

Effective Management Strategies to Minimize Environmental Effects due to the Built Environment Sector in the Maldives

I.P.Tharindu Sandaruwan, R.M.K.K. Nuwandhara, A. M. Philips
School of Civil Engineering and Built Environment
Liverpool John Moores University,
Liverpool, UK

J.A.B. Janardana
Department of Quantity Surveying International
College of Business and Technology, Colombo,
Sri Lanka

M.A.Mohamed Aslan
Department of Engineering
De Montfort University,
Leicester, UK

Abstract:- A major factor in climate change is the building industry, which is one of the leading producers of greenhouse gas emissions. Construction has a significant negative impact on the environment since it devastates habitats and extracts materials from priceless resources. Understanding the industry holistically and how the process, materials, and design all contribute to climate change can help to better comprehend its effects. Due to the rapid growth of the construction industry in the Maldives, there is various environmental impacts arise in the Maldives. Hence, the research aim was to minimize the environmental impact that occurred in the Maldives due to construction activities. Accordingly, the mixed-method research approach was selected. For the questionnaire survey, 150 professionals were selected as a sample and distributed the questionnaire survey. However, 117 responses were received for the questionnaire survey. Six numbers of professionals were selected as a sample for the qualitative approach. Accordingly, the study revealed that generation of inter waste, inert water, and inland water pollution, dust generation from construction activities chemicals pollution, increase land usage, operations with high potential soil erosion, water pollution, toxic generation, operations with vegetation removals, unnecessary building consumption, and shortage of natural resources are the main environmental impact occurred in the Maldives due to the construction industry. In addition to that, the study shows that lack of proper EMS process, lack of management level support, lack of proper guidance, and lack of knowledge regarding EMS by the stakeholders are the major problems in Maldives construction industry to implement and maintain proper environmental management system. Hence, this research identified by implementing proper rules and guidelines, enhancing the knowledge of stakeholders, adapting proper construction processes, adapting proper health and safety measures, and conducting awareness sessions and training sessions will lead to avoiding or minimizing the environmental impact and major problems mentioned above. Ultimately these strategies help to enhance the management of Maldives' environment.

Keywords:- Construction; EMS; Environmental; Maldives; Pollution.

I. INTRODUCTION

A. Background

The construction sector is seen as a major contributor to economic expansion, particularly in emerging nations. However, it had been noted that a number of industry-related activities had a major negative impact on the environment [17]. Tam et al (2004) stated that the description of the construction sector as a significant cause of environmental issues supported this study [22].

Ecosystem impact, impact on natural resources, and influence on the general population are all included in the environmental impact of the construction process [4].

Environmental Management Systems were proposed as a result of awareness of the detrimental consequences that diverse activities have on the environment (EMS) [6]. EMS is a global, effective system created to lessen environmental damage brought on by pollution from various businesses and organizations [10].

Additionally, it offers guidelines for businesses to design, develop, and analyze business processes in order to meet their corporate and environmental objectives. In other words, the invention of this system was motivated by the need to encourage environmentally responsible work habits and other tools, such as eco-management and audit systems [7].

Since the increasing population in the Maldives, it is expected to grow more than double in urban population by 2025[18]. Environmental problems are becoming more severe as a result of unsustainable population expansion and changing lifestyles. An excessive number of these trucks are parked in Male, contributing to road surface compaction and the loss of groundwater supplies [8]. As the number of automobiles on the road rises on neighboring islands, similar concerns are appearing [3]. Furthermore, Homavazir (2011) revealed beach erosion is a major worry since the Maldives' islands are continually changing and growing are most impacted environmental issue and in the Maldives,

erosion is brought on by a number of things, such as the disappearance of a sand source, increased exposure to incident wave climate as a result of historical house reef mining, modifications to nearshore current patterns as a result of natural or artificial factors, such as the building of coastal infrastructure, and modifications to the natural sediment [12]. Hence, this study focuses to investigate effective management strategies to minimize environmental effects due to the built environment sector in the Maldives.

II. LITERATURE REVIEW

This section of this study discusses the existing theories in relation to the research problem using published journal papers, conference papers, guidelines, reports, etc.

A. Overview of Maldives Construction Industry

Maldives is a collection of 1196 coral islands in the Indian Ocean that are organized into 26 different geographic atolls.

All nations' economy relies on the construction industry as a key sector. Abenayake (2018) supports this claim by claiming that this sector has the capacity to drive the whole economy.

The major driver of the Maldives' economy, however, is tourism, which also creates employment opportunities and a significant portion of the nation's foreign exchange earnings.

Recognizing the intimate ties between the construction and tourist sectors and their economic impact on the nation is crucial [12].

The Maldives' government has established statutory authorities to control and keep an eye on the growth of the resorts. However, other than financial and statistical surveys, no earlier research on building or resort growth in the Maldives has been located too far [1].

Maldives is a small island nation that is particularly sensitive to climate change and various environmental impact are arise Maldives due to the construction industry of Maldives [3].

All facts of the built environment have been touched by the resort industry's increased desire for environmentally friendly structures. A sustainable, environmentally conscious, and green/lean construction sector may be built in the Maldives with the help of the design and construction process [12].

B. Impact of Construction on the Environment

Any development project should be developed to have as many good effects as possible and as few adverse effects on the environment. Any strategy for development that aims to raise the standard of living has its own set of inherent advantages and disadvantages [14]. Early project planning that considers the environmental effects of building might enhance the environmental performance of construction sites and projects [9].

It is believed that building would have a negative influence on the delicate ecology. These effects include resource depletion, biological diversity loss due to raw material extraction, landfill issues due to waste generation, decreased productivity increases, negative people's health due to poor indoor air quality, climate change, acid rain, and smog due to the emission generated by the manufacture and transportation of building products, which uses energy [16]. Ecosystems impacts, impacts on natural resources, and effects on the general population are the three main subjects under which environmental impacts are classed [15], [6], [25].

a) Ecological System Impact

The effect of development on ecosystems has emerged as a significant concern in light of the numerous current construction projects. Such negative environmental effects include waste, noise, dust, solid wastes, toxic production, air pollution, water pollution, offensive odours, climate change, land usage, operations involving vegetation, and hazardous emissions [27]. Dust produced during construction as well as vehicle exhaust contribute to air pollution. Included in these emissions are Co₂, No₂, and So₂ [22]. Different types of construction machinery, air compressors, and cars all produce noise emissions. Around the building site, noise levels from various sources and construction equipment will vary from 70 to 120 DB [14].

b) Natural Resource Impact

The construction industry has a significant negative influence on the environment all around the globe, and this impact is expanding [15]. It accounts for more than half of total energy consumption in high-income countries, and it accounts for a significant portion of greenhouse gas emissions in poor and middle-income nations [5].

c) Public Impact

Construction sites are particularly sensitive when it comes to the consequences of mobility, noise pollution, and dust caused by construction activities [14]. Health damage contributes to less than half of the total impact (65 percent), but accounts for much more than resource depletion (8per8 percent his demonstrates the need for doing a health harm assessment allocated [25].

According to the above literature review following environmental impacts due to construction industry are identified and summarised in below Table 1.

No	Factors	References
1	Noise Pollution	1, 3, 5, 7, 8
2	Dust Generation with Construction Machinery	1, 2, 4, 6
3	Land Pollution	3, 4, 5, 7
4	Waterborne suspended substances such as lead and arsenic	1, 3, 4, 5
5	Air Pollution	1, 2, 3, 6
6	Increase Land Usage	1, 4, 8, 9
7	Operations with vegetation removals	1, 2, 3, 6, 7, 9
8	Emission of VOC and CFC	3, 4, 6, 10
9	Generation of Inter waste	1, 2, 4, 10
10	Operations with high potential soil erosion	2, 5, 7, 10
11	Water Pollution	1, 3, 5, 10
12	Dust generation from construction activities	4, 5, 7, 10
13	Inert water and inland water pollution	3, 4, 6, 10
14	Chemicals Pollution	2, 5, 7, 8, 10
15	Landscape Alteration	3, 4, 5, 7
16	Toxic Generation	3, 4, 8, 9
17	Greenhouse gas emission	6, 7, 8, 10
18	Climate Changes	2, 5, 7, 8
19	Wastewater discharge	2, 3, 5, 6
20	Ozone exhausting	1, 3, 6, 8
21	Global Warming	1, 6, 7, 9
22	Emissions de CO ₂ , SO ₂ , CO, N ₂ O	1, 2, 4, 5, 8, 10
23	Airborne suspended particles	1, 2, 3, 6
24	Acidification and waste heat	2, 3, 7, 9
25	Eutrophication	1, 5, 6, 8
26	Photochemical smog	4, 5, 7, 8, 9
27	Unnecessary building consumption	3, 4, 5, 7
28	Shortage of Natural resources	6, 7, 8, 9, 10
1 (Kaur & Arora, 2012), 2 (Gangoellis, et al., 2011), 3 (Lippiatt, 1999), 4 (Li, et al., 2010), 5 (Chang, et al., 2011), 6 (Zolfagharian, et al., 2012), 7 (Hwang & Yea, 2011), 8 (Pittet & Kotak, 2009), 9 (Shen, et al., 2005), 10 (Berry, 2018)		

Table 1: Environmental Impact Due To The Construction Industry

C. Environmental Management and Legislation in Maldives

Law has always had an important role in influencing the natural and physical environment, even though the development of a distinct legal corpus created or regularly implemented expressly with the objective of avoiding or addressing environmental issues is of recent origin. All citizens of the nation are expected to preserve the environment by little adjustments in lifestyle, such as turning off the faucet when performing daily tasks [2]. The following rules and legislations were used to manage the environmental impact in Maldives [3]. The National Environment Action Plan for the Maldives outlines the country's environmental protection program (NEAP). The NEAP was established in 1989 to handle the country's environmental planning and management needs [17].

The goal of NEAP is to safeguard and maintain the Maldives' natural environment and to manage its resources sustainably for the benefit of all current and future generations. It is advisable to create legal provisions to preserve a clean and healthy environment by reducing, as much as possible, the negative effects that environmental degradation is likely to have on people, animals, plants, nature, and physical components; and also, to preserve the environment with appropriate use and natural resources management, taking into consideration that environmental sustainability could be accomplished from the inseparable interaction between the economic, social [1]. Thus, in 1993, the People's Majlis created an Act known as the Environment Protection and Preservation Act to ensure the protection of the environment [17].

Environmental impact assessment (EIA) legislation, which incorporates environmental factors in decision-making processes, issue the modern equivalent of the "preventive approach to environmental protection." Environmental impact assessments must typically be prepared in accordance with EIA rules in order to study and evaluate any planned development activity's potential effects on the environment [1].

In order to address all of the environmental difficulties that the nation is facing, the government has taken due care in drafting this legislation to control environmental policies, laws, and institutions [25]. 1996 saw the establishment of the Environment Section within the Ministry of Home Affairs. Two years later, the Ministry of Planning and Development received The Environment Section, giving it the status of a ministry [18].

D. Major Problems in Management Strategies that Lead to Environmental Pollution

According to the Zutshi & Sohal (2004) revealed that lack of government or legislative support, low awareness of EMS, Organisation resistance to change, Unclear guidelines for EMS implementation and Limited pressure from stakeholders are the major management level challenges that lead to increase environmental pollution.

In addition to that lack of training and education about EMS, lack of top management support, weak environmental management culture, organization resistance to change, unclear guidelines for EMS implementation, and lack of knowledge of certifier systems are the management-level challenges to improving the process of EMS in Nigerian construction industry [21].

According to the Campos, et al. (2011), Shen & Tam (2002) and Palmer, (2012) revealed that lack of training and education about EMS, lack of top management support, weak environmental management culture, organization resistance to change, unclear guidelines for EMS implementation, lack of knowledge of certifier systems, lack of environmentally friendly technologies and materials, limited pressure from stakeholders, high costs of EMS implementation, complex documentation process, ambiguity in interpretations of EMS, negative attitudes of employees, multi-layered sub-contracting bottleneck, lack of leading

initiative among construction companies, lack of specialist in environmental issue, and difficulty in dealing with environmental issues the main barriers to implement EMS into the construction industry. In addition to the high disintegration of the construction process and the time-consuming for improving environmental performance are other management challenges to implementing and processing the EMS in the construction industry [6].

III. RESEARCH METHODOLOGY

According to Creswell (2014) quantitative research approach, qualitative research approach, and mixed-method research approach are the main research approach. Considering the characteristics of this study, mixed method research approach was selected. Accordingly, comprehensive literature review was carried out by referring to previously published journal articles, conference articles, research papers, books, reports, and websites. Based on the findings of the literature review, a questionnaire survey was carried out to further validate the findings of the literature review regarding environmental pollution in the construction industry in the Maldives. Using the google form questionnaire method, a sample size of 150 people was extracted for this study. The data collected through the questionnaire survey was analyzed using the Mean-weighted rating formula shown below.

$$\text{Mean Weighted Rating Formula} = \frac{\sum Vi \times Fi}{N} \quad (1)$$

Where,

- Vi - Rating is given by the respondent
- Fi - Frequency of responses
- N - Total number of responses

Questionnaire survey questions consist of five Likert scales. For that Likert scale was assessed along with the weightages of [-2] for highly not possible, [-1] for not possible, [0] for neutral, [1] for possible, and [2] for highly possible. Accordingly, the mean weighted rate value equal to or above 1.00 was selected as applicable factors for the considered context. As a second stage of data collection, series of expert interview was carried out. Accordingly, the interview guideline was consisting of main two sections. The first section was aimed to gather the demographic data of interview participants and other section aim was to gather data to minimize environmental impact in Maldives due to construction industry. The construction industry professionals and citizens who have the knowledge regarding environmental pollution due to the construction industry in Maldives were selected as a population of this study. From the selected population six numbers of professionals who are having environmental management experience in the Maldives construction sector was selected as a sample size for this study. The data collected through the interview was analyzed using content analysis method.

IV. DATA ANALYSIS AND DISCUSSION

Only 78.00% of the surveys that were received were used for analysis, with four being eliminated from analysis because they were incomplete. A total of 121 of the 150 questionnaires that were properly distributed were returned, however only 117 of them were appropriate for study.

A. Demographic Data Analysis of Questionnaire Survey

According to the respondents' academic backgrounds, 8% had just certificates or diploma-level credentials, 23% had diplomas, 15% had higher national diplomas, 23% had bachelor's degrees, and 31% had masters or post-graduate degrees (Refer Figure 1). Architects made up 17% of those who responded, engineers made up 60%, and quantity surveyors made up 23% (see Figure 2). 38% of respondents had less than five years of work experience, while 8% had 11 to 15 years of experience. More than 54% of those polled had more than five years of construction experience (see Figure 3). In addition to that, 8% of respondents had less than one year of experience in the Maldives construction sector, 77% had 1–5 years' experience and 15% of respondents had 6–10 years' experience in the Maldives construction industry (Refer Figure 4). As a result, the respondents' backgrounds indicate that they have the academic and professional credentials necessary to fulfil the study's objectives.

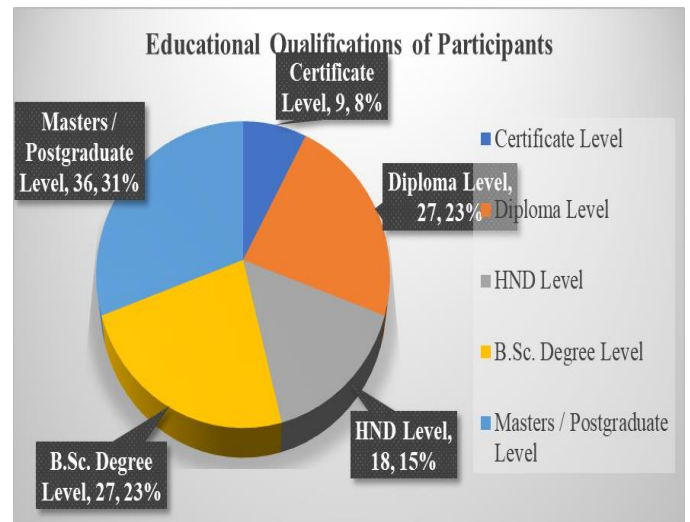


Fig. 1: Educational Qualifications of Questionnaire Survey Participants

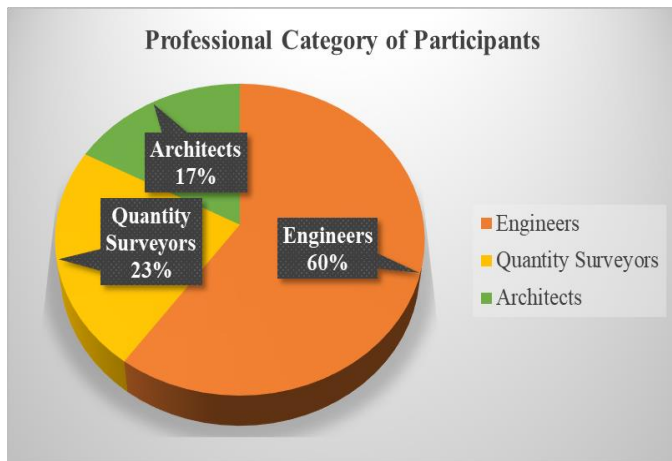


Fig. 2: Professional Category of Questionnaire Survey Participants

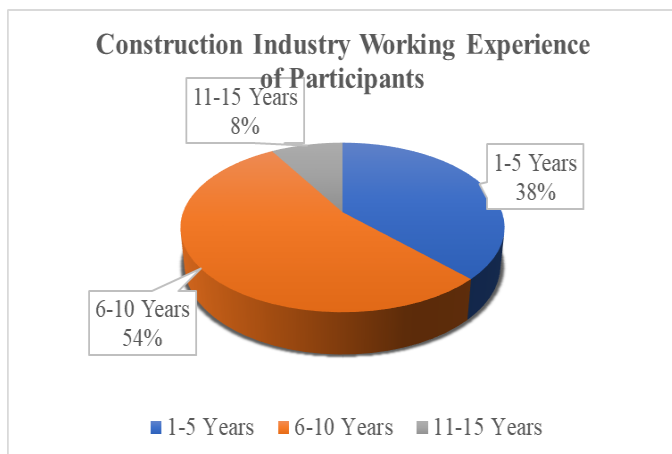


Fig. 3: Construction Industry Working Experience of Questionnaire Survey Participants

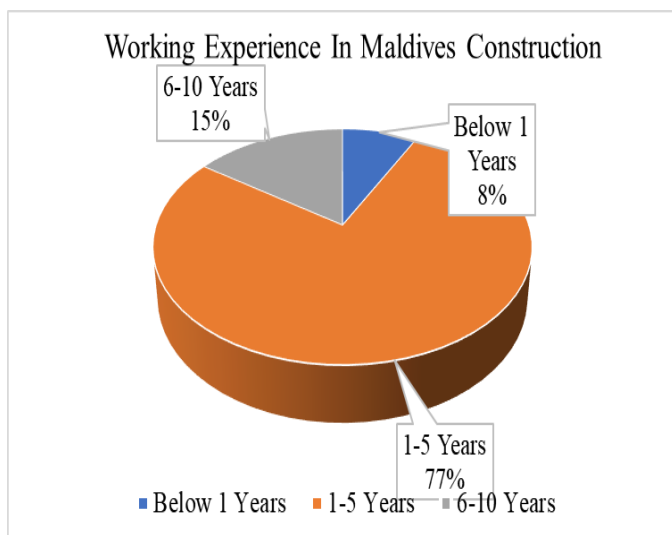


Fig. 4: Working Experience in Maldives Construction Industry of Questionnaire Survey Participants

B. Environmental Impacts in the Construction Industry of Maldives

The received data from the questionnaire survey was analyzed and the mean weighted rating value for each factor was determined, as shown in Table 2.

No	Factors	Mean Weighted Rating Value
1	Noise Pollution	1.0256
2	Dust Generation with Construction Machinery	1.0855
3	Land Pollution	1.2308
4	Waterborne suspended substances such as lead and arsenic	1.0513
5	Air Pollution	1.2222
6	Increase Land Usage	1.4274
7	Operations with vegetation removals	1.3248
8	Emission of VOC and CFC	1.0769
9	Generation of Inter waste	1.5299
10	Operations with high potential soil erosion	1.4274
11	Water Pollution	1.4017
12	Dust generation from construction activities	1.4872
13	Inert water and inland water pollution	1.5043
14	Chemicals Pollution	1.4444
15	Landscape Alteration	1.2137
16	Toxic Generation	1.3419
17	Greenhouse gas emission	0.1282
18	Climate Changes	0.1453
19	Wastewater discharge	0.6581
20	Ozone exhausting	0.4274
21	Global Warming	0.7692
22	Emissions de CO ₂ , SO ₂ , CO, N ₂ O	(0.4615)
23	Airborne suspended particles	(0.4615)
24	Acidification and waste heat	(0.5385)
25	Eutrophication	0.4786
26	Photochemical smog	0.4957
27	Unnecessary building consumption	1.3162
28	Shortage of Natural resources	1.2906

Table 2: Mean Weighted Value Of Environmental Impact Due To The Construction Industry In Maldives.

Results show that the generation of inter-urban waste had the highest mean weighted rating value of 1.5299, while inert water and inland water pollution ranked second and dust from construction activities ranked third. Increased land usage, operations with high potential soil erosion, water pollution and toxic generation were also found to have significant environmental impacts in the Maldives. Table 2 shows the mean weighted ratings value of environmental impact due to the construction industry in the country.

C. Major Problems in Management Strategies that Lead to Environmental Pollution in Maldives

Accordingly received data was analysed and found out each factor’s mean weighted rating value and shown in below Table 3.

No	Factors	Mean Weighted Rating Value
1	Lack of government or legislative support	1.245
2	Low awareness of EMS	1.325
3	Lack of training and education about EMS	1.246
4	Lack of top management support	1.024
5	Weak environmental management culture	1.321
6	Organization resistance to change	1.315
7	Unclear guidelines for EMS implementation	1.036
8	Lack of knowledge of certifier systems	1.054
9	Lack of environmentally friendly technologies and materials	1.098
10	Limited pressure from stakeholders	1.096
11	High costs of EMS implementation	1.075
12	Complex documentation process	1.425
13	Ambiguity in interpretations of EMS	1.564
14	Negative attitudes of employees	1.384
15	Multi-layered sub-contracting bottleneck	1.395
16	Lack of leading initiative among construction companies	1.257
17	Lack of specialist in environmental issue	1.624
18	Difficulty in dealing with environmental issues	1.059
19	High disintegration of construction process	1.065
20	Time consuming for improving environmental performance	1.238

Table 3: Mean Weighted Rate Value Of Major Problems In Management Strategies That Lead To Environmental Pollution In Maldives

Lack of specialist in environmental issue had the highest mean weighted rating value of 1.624, Ambiguity in interpretations of EMS ranked second, Complex documentation process ranked third, and Multi-layered sub-contracting bottleneck ranked fourth. Weak environmental management culture, organization resistance to change, lack of leading initiative among construction companies, and negative attitudes of employees were also identified as major problems that lead to environmental pollution in Maldives.

D. Demographic Data of Interview Participants

The expert interview participants’ demographic data was analysed and shown in below Table 4.

Code	Profession	Construction Industry Experience	Experience of Maldives Construction
R1	Principal Architect	20 Years	14 Years
R2	Engineer	15 Years	10 Years
R3	Project Manager	17 years	06 Years
R4	Quantity Surveyor	12 Years	03 Years
R5	Architect	11 Years	05 years
R6	Project Manager	13 years	06 years

Table 4: Demographic Data Of Interview Participants

The participants for expert interview were consisting of various professional categories such as Architects, Engineers, Project Managers and Quantity Surveyors. According to the demographic information of expert interview participants, it can be revealed that the selected sample size was good sample size for this study.

E. Appropriate Methods to Minimize Environmental Impact in Maldives Construction Industry

The expert interview was conducted to investigate the appropriate methods to minimize the environmental impact in the Maldives construction industry. The questionnaire survey identified nineteen environmental impacts in the Maldives due to the construction industry and how these can be minimized. The expert professionals suggested by adapting following the strategies environmental impact in the country's construction industry can be reduced. The below table describes that strategies that have been proposed by the professionals in order to minimize the environmental impact in Maldives construction Industry.

Pollution type	Strategies that can be taken to minimize
Noise Pollution	Reduce the voice generate machinery and use low noise-generated equipment and use the new soundproof machinery.
Dust Particles	Using the dust-reduce safety net covering the machinery within the site and cleaning the site and required machinery according to the guideline.
Land Pollution	Adapting proper waste management system and recycle material mechanism.
Waterborne suspended substances such as lead and arsenic.	use the appropriate method of water purifying system and deliver water as clear and pouring the clear water to the environment

Air Pollution	Reducing the demolition works, adapting better methodology to control dust and noise are the main solutions and mitigating the emission deliver contents also help to minimise air pollution impact.
Increase Land Usage	Adapting more high-rise buildings, encourage people to flat housing schemes within the available land and guidance of the government for the new concepts.
Operations with Vegetation removals	implement new regulations to reduce the vegetation removal
Emission of VOC and CFC	implement new technology to avoid all emissions
Generation of Inner waste	introducing a good waste recycling system can be minimise the generation of inter waste
Water Pollution and inter water island water pollution	By developing the water protection system and water reuse methods are the most suitable strategies to overcome this impact and initiate a protection system to protect the water.
Chemicals Pollution	Adapting proper storage, proper application process and waste management are the strategies overcome chemical pollution and introduce new government rules and regulations to waste management.
Landscape Alteration	introduce new government rules and regulations
Toxic Generation	introduce new government rules and regulations
Unnecessary Building consumption.	the government and relevant authorities need to encourage citizens to live more eco-friendly houses rather than the traditional houses and encourage co-living and Flat house concepts is the best solution
Shortage of Natural Resources.	government and relevant authorities need to encourage more green building materials usage rather than the traditional construction material

Table 5: Strategies That Can Be Taken To Minimize Environmental Impact In Maldives Construction Industry.

F. Strategies to overcome major problems in management strategies that lead to environmental pollution in the Maldives

The expert interview guideline was focused to gather data in relation to the Strategies to overcome major problems in management strategies that lead to environmental pollution in the Maldives. All the interviewer participants mentioned that by adding more rules from the government side to improve the environmental protection, improve the monitoring process of EMS and make clear guidelines to implement the system and rules, and make separate departments for documentation, new practices include maintaining.

V. CONCLUSION AND RECOMMENDATION

Building is said to have a detrimental effect on the sensitive environment. These negative effects include resource depletion, biological diversity loss as a result of raw material extraction, landfill problems as a result of waste production, decreased productivity gains, adverse effects on human health as a result of poor indoor air quality, climate change, acid rain, and smog as a result of the emissions produced by the production and transportation of building products, which consumes energy. Therefore, it is necessary to reduce the environmental impact arise due to the construction industry. Accordingly, the study was revealed that generation of inter waste, inert water and inland water pollution, dust generation from construction activities chemicals pollution, increase land usage, operations with high potential soil erosion, water pollution, toxic generation, operations with vegetation removals, unnecessary building consumption, shortage of natural resources, land pollution, air pollution, landscape alteration, dust generation with construction machinery, emission of VOC and CFC, waterborne suspended substances such as lead and arsenic, and noise pollution are the environmental impacts occurred in Maldives due to construction industry. In addition to that lack of specialist in environmental, ambiguity in interpretations of EMS, complex documentation process, multi-layered sub-contracting bottleneck, negative attitudes of employees, low awareness of EMS, weak environmental management culture, organisation resistance to change, lack of leading initiative among construction companies, lack of training and education about EMS, lack of government or legislative support, time consuming for improving environmental performance, lack of environmentally friendly technologies and materials, limited pressure from stakeholders, high costs of EMS implementation, high disintegration of construction process, difficulty in dealing with environmental issues, lack of knowledge of certifier systems, unclear guidelines for EMS implementation, and lack of top management support were identified as other major problems in management strategies that lead to environmental pollution in Maldives.

Accordingly, the studies were concluded that reduce the voice generate machinery and use low noise generated equipment, use the dust-reduce safety net covering the machinery, use the appropriate method of water purifying system and deliver water as clear & pure to the environment, mitigate the emission deliver contents, instead of land usage encourage people to flat housing schemes within the available land, implement new regulations to reduce the vegetation removal, implement new technology to avoid all emissions, introduce a good waste recycling system, grow the soil protection trees in soil erosion lands, develop the water protection system and water reuse methods, cover the construction location with a fully protected dust-catching safety net, initiate a protection system to protect the water, avoid the chemicals using, encourage co-living and flat house concepts and use the empty islands to increase the natural resources will lead to minimise the environmental impact which are arise due to the construction industry of Maldives. In addition to that the study recommended by adapting following strategies the construction industry

stakeholders can minimise the environmental issues and challenges in Maldives.

- Add more rules from the government side to improve the environmental protection and need to monitor EMS from the government sector.
- Encourage Youngers from university for EMS training.
- Add more training and workshops for management staff and new practices include maintaining.
- Make clear guidelines to implement the system and rules and introduce a new global system to protect the environment protection.
- Use the low-cost EMS implication methods.
- Make separate departments for documentation and maintaining.
- Give an awareness session for employees and clarify the importance of EMS.
- When a new construction company starts the project needs to give a brief understanding of the government sector.
- If knowledge is unavailable locally need to hire from abroad and improve the knowledge of local staff and management.
- Short-term methods implementation.

ACKNOWLEDGEMENT

This research work would not be possible without the assistance and guidance of various individuals and organizations. Therefore, we take this opportunity to convey my gratitude to every one of them.

REFERENCES

- [1.] Abdulla, A., & Ismail, N. (2015). The Determinants of Customer Retention in the Construction Industry of the Maldives. *International Journal of Accounting, Business and Management*, 1-26.
- [2.] Abeynayake, M. (2018). Legal Aspects Concerning Sustainable Buildings and Cities Relating to the Urban Development in Sri Lanka. Colombo: University of Moratuwa.
- [3.] Andréfouët, S., & Naseer, A. (2011). Chronic small-scale oil pollution in Addu A toll (Maldives). *Coral Reefs*, 30(4), 935-935.
- [4.] Al-Thani1, S. K. & Park, S., 2020. The Case for Sustainable Concrete Waste Management in Qatar. *Sustainability in Environment*, 5(1), pp. 1-13.
- [5.] Berry, D. (2018). *Designing an Automated Sustainable Green Roof System*. Research Gate.
- [6.] Chang, Y., Ries, R., & Wang, Y. (2011). The quantification of the embodied impacts of construction projects on energy, environment, and society based on I-O LCA. *Energy Policy*, 39(10), 6321-6330.
- [7.] de Oliveira, F. N., Salgado, E. & Beijo, E., 2017. Analysis of the Environmental Management System based on ISO 14001 on the American continent. *Journal of Environment Management*, Volume 199, pp. 251-262.
- [8.] Chen, P., Ong, C., & Hsu, S. (2016). Understanding the relationships between environmental management practices and financial performances of multinational construction firms. *Journal of Cleaner Production*, 139, 750-760.
- [9.] Gangolells, M., Casals, M., Gassó, S., Forcada, N., Roca, X., & Fuertes, A. (2011). Assessing concerns of interested parties when predicting the significance of environmental impacts related to the construction process of residential buildings. *Building and Environment*, 46(5), 1023-1037.
- [10.] Gomez, A. & Rodriguez, M., 2011. The effect of ISO 14001 certification on toxic emissions: an analysis of industrial facilities in the north in Spain. *Journal of Cleaner Production*, 19((9-10)), pp. 1091-1095.
- [11.] Hwang, B.-G., & Yea, Z. B. (2011). Perception on benefits of construction waste management in the Singapore construction industry. *Engineering, Construction and Architectural Management*, 18(4), 394-406.
- [12.] Homavazir , Z., 2001. Waste Characterization Study Komandoo Island, Shaviyani Atoll, Atoll Development for Sustainable Livelihoods Project. *Environment Management*, 13(2), pp. 68-76.
- [13.] Kaur, M., & Arora, S. (2012). Environment impact assessment and environment management studies for an upcoming multiplex- a Case Study. *IOSR Journal of Mechanical and Civil Engineering (IOSRJMCE)*, 1(4), 22-30.
- [14.] Li, X., Zhu, Y., & Zhang, Z. (2010). An LCA-based environmental impact assessment model for construction processes. *Building and Environment*, 45(3), 766-775.
- [15.] Lippiatt, B. (1999). Selecting cost-effective green building products: BEES approach. *Journal of Construction Engineering and Management* *Environment*, 45(3), 766-775.
- [16.] Ministry of Home Affairs Housing and Environment. (1991). *Second National Environment Action Plan NEAP II, Male*. Male: Ministry of Home Affairs Housing and Environment.
- [17.] Ministry of Home Affairs Housing and Environment. (2002). *National Biodiversity Strategy and Action Plan of the Maldives*,. Male: Ministry of Home Affairs Housing and Environment.
- [18.] Mossman, S. & Sarhan, A., 2021. Synchronizing Off-Site Fabrication with On-Site Production in Construction. *Construction Economics and Building*, 21(3), pp. 412-420. Ofori, G., Gang, G., & Briffett, C. (2002).
- [19.] Implementing environmental management systems in construction: lessons from quality system. *Build Environment*, 37(12), 1397-1407.
- [20.] Oladinrin, T., Ogunsemi, D., & Aje , I. (2012). Role of construction sector in economic growth: empirical evidence from Nigeria. *FUTY Journal Environment*, 7(1), 50-60.
- [21.] Pittet, D., & Kotak, T. (2009). Environmental impact of building technologies, a comparative study in Kutch District, Gujarat State, India. Bayamo, Cuba: Research Gate.
- [22.] Shen, L., Lu, W., Yao, H., & Wu, D. (2005). A computer-bed scoring method for measuring the environmental performance

- [23.] Tam, C., Tam, V., & Tsui, W. (2004). Green construction assessment for environmental management in the construction industry of Hong Kong. *International Journal of Project Management*, 22(7), 563-571.
- [24.] Varnäs, A., Balfors, V., & Faith-Ell, C. (2009). Environmental consideration in procurement of construction contracts: current practice, problems and opportunities in green procurement in the Swedish construction industry. *Journal of Cleaner Production*, 17(13), 1214-1222.
- [25.] Zolfagharian, S., Nourbakhsh, M., Irizarry, J., Ressang, A., & Gheisari, M. (2012). Environmental impacts assessment on construction sites. *Journal of Construction Management and Economics*, 18(4), 437-446.