USPCAS-W
Mehran University
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Automobile & Allied Sector

Brief Situation Analysis Report

Eco-Innovation for Sustainable Industrial Growth of Major Industrial Sectors in Special Economic Zones (SEZs) Under CPEC-75

(A Project funded by Higher Education Commission, HEC)

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Context to the study

- Status of Eco-Innovation in Automobile and Allied Sector
- Drivers of Eco-Innovation
- Identification of Eco-Innovation options

Summary of findings

(1) About 38% have introduced cleaner process technologies (EP2).
(2) Less than 30% of industries have taken eco-innovation initiatives related to other process technologies (EP1, EP3, EP4, EP5, and EP6).
(3) Many industries are not involved in product related Eco-innovation.
(4) 31% of industries responded that they had taken initiatives related to more energy-efficient products.
(5) 30% of responded industries acknowledged introducing innovation measures. Due to fewer industries involved in manufacturing, most allied industries are unstructured and work on traditional methods.
(6) Feasible eco-innovation options are listed in the report.

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Introduction

The automobile sector in Pakistan adds 2.8% to the country's GDP and 30 billion rupees in taxes and duties to the national coffers. This sector comprises several industries involved in producing, assembling, and distributing various types of vehicles, including passenger cars, light commercial vehicles, trucks, buses, tractors, and motorcycles, with 954 industrial units, including allied industries. Pakistan imports vehicles and auto parts from Japan (60% in 2017), Thailand, China, Indonesia, and Belarus. Pakistan exports automobiles (cars, motorcycles, and auto parts) to Afghanistan, Nigeria, and Botswana (20,035 thousand US$ in 2019-2020). The auto spare parts industry is also an essential part of the overall automobile and allied industry, as it supplies components and accessories to the manufacturers and assemblers of vehicles.

This research aims to identify the best solutions for preventing resource overuse and to determine the best approach to solving resource overuse problems. This study covers the potential of the automobile and allied sector in Pakistan, its significant position in the global market, and how this sector plays a role in Pakistan's economy. It also covers the status of eco-innovation and its adaptation in the industrial sector. This mentions details about the state of eco-innovation in the currently operating industrial units, focusing on challenges most industries face in moving towards eco-innovation. The current report covers the first year's activities of the 3-years project funded by the Higher Education Commission (HEC).

Approach and method

To determine the present state of the Eco-innovation approach, comprehension, and adaptation in the current textile sector, a thorough industrial survey was done in which approximately 150 industries were contacted, 13 industries responded, two from large scale, three were of medium scale and the rest eight from small-scale industries. Categorization of the industries was done based on number of employees.

There were 954 industrial units in Pakistan, largely in the auto manufacturing and related industries, according to the Census of Manufacturing Industries 2015-2016 [1]. The Punjab province was where more than 60% of these industries were located. A GIS location map of Pakistan's automotive and related sectors is also given in fig 1.

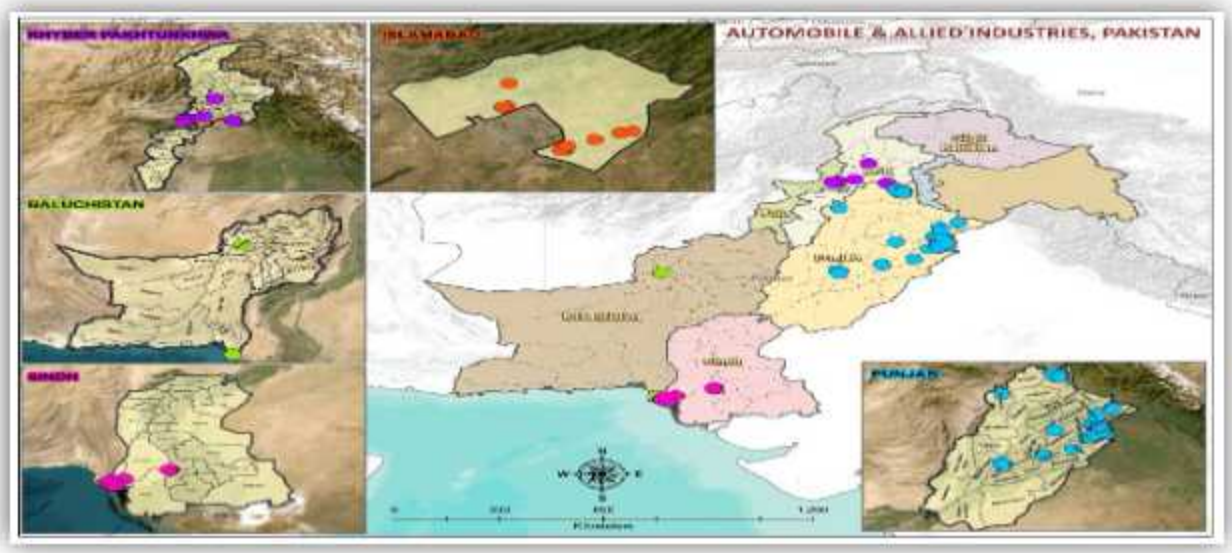


Figure 1: GIS Location Map of Automobile & Allied Industries in Pakistan

A mixed data collection method was employed:

- ***Interviews*** with industries managers, environmental representatives, and owners
- Focused group meetings (***FGM***) and
- Questionnaire survey (***both online and in-person)***
- The assessment framework comprises three main elements [2] on which the questionnaire survey was designed. These key elements are given below.
  - *i.* ***Eco-Innovation related to process technology (EP)***
  - *ii.* ***Eco-Innovation related to Product (EPR)***
  - *iii.* ***Eco-Innovation related to Organization (EO)***

Research Findings

1. State of Eco-Innovation

(i) Process Technology Innovation (EP)

New addition/modification in the process for environmental damage minimization. Six questions were asked, labelled as EP1, EP2, EP3, EP4, EP5, and EP6 (Table 1).

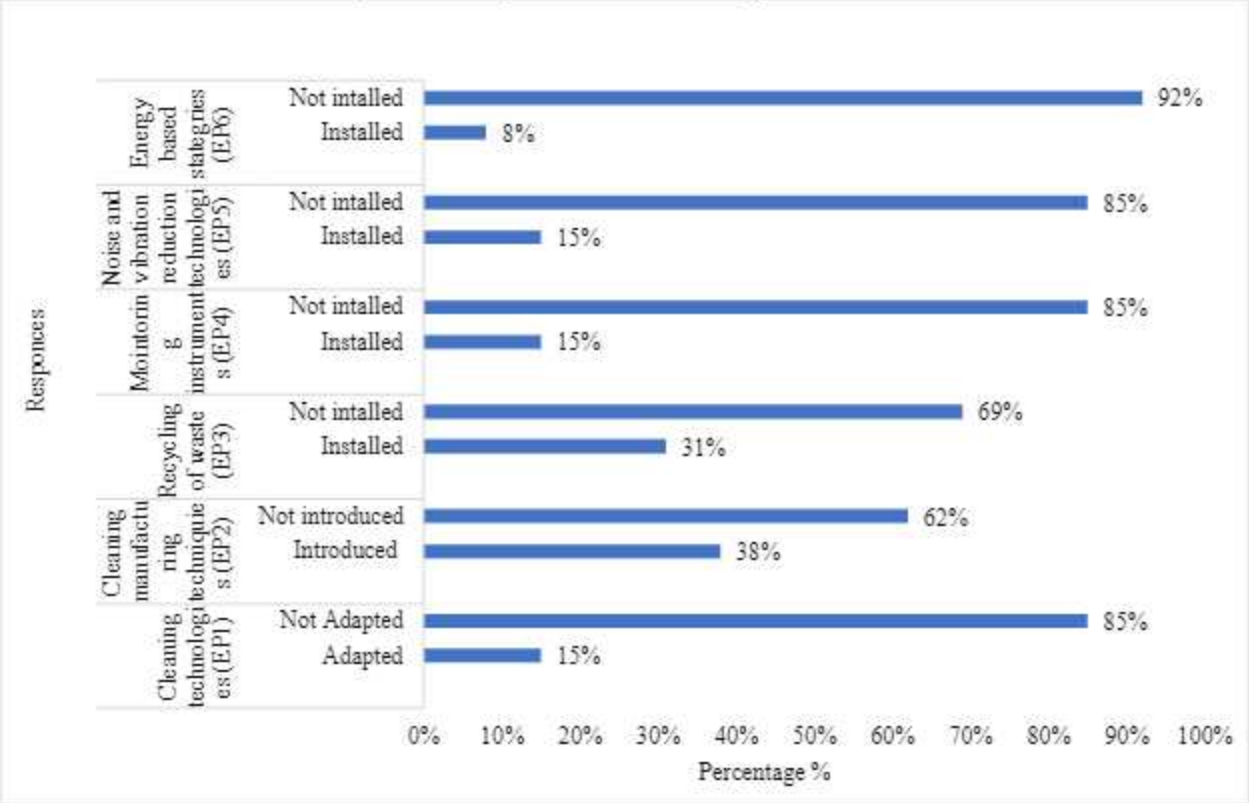
Table 1: Quarries for ranking the process technology innovation (EP).

Process technology eco-innovation	**EP1**: Technologies for cleaning the air, water, soil, and solid waste.
	EP2: Cleaner manufacturing techniques
	EP3: Final disposal of recycling/waste equipment
	EP4: Instruments used in the industry to monitor solid, liquid, and environmental contaminants.
	EP5: Technology for reducing noise and vibration.
	EP6: Energy-based strategies for renewal (solar or wind energy)

Findings:

- The survey results revealed that few firms are involved in eco-innovations related to Process Technology.
- Among all the responding industries, most of the industries (about 38%) have introduced cleaner process technologies (EP2).
- However, less than 30% of industries have taken eco-innovation initiatives related to other process technologies (EP1, EP3, EP4, EP5 & EP6)

Fig 2. State of Process technology innovation



(ii) Product Technology Innovation (EPR)

Any modification/improvement in the product design. For environmental impact reduction during the lifecycle of the product. There were three questions EPR1, EPR2, and EPR3 (Table 2).

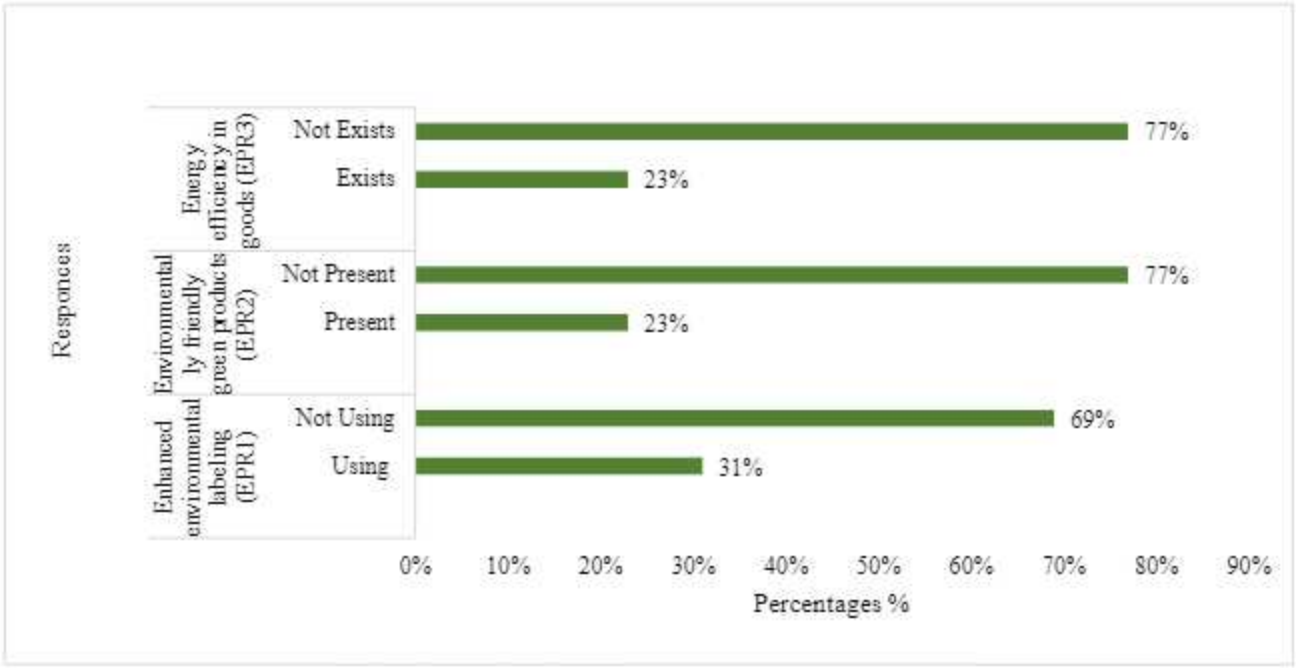
Table 2. Quarries for ranking the product technology innovation (EPR).

Product technology eco-innovation	**EPR1:** Enhanced environmental labelling
	EPR2: Green products that are environmentally friendly.
	EPR3: Greater energy efficiency in goods and services

Findings:

- Most industries are not involved in product-related Eco-innovation.
- 31% of industries responded that they had taken initiatives related to more energy-efficient products.

Fig 3. State of product eco-innovation (EPR)



(iii) Organizational eco-innovation

Organizational management system and coordination. Three questions were asked (i.e., EO1, EO2 & EO3). The description of questions is given in table 3.

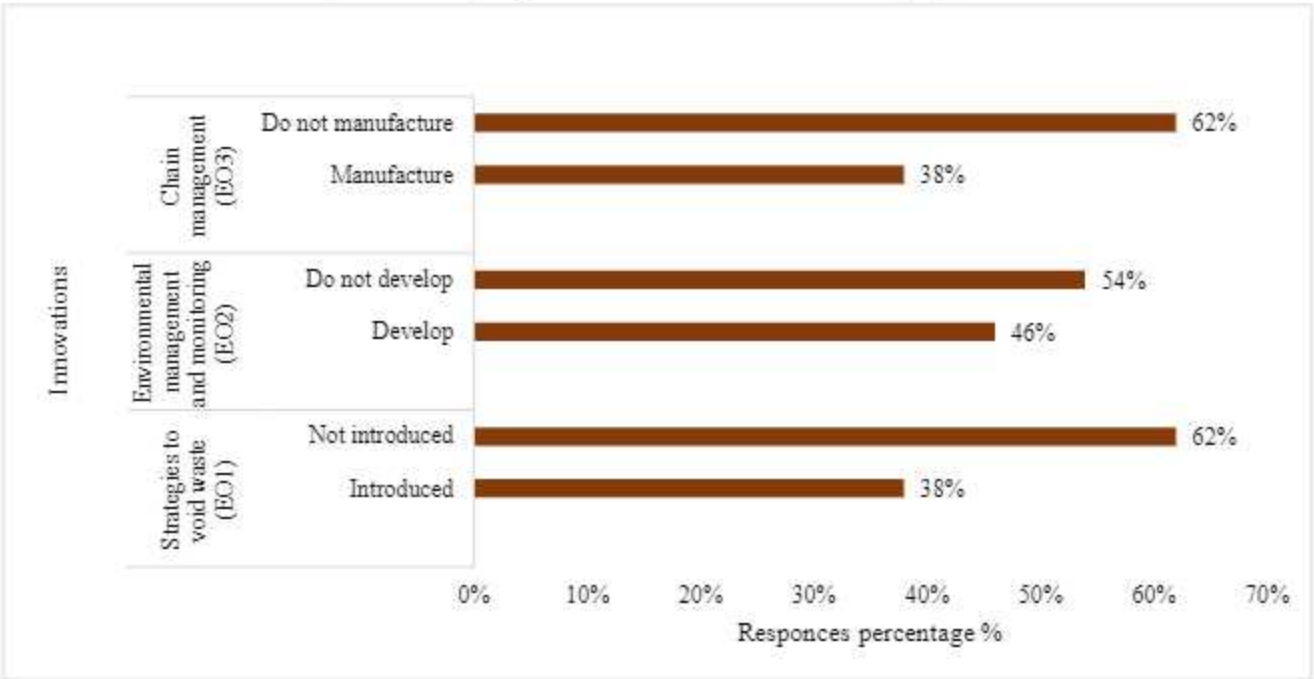
Table 3. Quarries for ranking the product technology innovation (EO)

Organizational eco-innovation	**EO1:** Avoid waste-producing management strategies.
	EO2: System for structured environmental management and monitoring (ISO 14001, EMAS, etc.)
	EO3: Chain management

Findings:

- The responded participants were involved in Eco-innovation related to the organization far better than the process and product eco-innovation.
- Most automobile and allied industries have good organization and management practices.

Fig 4. State of organizational eco innovation (EO)



2. Drivers of Eco-Innovation

The survey investigated the elements that influence eco-innovation and found both internal and external ones. These forces include the availability of resources, technological aptitude, ethical responsibility, buyer pressure, international standards, and local laws. The study covered six aspects of the factors that drive eco-innovation.

(i) Environmental regulation (ER)

By establishing criteria and objectives for decreasing environmental impact and motivating businesses to create new technologies and methods to achieve those goals, environmental regulation can operate as a catalyst for eco-innovation. The survey included numerous aspects of environmental legislation as a catalyst for eco-innovation (Table 4).

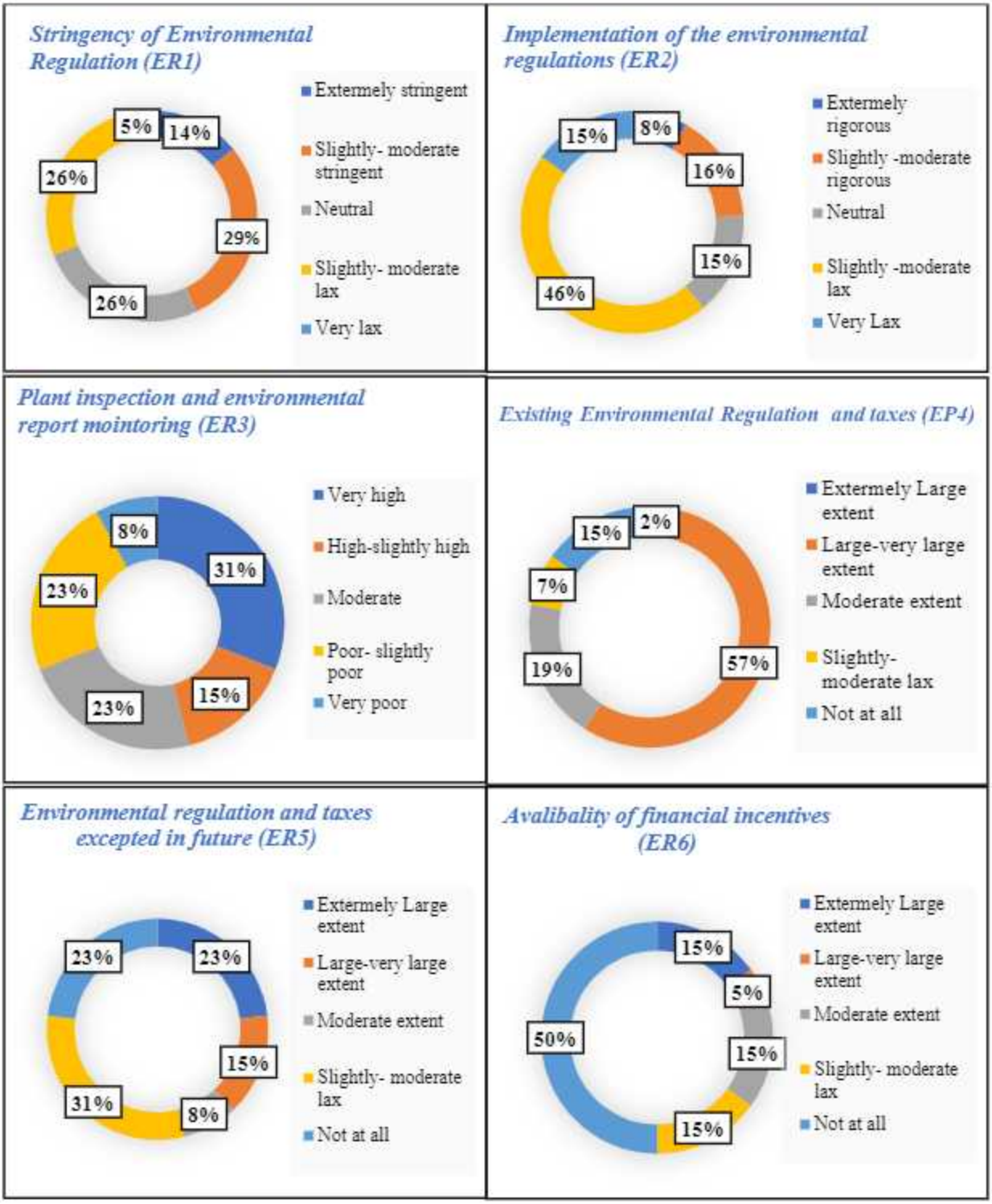
Table 4. Quarries for ranking environmental regulations in industries (ER)

Environmental Regulations (ER)	**ER1**: Stringency of the environmental regulations
	ER2: Environmental regulations implementation
	ER3: Level of monitoring by the regulatory authority through audits and reporting
	ER4: Environmental benefits in response to existing environmental regulations or taxes on pollution
	ER5: Environmental benefits in response to the environmental laws or taxes to be imposed in the future
	ER6: Availability of government grants, subsidies, or other financial incentives

Findings

- ***ER1***: About 29% responded think that environmental regulations are relaxed. 26% remain neutral. The reason of being neutral is, perhaps, reluctance due to 'unknown' fear from monitoring authority and 5% of them expressed that the environmental regulations are extremely stringent.
- ***ER2***: Majority of industries (46%) think that implementation of environmental regulations is moderate lax.
- ***ER3:*** About 31% industries responded that level of monitoring by the regulatory authority through audits and reporting is very high.
- ***ER4:*** 57% of respondents think that organizations do innovation in response to environmental regulation and taxes are to a large extent.
- ***ER5:*** About 31% believe that industries generate innovation to a moderate extent in response to environmental regulation expected to be introduced in the future. While 23% responded that the industry does innovation to a large extent.
- ***ER6:*** In response to the availability of government grants or any other financial incentives provided around 50% of respondents believe that industry introduces no innovation. However, 15% of respondents have an opinion to large-moderate extent.

Fig 5. Staus of environmental regulations (ER1-ER6) in industries



(ii) Organization Efforts

Through policies, procedures, and investments in the development of eco-friendly practises and products, organisations can promote eco-innovation and reduce their environmental impact by giving sustainability and environmental stewardship a high priority. Table 5, describe the questions that were asked during the survey.

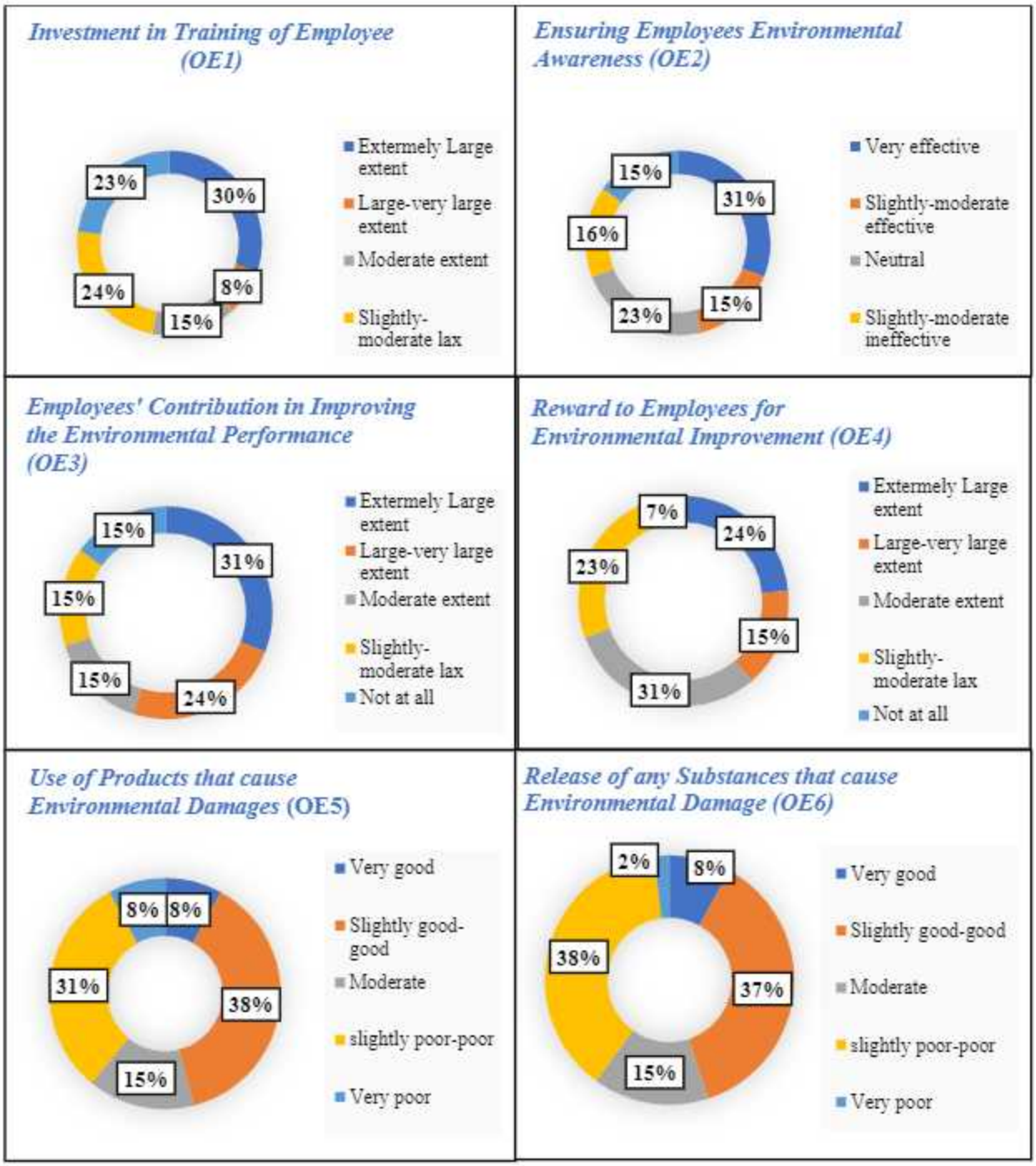
Table 5.Qurries for ranking organization efforts (OE1-OE7) in industries

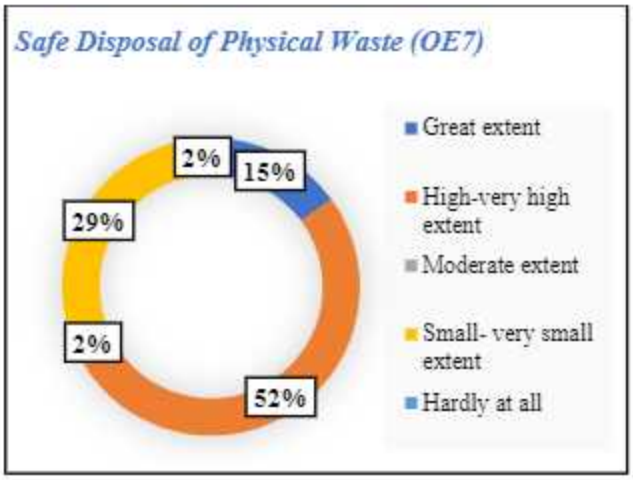
Organizational Efforts (EO)	**OE1:** Investment in environmental training and employee development.
	OE2: Efforts in ensuring employees' environmental awareness.
	OE3: Efforts to assess the role of employees in improving environmental performance.
	OE4: Reward (i.e., promotion and salary increase) to employees for environmental improvement.
	OE5: Efforts to eliminate the use of products that cause environmental damage.
	OE6: Efforts to eliminate the release of any substances that cause environmental damage.
	OE7: Efforts to dispose of physical waste through environmentally safe methods

Findings

- ***OE1***: 30% respondents said that investment in employee training is at an extremely large extent.
- ***OE2***: 23% remained neutral in response. While (about 31%) respondents believe that there is a very effective mechanism for ensuring employee awareness and training.
- ***OE3:*** About 31% believe that organizations assess their employee contribution to improving environmental performance to an extremely large extent. About 15% responded that organizations made no efforts to access employee contributions.
- ***OE4:*** Many respondents (31%) said that there is a moderate mechanism for ensuring employee awareness and training.
- ***OE5:*** About 38% of respondents think that efforts made by organizations to eliminate the use of products that cause environmental damage are good, while 31% believe that organizations put moderate efforts.
- ***OE6:*** Majority of industries (38%) think that efforts made by organizations are poor to reduce emissions/substances that cause environmental damage, and 37% believe that organizations put good efforts.
- ***OE7:*** Most respondents (about 52%) believe that organizations' efforts to dispose of the waste in an environmentally safe manner are to a great extent. While only 2% think that the organization put no efforts.

Fig 6. Status of organization efforts (OE1-OE7) in industries





(iii) Organizational Collaboration (OC)

Organizational Collaboration (OC) includes partnerships between companies in the same industry to share resources and expertise and collaborations with research institutions. Table 7, briefly describe the questions related to organizational collaboration.

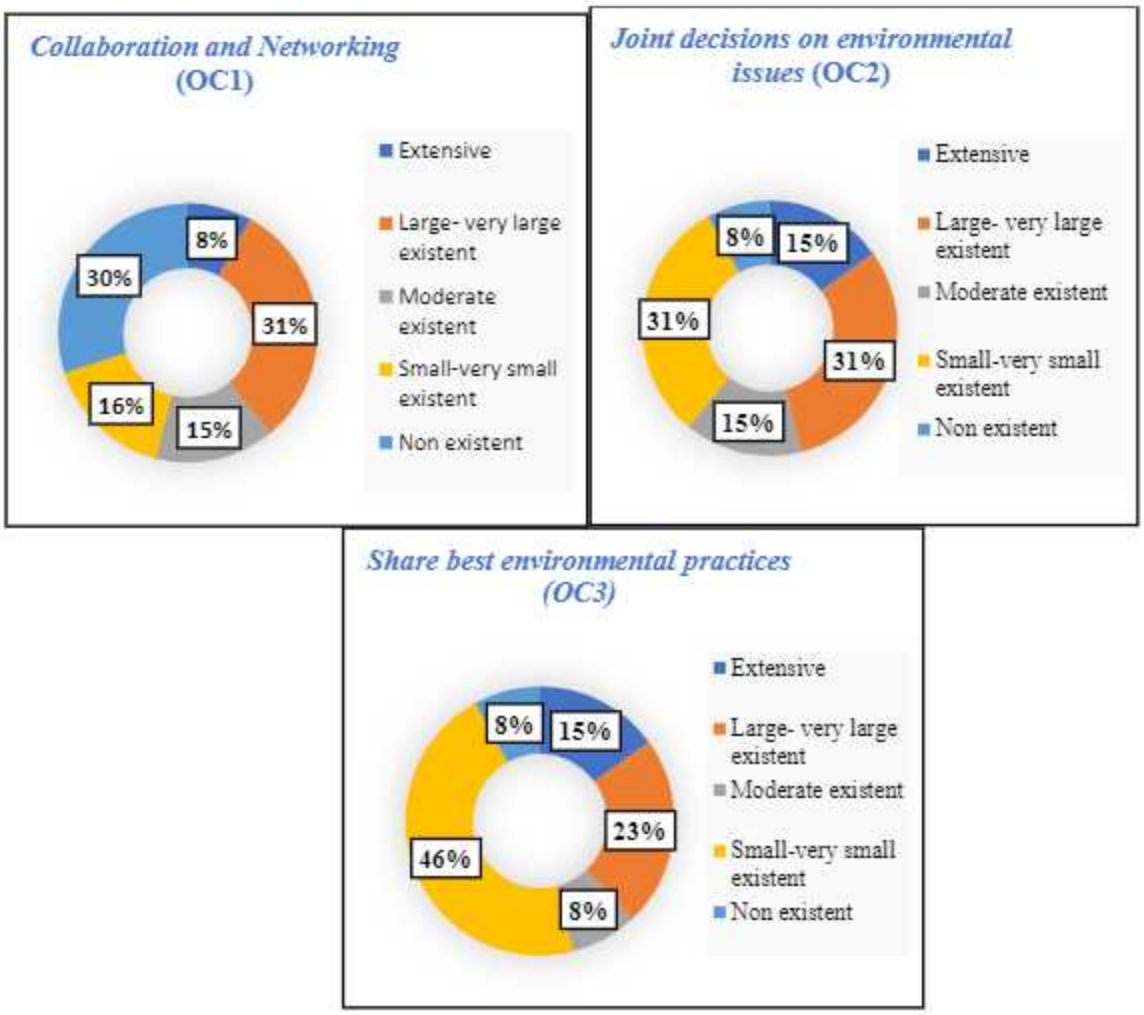
Table 7. Quarries for ranking Organizational Collaboration (OC1-OC3) in industries.

Organizational Collaboration (OC)	**OC1**: Knowledge/ information/ expertise related to environmental issues acquired through collaboration and networking (among groups, firms, suppliers, partners, and associations).
	OC2: Collaboration and networking to make joint decisions on environmental issues.
	OC3: Collaboration and networking to share best environmental practices

Findings

- ***OC1:*** 23% respondents believe that they have a high level of partnership and networking to acquire knowledge and expertise on environmental issues. While 23% responded that there is no existence of collaboration and networking.
- ***OC2:*** 31% responded that they have a higher level of collaboration and networking between industries to make joint decisions regarding environmental issues. Also 31% responded that they have a smaller level of collaboration and networking.
- ***OC3:*** 46% think that in industries, sharing information about best environmentally sustainable initiatives is at small extent.

Fig 7. Status of organizational collaboration (OC1-OC3) in industries



(iv) Environmental Management System (EMS)

An Environmental Management System (EMS) provides a framework for organizations to identify and manage their environmental impacts systematically. An EMS can also help organizations monitor and measure their environmental performance, providing valuable data that can be used to identify areas where eco-innovation is needed. Table 8, briefly describe the questions related to EMS.

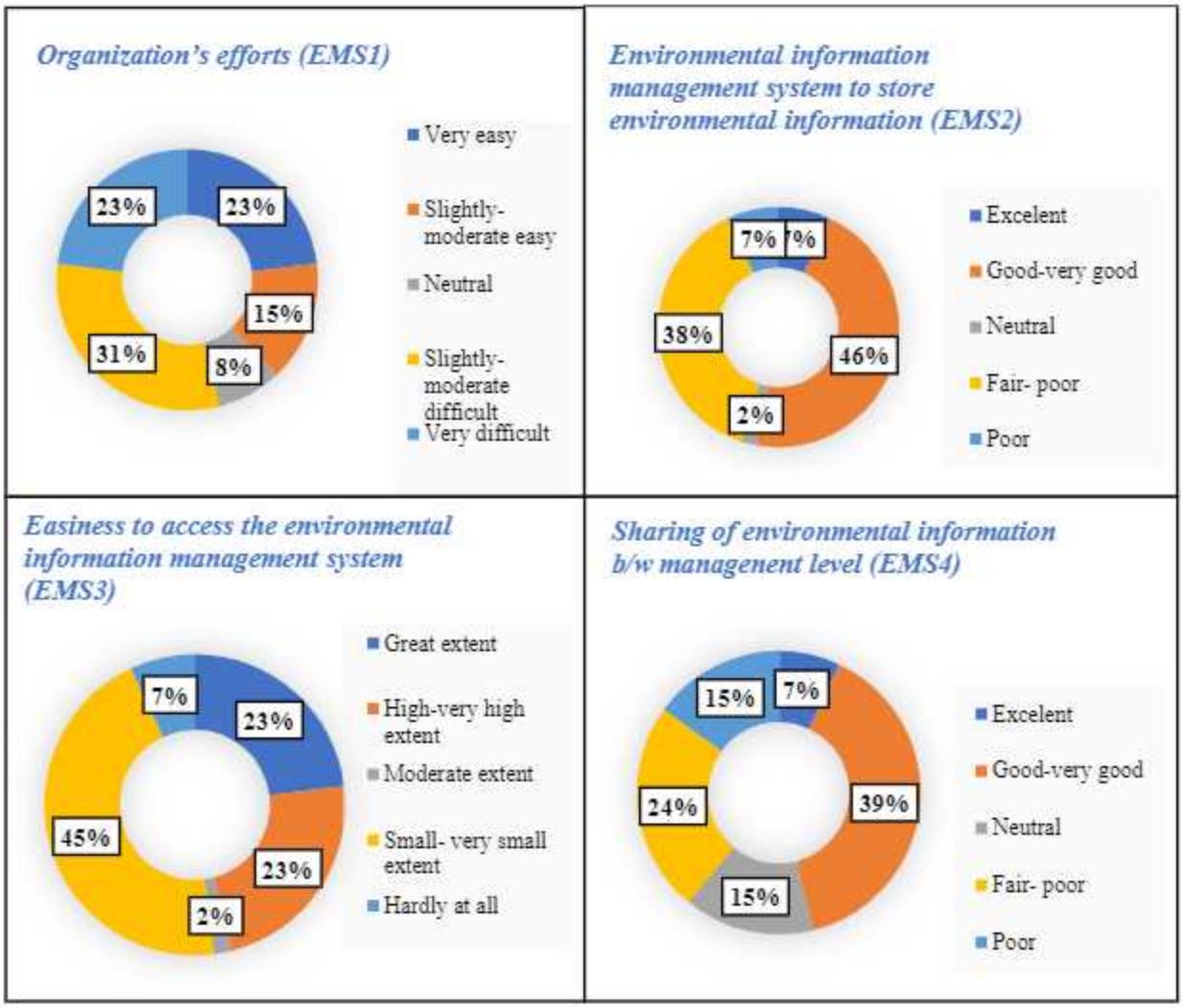
Table 8 Quarries for ranking Environmental Management System (EMS1-EMS4) in industries.

Environmental Management System (EMS)	**EMS1:** Organization's efforts to routinely update its environmental information.
	EMS2: Environmental information management system to store environmental information
	EMS3: Easiness to access the environmental information management system.
	EMS4: Sharing of environmental information between management levels in an organization

Findings:

- ***EMS1***: 31% responded that the EMS system existed at moderate level.
- ***EMS2***: 46% believe that organizations continuously update their environmental information at a reasonable level (in the range of good to very good). About 2% responded as neutral while answering this question.
- ***EMS3***: 45% responded that access to environmental information management (MIS) is slightly easy to access environmental information in the industry.
- ***EMS4***: 39% think the flow of environmental information between the managers within the industry is satisfactory (good to very good) quality.

Fig 8. Status of environmental management system (EMS1-EMS4) in industries



(v) Customer's Pressure

With the increasing demand for sustainable products, industries may be motivated to invest in research and development to create new eco-friendly products and services. It can lead to the

development of new technologies and manufacturing processes that are more sustainable. The questions regarding customer pressure are given in table 9.

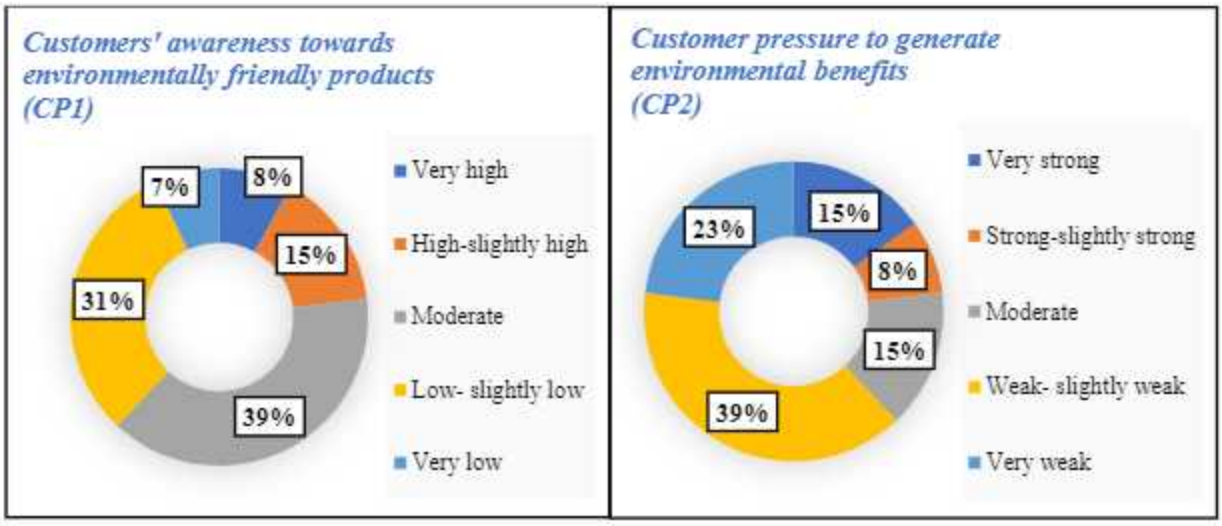
Table 9. Quarries for ranking customer pressure (CP1-CP4) in industries.

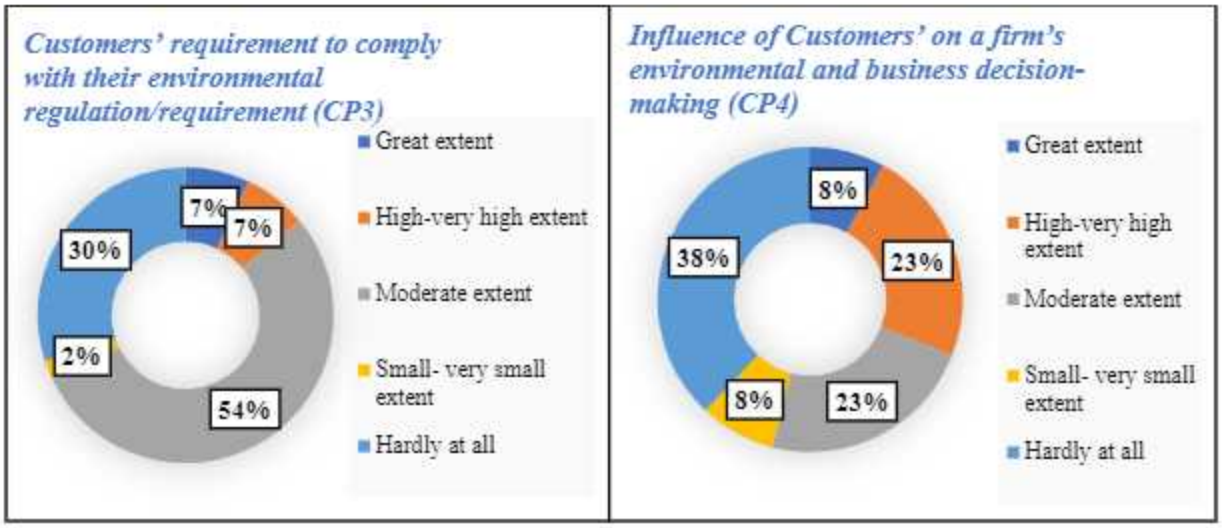
Customer's Pressure (CP)	**CP1:** Customers' awareness towards environmentally friendly products.
	CP2: Customer pressure to generate environmental benefits.
	CP3: Customers' requirement to fulfill their environmental regulations/standards (for example, ISO14001, REACH, RoHS, chemical labeling, and others).
	CP4: Influence of Customers' environmental regulations on a firm's environmental and business decision-making

Findings:

- *CP1*: About 39% responded that customers' awareness is moderate. However, 31% of respondents rate the customers' attention about sustainable products in the organizations in the range of low to slightly low.
- *CP2*: Many responded (39%) with a view of weak stemming from customers. However, 15% responded customers' pressure as a driving force for the industry to generate environmental benefits is vital.
- *CP3*: About 54% have the opinion customer requirement to comply with their environmental regulations and procedures is, to a moderate extent.
- *CP4*: 39% responded that customers' influence on decision-making is small whereas, 8%think customers' environmental regulations greatly influence industry decision-making.

Fig 9. Status of customer's pressure (CP1-CP4) in industries





(vi) Cost barrier

Cost can be a barrier to eco-innovation, as implementing sustainable practices and developing new eco-friendly products and services can be costly. The cost of research and development, as well as the cost of new equipment and technology, can be a significant barrier to eco-innovation. Table 10 shows the quarries related to cost barrier.

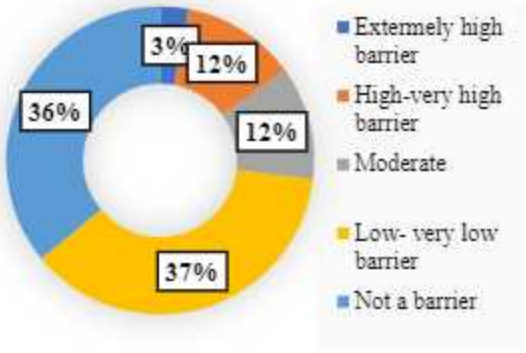
Table 10. Quarries for ranking customer barrier (CB1-CB3) in industries.

Cost Barrier (CB)	**CB1:** High cost is a barrier to executing environmental projects/activities /innovations.
	CB2: No financing source is a barrier to executing environmental projects/activities/ innovations.
	CB3: Slowness in creating funds is a barrier to initiating environmental projects/activities/innovations.

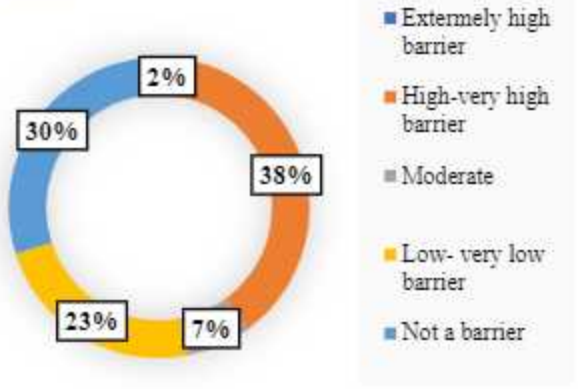
Findings:

- ***CB1***: About 36 % respondents believe that high cost is not a barrier for industries to introduce innovations. While 37% thought the financing source was a small barrier.
- ***CB2***: 38% responded that the high cost to execute environmental projects is high to an extremely high barrier.
- ***CB3***: 38% have similar opinions that it is a high barrier. Whereas 23% responded think it is a not a barrier.

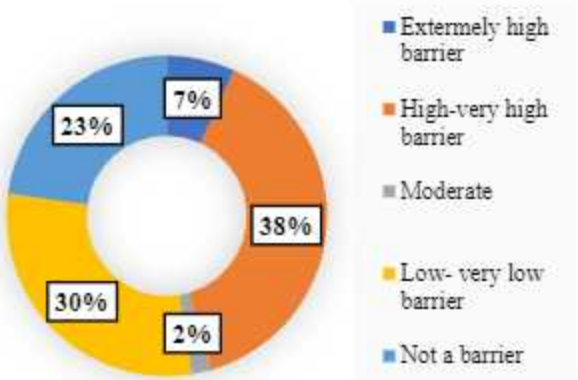
High cost is a barrier (CB1)



No financing source is a barrier to executing environmental projects (CB2)



Slowness in Setting up is a barrier to execute environmental projects (CB3)



IDENTIFICATION OF ECO-INNOVATION OPTION

Environmental problems with water and local air pollutants during car assembly are faced by the automotive industry and its supporting industries. On the basis of advice from experts, suggestions from related industries, and literature analysis, many eco-innovation ideas (table 11) have been chosen for debate in the future focus group meeting. The current financial predicament has temporarily suspended production in significant vehicle assembly plants.

Table 11. Eco-Innovation Options for Automobile & Allied Sector

Automobile & Allied Industry	
Eco-Innovation options	**Description**
Environmental Issues: Organization-operation-based options/new business models	
Managing waste in the automotive (components) manufacturing industry [3]	Waste management practices include: • Proper Production Planning • Usage of on-site wastewater. • Recycling practices. • solid waste management practices. • Monitoring of activities. • Environmental compliance. • Proper documentation etc. **Benefits of reducing waste** • Reduced cost of garbage treatment and disposal. • Low cost of buying metals and other raw resources by optimizing processes (e.g., fewer offcuts and rejects). • Minimize the adverse environmental effects caused by waste disposal and the use of finite resources.
Production capacity planning [4]	• Improvement in the environmental performance of the industry. • Considering the design innovation process, resource and material consumption, interior environmental quality, and production site sustainability. • Increased worker productivity, an improved interior environment, lower costs for health and safety, water and energy savings, and better waste management during the operational phase.
Process & product development [4]	• Considering the product's life cycle when designing it. • Recyclability, remanufacturing, and reuse Possibilities for improvement, a decrease in dangerous substances, benefits from royalties and access to green market niches, a reduction in disposal costs, and increased efficacy and eco-friendliness.

Green supply chain [4]	• Reusability recyclability and remanufacturing, enhancement possibilities, hazardous substance reduction, the advantages to (royalties, access to green market niches), disposal cost reduction, higher eco-efficiency, and effectiveness. • Sharing supply chain risk and presence, transferring eco-technology, and cutting waste and costs in supplier operations.
Greener Manufacturing [4]	• Boost ongoing effectiveness and incorporate the 4Rs into production. • reduce, reuse, recycle, and remanufacture. • Cost and waste reduction have improved performance in terms of the environment, economy, society, and economy.
Reverse logistics [4]	• Relationships with suppliers, logistics, and after-sales during and after using finished goods, primarily end-of-life items, plan, implement, and regulate backward flows. • Reduce landfill and environmental liability costs, lessen the environmental responsibilities associated with final disposal, and repurpose valuable resources.

Conclusion

In conclusion, although some organizations have adopted cleaner process technology and formed eco-innovation programs, the general engagement in environmental innovation in manufacturing remains low. There is a lack of efficient collaboration among small and medium-sized businesses to share best practices, and many similar businesses continue to operate in the old manner. Additionally, organizations do not keep environmental information on file or update their environmental data. The variations in responses across the different industry groupings imply that regulation may need to be modified for industry size. In addition, while some believe that high prices prevent the implementation of environmental innovation, a sizable majority of people believe that environmental enforcement is not as tough as it ought to be. In order to promote environmental innovation in manufacturing, there is a need for more dedication and cooperation.

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The proposed research aims to develop a policy framework for adopting the eco-innovation approach. The objectives of the research are:

(1) To examine existing environmental measures in major industrial sectors.

(2) To develop new eco-innovation options.

(3) To develop a plan for the management of underlying factors creating challenges in the adoption of eco-innovation strategies.

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