2.8 Government Support





Graphical normality test of Government Support.

4.4 Correlation

For initial hypothesis testing correlation test is performed. According to the correlations test results below. All the hypothesis are proved and all independent variables (Corporate Environmental Ethics, Organizational Support, Quality of Human Resource, Government Support and Competitive Advantage) are corelating with dependent (Green Practice Adoption) variable. Results are not only corelating they also show high level of significance and strength. Corporate Environmental Ethics (0.648) and Competitive Advantage (0.636) are showing high level to correlation with Green Practice Adoption following by the Organizational Support (0.421).

The variables in the study are scaled so Pearson correlation is applied between the variables[53]. Two tail correlation results are presented in the study.

Correlations

		Corporate Environmental Ethics	Green Practice Adoption	Organizational Support	Quality human resource	Competitive advantage	Government Support
Corporate Environmental Ethics	Pearson Correlation	1	.648**	.613**	.479**	.683**	.269**
	Sig. (2-tailed)		.000	.000	.000	.000	.002
	N	132	132	132	132	132	132
Green Practice Adoption	Pearson Correlation	.648**	1	.421**	.377**	.636**	.312**
	Sig. (2-tailed)	.000		.000	.000	.000	.000
	N	132	132	132	132	132	132
Organizational Support	Pearson Correlation	.613**	.421**	1	.346**	.312**	.197*
	Sig. (2-tailed)	.000	.000		.000	.000	.024
	N	132	132	132	132	132	132
Quality human resource	Pearson Correlation	.479**	.377**	.346**	1	.207*	-.046
	Sig. (2-tailed)	.000	.000	.000		.017	.599
	N	132	132	132	132	132	132
Competitive advantage	Pearson Correlation	.683**	.636**	.312**	.207*	1	.441**
	Sig. (2-tailed)	.000	.000	.000	.017		.000
	N	132	132	132	132	132	132
Government Support	Pearson Correlation	.269**	.312**	.197*	-.046	.441**	1
	Sig. (2-tailed)	.002	.000	.024	.599	.000	
	N	132	132	132	132	132	132

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Figure 13 Correlation Matrix

4.5 Regression

Relationship between independent and dependent variable can be expressed numerically using regression test. Regression test can be simply a single linear regression test between one independent and one dependent variable. Regression can also be multiple know as multiple regression test involving multiple independent variables and one dependent variable.

4.5.1 Simple linear regression

A simple linear test between each independent variable and dependent variable is performed first one by one.

Corporate Environmental Ethics relationship with Green Practice Adoption

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.648[a]	.420	.416	.82428

a. Predictors: (Constant), Corporate Environmental Ethics

The above model shows that 1% change in Corporate Environmental Ethics brings about 42.0% change in Green Practice Adoption. The model is also significant by looking at the sig. value in below table which is less than (α=0.05)[54].

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	64.056	1	64.056	94.278	.000[b]
	Residual	88.326	130	.679		
	Total	152.382	131			

a. Dependent Variable: Green Practice Adoption

b. Predictors: (Constant), Corporate Environmental Ethics

Organizational Support relationship with Green Practice Adoption

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.421[a]	.177	.171	.98205

a. Predictors: (Constant), Organizational Support

The above model shows that 1% change in Organizational Support brings about 17.7% change in Green Practice Adoption. The model is also significant by looking at the sig. value in below table which is less than (α=0.05)[54].

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	27.007	1	27.007	28.003	.000[b]
	Residual	125.375	130	.964		
	Total	152.382	131			

a. Dependent Variable: Green Practice Adoption

b. Predictors: (Constant), Organizational Support

Quality of Human Resource relationship with Green Practice Adoption

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.377[a]	.142	.135	1.00295

a. Predictors: (Constant), Quality human resource

The above model shows that 1% change in Quality Human Resource brings about 14.2% change in Green Practice Adoption. The model is also significant by looking at the sig. value in below table which is less than (α=0.05)[54].

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	21.613	1	21.613	21.486	.000[b]
	Residual	130.769	130	1.006		
	Total	152.382	131			

a. Dependent Variable: Green Practice Adoption

b. Predictors: (Constant), Quality human resource

Competitive Advantage relationship with Green Practice Adoption

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.636[a]	.405	.400	.83544

a. Predictors: (Constant), Competitive advantage

The above model shows that 1% change in Competitive Advantage about 40.5% change in Green Practice Adoption. The model is also significant by looking at the sig. value in below table which is less than (α=0.05)[54].

ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	61.646	1	61.646	88.322	.000[b]
	Residual	90.736	130	.698		
	Total	152.382	131			

a. Dependent Variable: Green Practice Adoption

b. Predictors: (Constant), Competitive advantage

Government Support relationship with Green Practice Adoption

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.312[a]	.097	.090	1.02865

a. Predictors: (Constant), Government Support

The above model shows that 1% change in Government Support brings about 9.7% change in Green Practice Adoption. The model is also significant by looking at the sig. value in below table which is less than (α=0.05)[54].

ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	14.827	1	14.827	14.013	.000[b]
	Residual	137.555	130	1.058		
	Total	152.382	131			

a. Dependent Variable: Green Practice Adoption

b. Predictors: (Constant), Government Support

4.5.2 Multiple Regression

Statistical mathematical relationship among multiple independent and a single predictor is derived in the multiple regression test. Not only the relationship among dependent and independent is studied but also the relationship among independents effect the results of multiple regression.

Coefficients are most important in multiple regression test. They tell us about each independent variable significance in the model and what changes it brings numerically in the dependent variable. Coefficients are derived by analysing intercorrelation of all independents and dependent variables. It means that the correlation among the independents can affect the multiple regression test.

According to the table below only three variables (Corporate Environmental Ethics, Quality of Human Resource and Competitive Advantage) are significantly influencing the dependent one if the model is constant.

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	.643	.396		1.622	.107
	Corporate Environmental Ethics	.202	.094	.243	2.161	.033
	Organizational Support	.074	.069	.086	1.066	.288
	Quality human resource	.150	.071	.155	2.121	.036
	Competitive advantage	.405	.100	.381	4.055	.000
	Government Support	.060	.061	.069	.973	.332

a. Dependent Variable: Green Practice Adoption

Table 7 Regression Coefficients Table

The overall model is not a fit. Only three variables Corporate Environmental Ethics, Quality of Human Resource and Competitive Advantage are significantly bringing change in the dependent one with significance values of .033, .036 and .000 respectively.

Key take away from the above table

1. About 1% variation in Corporate Environmental Ethics brings about 20.0% change in Green Practice Adoption.
2. About 1% variation in Quality of Human Resource brings about 15.0% change in Green Practice Adoption.
3. About 1% variation in Competitive Advantage brings about 40.5% change in Green Practice Adoption

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.718[a]	.516	.496	.76535

a. Predictors: (Constant), Government Support, Quality human resource, Organizational Support, Competitive advantage, Corporate Environmental Ethics

Table 8 Regression Model Summary

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	78.576	5	15.715	26.829	.000[b]
	Residual	73.806	126	.586		
	Total	152.382	131			

a. Dependent Variable: Green Practice Adoption

b. Predictors: (Constant), Government Support, Quality human resource, Organizational Support, Competitive advantage, Corporate Environmental Ethics

Table 9 Regression Model Significance

4.6 ANOVA (Analysis of variance)

ANOVA (Analysis of variance) test is used to check for any statistical difference between means of various independent groups. I am going to perform this test to check if there is difference in means of different cluster/divisions of Pakistani manufacturing units. On the basis of results next test on finding out which group is different from other will be carried out.

ANOVA

Green Practice Adoption

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	33.176	3	11.059	11.874	.000
Within Groups	119.206	128	.931		
Total	152.382	131			

Table 10 ANOVA Significance Table

In above table the Sig. value is 0.000 which is less than 0.05. Hence, we can say that statistically there is some difference among clusters/divisions of Pakistani manufacturing firms in adopting green practices. Here the questions arise which group is different from others? Unfortunately, ANOVA cannot tell us which group is different from other, for this we have run another test in SPSS called the **Post Hoc** test. **Turkey Post Hoc** test is generally the most popular test in SPSS used to find statistical difference between means which are different with each other. I am going to utilize ANOVA in conjunction with **Turkey Post Hoc** test to find out which clusters/divisions are statistically different from each other.

4.6.1 Turkey Post Hoc test results

Multiple Comparisons

Dependent Variable: Green Practice Adoption

Tukey HSD

(I) Clusters means	(J) Clusters means	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Sialkot	Lahore-Sheikhupora-Muridke	-.06504	.26899	.995	-.7652	.6352
	Kasur	1.04465*	.27559	.001	.3273	1.7620
	Hafizabad-Gujranwala	.59869	.32638	.262	-.2509	1.4483
Lahore-Sheikhupora-Muridke	Sialkot	.06504	.26899	.995	-.6352	.7652
	Kasur	1.10969*	.19682	.000	.5974	1.6220
	Hafizabad-Gujranwala	.66373	.26327	.061	-.0216	1.3490
Kasur	Sialkot	-1.04465*	.27559	.001	-1.7620	-.3273
	Lahore-Sheikhupora-Muridke	-1.10969*	.19682	.000	-1.6220	-.5974
	Hafizabad-Gujranwala	-.44596	.27001	.354	-1.1488	.2569
Hafizabad-Gujranwala	Sialkot	-.59869	.32638	.262	-1.4483	.2509
	Lahore-Sheikhupora-Muridke	-.66373	.26327	.061	-1.3490	.0216
	Kasur	.44596	.27001	.354	-.2569	1.1488

*. The mean difference is significant at the 0.05 level.

Table 11 Post Hoc test Table - Results

4.6.2 Key take away from Turkey Post Hoc Test

1. Kasur and Sialkot cluster/division are statistically different(p=0.01) from each other in adopting green practices.
2. Sialkot and Lahore-Sheikhupora-Muridke cluster/division are not statistically different(p=.995) from each other in adopting green practices. They show same willingness in adopting green practices and reducing waste.
3. Lahore-Sheikhupora-Muridke and Kasur cluster/division are statistically different from each other in adopting green practices.
4. No statistical difference is found between Hafizabad-Gujranwala and rest of the three clusters.

4.6.3 Means Plot

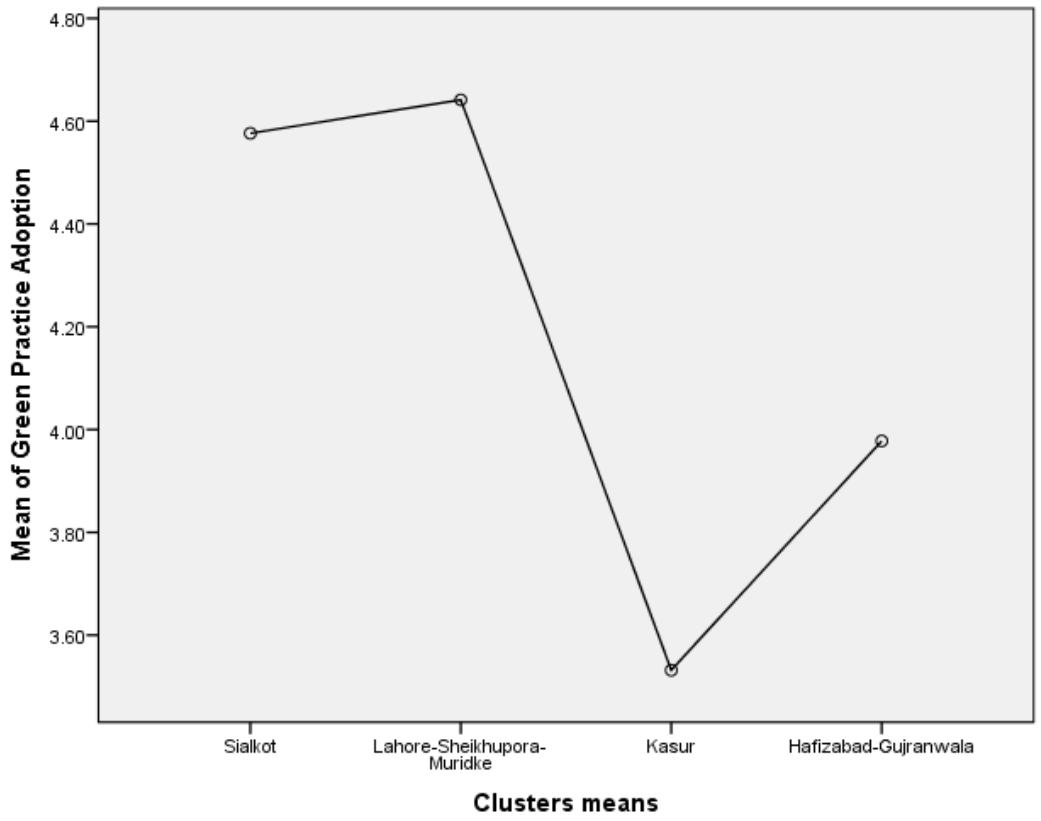


Figure 14 ANOVA Means Plot

CHAPTER V

CONCLUSION, LIMITATIONS & FUTURE DIRECTIONS

Results show that corporate environmental ethics, quality of human resource and competitive advantage are the most significant factors contributing to adopting greener technologies and practices. On the other hand, the role of government and organization support on industrial units do not play a vital role in motivating industries to change traditional manufacturing towards greener and eco-friendly manufacturing.

To build up the environmental ethics in managers and to improve the quality of human resource it is suggested to continuously organize seminars and sessions in which light must be shed on pollution generated by the industrial firms. After highlighting the disastrous effects of pollution on humans and mother nature the advantages of going green must be put forward to build up the green manufacturing awareness.

Competitive advantage role in motivating the industries to go green is proved to be highly significant and it makes the firm to stand out from the rest. Mangers are requested to consider in to account the advantage of competitive advantage offered by adopting the green practices.

Government support dint play a vital role in motivating industries to adopt green practices. It is obvious from the above study that government is present in the field but government poor management and weak enforcement of laws are questionable. Government should instruct the environmental protection departments to perform and beer some positive results. At the end it's the responsibility of government to fulfil all the gaps in between its rank and take work from its departments.

Difference between individual clusters of industrial units is also reported. Kasur cluster is found different from other industrial units in adopting green practices except Gujranwala-Hafizabad. This difference is may be due to the small-scale industry in Kasur. Kasur has large number of tanners and all of them are not big industrial units. No difference is found between Gujranwala-Hafizabad cluster when compared with their counter parts.

Environment friendly business is dire need of 21st century and being a third world country Pakistani industry must invest heavily in green ecological business. Running a eco-friendly business is not complicated only the knowledge and willingness of humans is required as

concluded in this study. It is there for recommended to establish an environmentally friendly community by educating the people from grass root level.

Limitations

The study finds out some determinants which motivates industrial units to adopt green practices but there are some limitations. Firstly, this study is heavily dependent on the tanners and textile industry located in the Punjab province of Pakistan. So, the determinants derived in this study reflects the tanners and textile green measure adoption and particularly the tanners and textile industry of Punjab. Though data collected from other industries is also the part of the study and is included in the data analysis the significance of tanners and textile can be seen in the number of respondents of the tanners and textile industry.

Considering other provinces and the industry located in those provinces may yield different results. Taking in to account other industrial sectors like oil and gas and cement etc may also yield different results.

Future Directions

This study took in to account tanners, paper and pulp, textile, plastic and fabric, tiles and ceramic, tyres/tubes and resins industry. Individual research on each industry to find out the determinants and motivations of each industry is a dire need. At the end individual determinants of each industry can be compared to see if there is any significant difference in adopting the greener technologies among the particular industries.

Company size is a variable studied universally in adopting the green measures. Sadly, in this study company size was dropped due to unwillingness of respondents to reveal it. Firstly, it can be studied why the respondents are reluctant to reveal their company size. Company size variable effect on green production adoption can then be studied. Industries can be classified on size and their willingness to take green measures.

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APPENDIX

Corporate Green practices adoption fulfilling corporate social responsibility

Industrial waste water treatment---- Control of industrial smoke emissions---- Solid Industrial waste proper disposal

Variables and items in the below questionnaire are picked from [55] - [22]

Please indicate your degree of agreement with the following items.

Corporate Environmental Ethics

My company has clear and concrete environmental policies.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree

My company's budget planning includes the concerns of environmental investment or Procurement.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree

In marketing events, environmental measures/plan by company are also highlighted.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree

My company has integrated its environmental plan, vision, or mission to company's culture.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree

Organizational support

Top management encourages employees to learn green knowledge (eco-friendly processes).

Strongly disagree	Disagree	Disagree somewhat	Neutral	Agree somewhat	Agree	Strongly agree

Our company provides rewards for employees' green behaviour.

Strongly disagree	Disagree	Disagree somewhat	Neutral	Agree somewhat	Agree	Strongly agree

Our company provides resources and training’s for employees to learn green knowledge.

Strongly disagree	Disagree	Disagree somewhat	Neutral	Agree somewhat	Agree	Strongly agree

Top management can help employees dealing with environmental issues.

Strongly disagree	Disagree	Disagree somewhat	Neutral	Agree somewhat	Agree	Strongly agree

Quality of human resources

My company employees are capable of learning new technologies easily.

Strongly disagree	Disagree	Disagree somewhat	Neutral	Agree somewhat	Agree	Strongly agree

My company employees are capable of sharing knowledge with each other’s.

Strongly disagree	Disagree	Disagree somewhat	Neutral	Agree somewhat	Agree	Strongly agree

My company employees are capable of using new technologies to solve problems easily.

Strongly disagree	Disagree	Disagree somewhat	Neutral	Agree somewhat	Agree	Strongly agree

My company employees are capable of providing new ideas for our company.

Strongly disagree	Disagree	Disagree somewhat	Neutral	Agree somewhat	Agree	Strongly agree

Governmental support

Government provides financial support for adopting green practices.

Strongly disagree	Disagree	Disagree somewhat	Neutral	Agree somewhat	Agree	Strongly agree

Government provides technical assistance for adopting green practices.

Strongly disagree	Disagree	Disagree somewhat	Neutral	Agree somewhat	Agree	Strongly agree

Government helps training manpower with green management skills.

Strongly disagree	Disagree	Disagree somewhat	Neutral	Agree somewhat	Agree	Strongly agree

Green marketing competitive advantage

The quality of the products or services that my company offers is better than that of the green marketing competitor's/firms products or services.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree

The company is more capable of R&D than the green marketing competitors.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree

The company has better managerial capability than the green marketing competitors.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree

The company's profitability is better than the green marketing competitors.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree

The corporate image of my company is better than that of the green marketing competitors.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree

The green marketing competitors are difficult to take the place of my company's competitive advantage.

Strongly disagree	Disagree	Neutral	Agree	Strongly agree

Green Practice Adoption

Our company purchased machinery which is environmental friendly.

Not at all	To a very small extent	To a small extent	To a moderate extent	To a fairly great extent	To a great extent	To a very great extent

Our company treat waste (Hazardous Water, Smoke and Solid) properly.

Not at all	To a very small extent	To a small extent	To a moderate extent	To a fairly great extent	To a great extent	To a very great extent

Our company try to minimize waste during production.

Not at all	To a very small extent	To a small extent	To a moderate extent	To a fairly great extent	To a great extent	To a very great extent

Our company invest on employee's safety and healthy working conditions.

Not at all	To a very small extent	To a small extent	To a moderate extent	To a fairly great extent	To a great extent	To a very great extent

Our company procurement and supply chain process are eco-friendly.

Not at all	To a very small extent	To a small extent	To a moderate extent	To a fairly great extent	To a great extent	To a very great extent

Size of your company (Total no of employees) _____?