A Research study on the role of the built environment stakeholders in climate change adaptation

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Contents

1 Introduction

Sri Lanka is highly vulnerable to the impacts of climate change as it is a small island in the tropical region (CCS and MoMDE, 2016). According to the IPCC report (2014), sea levels (MSL) have increased globally by 0.19 meters during the last hundred years, and it is projected that it would occur faster during this century. Also, the National Adaptation Plan of Sri Lanka (2016-2025) has identified 5 major types of changes in atmospheric and oceanic systems such as increased atmospheric concentration of greenhouse gases, rising atmospheric temperature, changing patterns of precipitation, increased incidence and severity of rainfall and sea level rise that are predicted to occur. Important sectors in the country such as tourism, fisheries, biodiversity, agriculture, food security (De Costa, 2008; De Silva, 2006; Marambe et al., 2013, 2015) productions related to export crops (Nissanka et al., 2011; Ranasinghe, 2013; Wijeratne et al., 2007) and health and human settlements (ME, 2010 a and b) could be affected due to the impacts of climate change. Accordingly, every aspect of the built environment is highly susceptible to the impacts of climate change. Therefore, it is important to streamline climate adaptation plans and mitigation strategies to reduce the cost of climate change impacts. As a country, Sri Lanka initiated work on climate change since 1990, when initial talks on climate change began to emerge. Originally, climate change was identified as a meteorological issue in Sri Lanka and the Department of Meteorology was the national focal point for the Intergovernmental Panel on Climate Change (IPCC) for Sri Lanka. Later this issue was taken under the purview of the Ministry of Mahaweli Development and Environment (Pallawala, 2018). The Climate Change Secretariat, which is currently the national focal point on climate change was established in 2008 to address the impact of climate change. In addition, the National Expert Committees of Climate Change (NACC) and the Inter-Ministerial Coordination Committee were established to address climate related matters under the Climate Change Secretariat.

2 Built environment stakeholders linked to climate change adaptation

Amaratunga and Haigh (2011) mention that the nature, objectives, and content of any specific project determine its stakeholders. Several categories and classifications were introduced by researchers for built environment stakeholders. Chandrasekhar (2012) has divided stakeholders into government agencies, non-government organizations, and community-based organizations. Shaffique and Waren (2016), divided stakeholders into ‘principal’ and ‘primary’ stakeholders. In another study by Ginige, Amaratunge, and Haigh (2010), national and local governments, the international community, community, civic society, the private and corporate sector, academia, and professional associations are identified as key built environment stakeholders involved in construction. Accordingly, for the specific topic of climate adaptation, the National Adaptation Plan (2016-2025) of the Climate Change Secretariat of Sri Lanka identifies the government sector (line ministries, line agencies, the central government, and provincial councils), the private sector (Corporate sector and SMEs), civil society organizations, academics, researchers, other knowledge makers, and local community-based organizations as key stakeholders in climate adaptation. As the above-mentioned built environment

stakeholders and climate adaptation stakeholders have similar qualities, the below-mentioned categories could be identified as built environment stakeholders in Sri Lanka.

2.1.1 Local and National Governments

When considering climate change adaptation and mitigation, the national government and local governments play major roles. This can be discussed as institutional arrangements and policy initiatives led by the government of Sri Lanka. Initially climate change was identified as a meteorological issue and the Meteorology Department of Sri Lanka was known as the national focal point of the Intergovernmental Panel on Climate Change (IPCC). However, later climate change was taken under the purview of the Ministry of Environment (MoE) (Pallawala, 2018). Later the MoE was renamed as the Ministry of Mahaweli Development and Environment (MoMDE). The Ministry of Environment, which is the National Focal Point for the UNFCCC and Kyoto Protocol established the Climate Change Secretariat (CCS) in 2008 under its purview. The Climate Change Secretariat is the main body which addresses climate change adaptation and it is also the national focal point of climate change. It also addresses cross-sectoral challenges caused by climate change and fulfils commitments under the United Nations Framework Convention on Climate Change (UNFCCC) & the Kyoto Protocol. The climate change secretariat provides a platform to liaise with other key stakeholders and ensures wider consultation for policy implementation (CCS and MoMDE, 2016). Two expert committees have been established under the climate change secretariat, namely the National Expert Committee of Climate Change Adaptation (NECCA) and the National Expert Committee on Climate Change Mitigation (NECCCM) (Pallawala, 2018). These expert committees consist of 31 members from key stakeholder organizations such as ministries, departments, authorities, non-governmental organizations, the private sector, and academia. The main role of these expert committees is to bring key stakeholders together and to coordinate all climate related activities (Pallawala, 2018). The Inter-Ministerial Coordination committee has been implemented to mainstream climate change into development processes of the country by providing a perfect platform to coordinate national level climate change related matters at the government level. In addition, the Nationally Appropriate Mitigation Action Coordinating Body was approved by MoMDE and CCS in partnership with the UNDP. Institutional mechanisms and relevant institutions for mitigation actions were identified through this process. The Nationally Determined Contributions (NDCs) have also proposed legislative frameworks such as the "Climate Commission," even though it is not legally empowered to implement capacity building and other functioning activities due to the current institutional mechanism.

Considering the public policies and guidelines in Sri Lanka, the CCS developed the National Climate Change Policy in 2012 and the National Climate Change Adaptation Strategy (2011-2016) in 2010. The NCP consists of twenty-five policy statements which are categorized under topics such as vulnerability, adaptation, mitigation, sustainable consumption, production, knowledge management and general statements (CCS and MoMDE,2012). Further, the National Adaptation Plan for climate change impacts in Sri Lanka (2016 – 2025) was made according to the UNFCCC guidelines. This was the next mile stone initiative taken at national level to tackle the adverse effects of climate (CCS and MoMDE,2012). Also, adaptations proposed in NAP have covered sustainable development goals that need to be achieved by 2030. The Nationally Determined Contribution (NDCs) have been planned by including adaptation, mitigation, loss, and damages. The above-mentioned policy documents reveal the vision and strategic priorities that the Sri Lankan government has adopted to address the impacts of climate change. Further, several guidelines and policies in the country also play a major role in climate change

mitigation and adaptation even though they do not directly discuss climate change as only several environmental effects are addressed. Such guidelines are mentioned below:

1. The National Action Plan for Haritha Lanka Programme
2. Sri Lanka Comprehensive Disaster Management Programme 2014-2018
3. The National Action Programme for combating land degradation of Sri Lanka
4. The Coastal Zone Management Plan
5. National Physical plan (2011-2030)
6. Sri Lanka Water Development Report
7. Draft National Agricultural Policy

All the above mentioned plans and policies were formulated by different government ministries and departments. In addition to that, Sri Lanka National scoping study, 2017 have identified other policies that can be applied in mitigation and adaptation. They are as follows.

Climate Related Policies	Year
National Forest Policy	1995
Forestry Sector Master Plan	1995-2020
National Air Quality Management Policy	2000
National Solid Waste Management Strategy	2000
Initial National Communication developed in 2000	2000
National Policy on Wildlife Conservation	2003
National Environmental Policy	2004
National Watershed Management Policy	2004
National Wetlands Policy	2006
National Land Use Policy	2007
Sector Vulnerably Profiles: Water, Health Agriculture and Fisheries, Urban Development, Human Settlements and Economic Infrastructure	2007-2016
Forest Ordinance	2009
Fauna and Flora Protection Ordinance	2009
Nationally Appropriate Mitigation Action (NAMA) on Energy Generation and End Use Sectors	2010
National Climate Change Policy (2016 - 2025	2011
Second National Communication	2011
National Climate Change Adaptation Strategy (NCCAS)	2011-2016
Technology Needs Assessment and Technology Action Plans for Climate Change Adaptation (for food, health, water sectors)	2011-2016
Urban Transport Master Plan 2032 based on the National Transport Policy	2013-2025
NAMA on Transportation (Draft)	2015
National Climate Change Adaptation Plan of Sri Lanka	2015-2024
The Long-Term Electricity Generation Expansion Plan	2015-2032
National Adaptation Plan (NAP) for Climate Change Impact in Sri Lanka	2106-2025

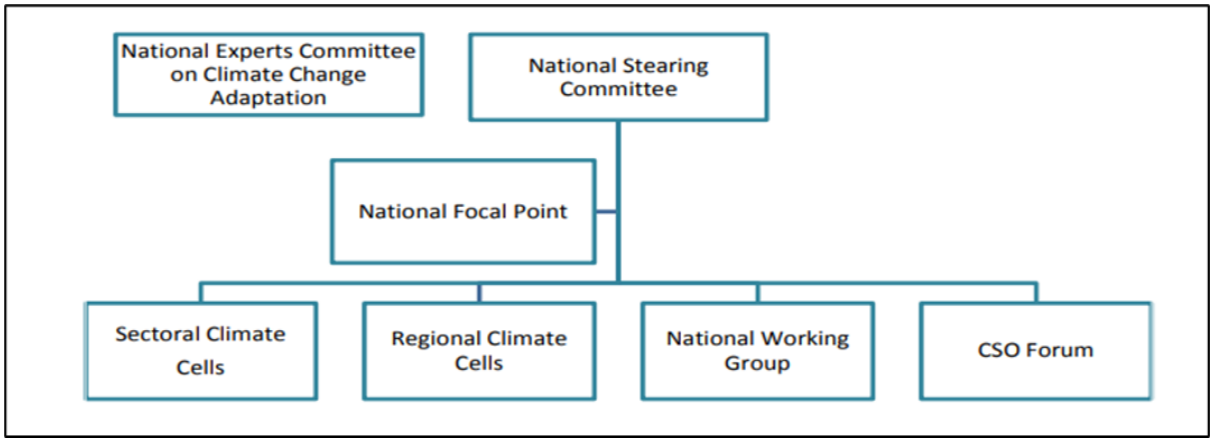
National Biodiversity Strategic Action Plan (NBSAP	2016-2022
National REDD+ Investment Framework and Action Plan (NRIFAP)	2018-2023

Source: Sri Lanka National scoping study, 2017

According to the National adaptation plan 2016-2025, 5 major types of changes with long- and short-term physical effects have been identified in atmospheric and oceanic systems. Eventually, these physical effects would create different socio-economic issues in different sectors (CCS and MoMDE,2016). The National adaptation plan has suggested ways to implement the adaptations with the guidance of the climate change secretariat (See image 1) (CCS and MoMDE,2016).

In order to implement adaptation measures at local level, the NAP (2016-2025) has proposed Sectorial Climate Cells, National Working Groups and Regional Climate Cells, and civil organizations. CCS is the coordinating agency of the above-mentioned bodies (CCS and MoMDE,2016). The central government (National level) has an administrative structure which connects with the grassroots level. District Secretariats and Divisional Secretariats are the main representatives of national level ministries that reach the local level. Further, local governments also have a major role in the implementation of climate change adaptation and mitigation measures with the collaboration of the central government. However, provincial councils and local councils (Municipal Councils, Urban Councils and Pradeshiya Sabas) do not have a clear local mandate on climate change. Both PCs and LCs carry out actions relevant to climate change under their current mandate though not recognized as climate actions (Pallawala, 2018).

Image 1: Structure of Institute and Coordination Mechanism



Source: National Adaptation Plan, 2016-2022

Primary data collection Findings

According to the results, government and local government bodies have key responsibilities in policymaking and policy implementation related to climate change adaptation. The Ministry of Environment is the focal point for climate change, and the director general of the Climate Change Secretariat is the operational focal point of the UNFCCC. All other line ministries and government departments are part of climate change adaptation responsibilities.

Considering training on climate change adaptation, the government and local government institutions officials receive different kinds of training, though not on a regular basis. On the other hand, those

pieces of training don't focus on climate change adaptation predominantly. Individual professionals and teams receive such training. Most respondents mentioned that this training is insufficient. They clamored that a proper training program on climate change adaptation must be implemented. Except for 2 government institutions others did not have continuous professional development (CPD) courses. Further the available CPD courses do not cover climate adaptation in a holistic manner. In Sri Lanka, there are Efficiency Bar exams, which do not deal with climate adaptation. Professionals like engineers and geologists can follow CPDs from their respective professional bodies but their main topics are not related to climate adaptation. There is a gap in climate change adaptation training according to professionals from government organizations and local institutions that have responsibilities related to climate adaptation. Certain respondents from the state sector mentioned that trainings or CPD course should be short as they are unable to follow long courses due to other duties. On the other hand, one key institution which is responsible for climate change adaptation and mitigation stressed that any CPD or course to be introduced should come under their collaboration. In addition, government officials mentioned that this course should be able to refresh the knowledge of officials. All in all, all government and local government officials accepted that having a CPD course with proper training is a timely need. It could be further confirmed through this quote by a respondent from a government institute: **"It was insufficient; the training should continue. When you're at a workshop you learn but with the workload, you tend to forget. There should be a refresher every six months. There is a need for courses."**

Considering vacancies within government bodies, some institutions do not have such a shortage, though some do. Major reasons for these vacancies are frequent transfers of officials, reduction of government recruitment due to current government regulations, and personal matters of officials. These frequent transfers of officials also undermine the training process. For example, if a well-trained officer is transferred to some other department, his knowledge can't be obtained and another official should be trained. Considering recruitment, the respective heads of institutions do not have the power of recruiting people according to their requirements as it should be done according to normal government procedures. As a result, institutions are not equipped with officials that have climate change education, which indicates the need for training on climate-related matters. **"We have a specific carder. The recruitment of this cadre occurs according to government procedures. We don't have control over positions- this is a limitation. If we ask for a position on climate change, we wouldn't get it as the management service is very reluctant to recruit such personnel even on a contract basis."** This quote reveals the problems when recruiting people for available vacancies. Certain government institutions had another issue since experts are reluctant to fill in the position due to less attractive salaries within the institutions. On the other hand, local governments have labor shortages for their daily activities and laborers tend to get transfers within departments of the local government by using regional political affiliations**. "We don't have enough workers for the implementation of policies. We have shortages of overseers and laborers. To reduce this shortage, we use substitute employees to perform their duties."** This was a response from a local government official. Therefore, such initiatives can hamper activities related to climate change adaptation.

Most government officials mentioned that mid and junior-level management have skill gaps as they don't have experience in a particular subject. However, few respondents mentioned that senior management levels also have skills and knowledge gaps related to climate adaptations. All include a lack of knowledge related to climate change and adaptation, global frameworks on climate change, project evaluation methodologies related to climate change phenomenon, proposal writing, coordination skills, rules, and regulation on climate adaptation, etc. "**It all depends on the area of the professional. If the head of the institution has a technical background, then he would be aware but if he is from another background there's a reluctance to get skilled personnel for climate change**

adaptation. Implementation takes place at the Assistant Director / junior management level-hence it's very important to educate the middle management on this." This quote indicates the skills and knowledge gaps within the institute. That is also a huge problem that exists in the government and local government institutions. According to the respondents, proper training with CPD courses is important to fill these skills and knowledge gaps.

In terms of building codes, most officials mentioned that they do not have sufficient knowledge of building codes and that building codes do not impact considerably on climate adaptation. However, local council officials from local governments mentioned that they consider building codes when approving construction plans. Also, the results reveal they have less understanding of building codes.

2.1.2 Private Sector

Climate change will become the most significant challenge for economies and societies in the forthcoming decades. Therefore, climate adaptation is crucial at this juncture (Cochu et al.,2019). In the context of climate change, the engagement of the private sector is important whenever governments have problems with their public budgets and rising costs to manage climate change to achieve global climate resilience of business, financial and other sectors. Also, this would help to disclose risks and maintain profitability of their business. According to the estimations of the World Bank, developing countries need $70 to $100 billion USD per year until 2050 to meet their current and future climate adaptation needs. But in 2011, only $4.4 billion USD was incurred as adaptation finance in developing countries. Therefore, the private sector can play a major role in filling this gap (Terpstra et al., 2013). According to the climate change risk index (2017), Sri Lanka was ranked 2nd and in the same year a loss of 1.13% was incurred as a percentage of GDP (Fernando, 2020). The National Expert Committee on Climate Change Adaptation and the National Expert Committee on Climate Change Mitigation have included individuals from the private sector in such committees. Further, measures were proposed to promote micro, small and mid-level private sector organizations and companies to utilize renewable energy in their operations according to the Nationally Determined Contributions (CCS and MoMDE,2016). Companies, private association, cooperatives, banks, investors and insurance companies could be identified as private sector actors in the global context. All in all, these private sector actors can play three different roles in adaptation as mentioned below (Cochu et al.,2019):

1. Adapt to climate change according to their institutional level
2. Finance climate adaptation of other organizations
3. Support through products and services for resilience

Through the utilization of their own operations the private sector will be able to ensure business continuity and protect the people that depend on private jobs or infrastructure. Further, through financing and provision of products and services for resilience, respective companies/organizations will contribute to achieve Sustainable Development Goals and Nationally Determined contributions. Therefore, the following private sector categories can have different implementation scopes.

1. Small scale, local companies and entrepreneurs have to focus on their own adaptations for climate change issues.
2. Large companies can majorly play three roles such as protecting their own immediate assets to finance and support the wide range of stakeholders in their supply chain.
3. Private associations, cooperates and multipliers work with all the mentioned roles.
4. Banks and investors should finance both private and public adaptations.
5. Insurance companies can finance public and private entities' reaction to climate change, but can also support them in reducing their vulnerabilities (Cochu et al.,2019).

Some examples of mitigation and adaptation initiatives of the private sector in Sri Lanka can be discussed as follows. These examples could be shown according to the above-mentioned roles. Since the existing fiscal challenges in Sri Lanka, private sector has more opportunities in future, transport, waste, energy, management, and infrastructure sections. Several activities have been implemented with the contribution of the International Finance Cooperation (IFC) of the World Bank. In August 2017, IFC extended its long-term partnership with Commercial Bank of Ceylon by committing a $100 million own account senior loan to help the bank increase its lending capacity for renewable energy and energy efficiency projects in the country. This initiative intended to reduce greenhouse gas emissions, promote energy efficiency and non-conventional renewable energy projects. Another investment of $28 million was made by the same IFC to MAS Capital Private Limited for their expansion and innovation plans. This included the investment on capacity expansions, sustainability projects and product developments to improve the apparel sector's compliance with environmental standards and energy efficiency. In March 2016, IFC committed to invest $15million in Richard Pieris Distributors Limited. Except for the improvement of the company, this project was implemented to adapt green building measures and climate smart technologies. Rooftop solar photovoltaic installations were funded through the project to help reduce greenhouses gas emissions by 2200 tons of Carbon Dioxide equivalent annually (IFC, 2017). Further, the International Labour Organization has named seven Sri Lankan companies namely Hatton National Bank, Seylan Bank, Heritance Kandalama, Part of the Aitken Spence group, Cinnamon Lodge hotel of the John Keels group, CKT Apparels, MAS Active (Pvt ltd.) and Halgolle Estate of Kelani Valley Plantations (Gallego-Ngo, 2013) as having good 'green' practices. In addition, there are certain private banks which are financed by green energy initiatives. For example, DFCC Bank, Commercial Bank of Ceylon and Hatton National Bank partnered as co-financiers with the European Investment Bank to source green funding for the 10MW utility-scale grid connected solar power project in Hambantota. Further, Pan Asia Bank, Commercial Bank of Ceylon and Sampath Bank have also started to provide loan schemes for solar and renewable energy projects (Sri Lanka National scoping study, 2017). Other private companies such as Climate Smart Initiatives Private Limited, National Cleaner Production Centre of Sri Lanka, and Sri Lanka Climate Fund also work in the area of climate change mitigation, adaptation and financing. Insurance schemes related to climate change impacts are offered by private insurance organizations such as Allianz Lanka Private Limited, Ceylinco General Insurance Limited and Continental Insurance Limited etc.

Primary data collection Findings

Private organizations play a key role in contributing towards drafting national policies, implementing climate change adaptation measures, financing climate change strategies, producing products, and providing services to relevant organizations.

Professionals from private organizations do not need a special license to perform their duties in climate change adaptation. However, if there are professionals in the private sector belonging to the litigation subject, they need to obtain proper licenses such as attorneys at law for lawyers. Considering training, while some private organizations mentioned that they are satisfied with the training available certain other private organizations mentioned that they lack training especially based on climate change adaptation modelling works. On the other hand, some private organizations receive foreign training related to climate change adaptation: "**Yes. We receive some training, and we obtain assistance from the UNFCC help desk when a problem is raised. However, I think we need more training opportunities to improve our knowledge on diverse areas in climate change adaptation."**

Since private organizations work closely with other stakeholders, their training and knowledge of climate change adaptation is important. Further, as most intergovernmental organizations provide grants to private sector organizations, they should have adequate knowledge. Some respondents stated that their organizations did not previously consider climate change-related activities, but that they are now planning to accept projects connected to climate change adaptation, such as deforestation. As a result, they are looking for professionals who are well-versed in CCA procedures and tools: **"We do not directly address climate change in belt, but we do handle its consequences indirectly. We will now implement CCA-related programmes such as deforestation".**

Respondents mentioned that they did not receive CPD courses from their organizations and stressed the need for proper CPD courses which allows any kind of professional to participate without any problem. Since updated knowledge is very important in climate change adaptation (as the subject is dynamic in nature), the CPD course should be able to refresh the knowledge of professionals. One respondent from the private sector further stated that universities in the country have a key responsibility of providing fresh courses**: "There are some private organizations that provide courses about environment-related aspects. However, universities in Sri Lanka should pay attention to providing fresh courses."** These private organizations do not have shortages of vacancies and they have the freedom of recruiting persons when filling vacant positions. Some respondents stated that there is a gap in the co-operation between universities and private organizations, and as a result, they were unaware of any CPD courses related to climate change adaptation.

Private sector organizations also have skills gaps within their organizations. One respondent mentioned that skills and knowledge gaps exist at the junior level. Further, respondents assumed that this gap was created because of their age. If the employee is young, he or she may have less knowledge and skills. In addition to that other respondents stated that there are major skill shortages in the senior level as well with regard to the climate change adaptation. Another respondent mentioned that skills gaps could be identified at the senior management level, especially in technical areas. One respondent mentioned that there is a knowledge gap on Environmental Impact Assessments (EIA), knowledge of climate conventions, and issues with proposal writing among different stakeholders. Proper training is needed to build skilled professionals.

According to private sector organizations, there are some standards followed by the Urban Development Authority and Municipal councils for building codes. But they are not followed as it is at the local level. Finally, it can be mentioned that there is a significant knowledge gap within the climate change adaptation with respect to the other organizations.

2.1.3 Community

Adaptation should be seen as 'part of the dynamics of societies rather than simply being a technical adjustment to biophysical change by society' (Eriksen et al., 2015). In some occasions, climate change adaptation measures are harmful to the community. Therefore, it is important to obtain the contribution of the community for climate adaptation and mitigation efforts (Bulkeley et al., 2013; Naess 2013). The top to down approach adopted in most countries are highly criticized when imposing government policies and engineering solutions as such efforts have been unsuccessful on certain occasions as they refrain from consulting the community even though the community has the best understanding regarding their ground situations. Therefore, various authors claimed for more bottom up approaches in climate adaptation (Simon et al.,2019) in order to address the issue. Community based adaptation consists of participation, collective action, social capital, access to information and local knowledge of risk management (Bryan and Behrman, 2013). Using a community-based climate

change adaptation entails many benefits such as reducing the risks of failure of policy implementation, increased ground understanding of the impacts of climate change, increased trust between the local government and communities and construction of a wider range of options for adaptation (Simon et al.,2019). Considering the Sri Lankan initiatives on community-based adaptations, the report "Coping with Climate Change and variability: Lessons from Sri Lankans community" discusses about key CBA initiatives led by the project. The project was a small Grant Programme of the Global Environmental Facility(GEF) in Sri Lanka with the financial assistance from Australian Aid. The farmer community and coastal communities were selected for CBA projects from different settings.

1. Rehabilitation of Imbulgodayagama Village reservoir through community participation
2. Climate related disaster management in Thoduwawa Lagoon in Barudelpola
3. Minimizing land degradation in the Serupitiya Village to facilitate community based adaptation to climate change
4. Developing community-led strategies and infrastructure to ensure adaptation to drought Conditions
5. Community based adaptation to floods in the Elapatha DS Division of the Ratnapura District / provincial governments as key barriers.

Adaptation measures such as raising awareness of slope management and soil conservation, implementing drinking water projects, development of irrigation canals, rehabilitation of old tanks, developing a green belt, rain water harvesting technology etc. were implemented by the project. Considering the results of the above projects, it was clear that issues were identified when working with government agencies, especially in terms of transparency. Community organizations understood the ability of cost reduction because they were given the sole authority of finance management with transparency. Volunteer work with the rest of the villagers also enhanced unity as well as reduced the labour cost. The NGO handled the above-mentioned projects and commendable coordination was identified among community, non-government organizations and local governments of Sri Lanka which built a strong relationship among the stakeholders. As a country it is difficult to implement such community-based adaptations without funds from international organizations.

Primary data collection Findings

Communities have key roles and responsibilities in the implementation of climate change adaptation measures by providing inputs to formulate national policies and regulations and agitating to improve the quality of measures employed by different organizations. Sri Lanka doesn't have dedicated community organizations on climate change adaptations: **"I did not see community-based organizations that try to bridge the gap between society and community".** Here officials who worked with community-related projects and persons who represented farming, fishing, and tourism sector communities were identified as respondents.

Officials who deal with community projects don't have many training opportunities on climate change adaptation. As in other sectors, officials don't need a license requirement for their profession. Further, no CPD courses are available for them. However, they receive considerable training if they work on a climate-related project by a particular nongovernmental or inter-governmental organization. New vacancies are generated from time to time. Most officials work on a contract basis and senior officials have the opportunity for recruiting new people. However, respondents mentioned that some misconduct happens when shortlisting suitable candidates. Individually and as a team they also mentioned the importance of having good training on climate change adaptation since they work

directly with the people from the community. Thereby, they can correctly convey the message of climate change adaptation by removing any mythical beliefs in society. Agricultural activities of farmer communities are impacted by saltwater intrusion and severe drought conditions. Therefore, having a good understanding of climate change adaptation is very important. According to the findings, their knowledge is very limited. They only have a surface idea of changing weather patterns, but they don't have an in-depth knowledge of climate change adaptation. This is confirmed through the view of community researchers: **"Although most farmers don't know the definition of climate change, when we speak with them they say that the rain is limited than in previous times and that the temperature is greater now, etc."** The farmer community engages in "Kanna Resweem" or cultivation period meetings. At such meetings, they are educated about changes in weather patterns and the use of resistant seeds for dry weather and saltwater conditions by respective agricultural officers in the area. Further, when a climate-resilient project is conducted in a particular village or area, the respective organizations provide guidance to farmers. Several subcommittees have been appointed to actively incorporate villagers in the project. However, due to their lack of knowledge of climate change adaptation, they are reluctant to use them. In addition, prevailing poverty and social norms cause a reduction in the practical usage of these adaptations.

Some respondents mentioned that some adaptation measures are too costly, therefore it is difficult to implement them. This quote further confirms it: **"There is no proper awareness of smart climate practices. They utilize traditional methods. Their lack of awareness is the main issue as there is a reluctance to change and adopt new ideas. Moreover, the community in that area is poor- they find it difficult to participate in certain programs due to the present crisis in the country."** Therefore, respondents mentioned that there must be a good awareness program or training which specifically aims at the community. The training providers should be able to convince the community rather than using scientific descriptions to elaborate on climate change adaptation. On the other hand, stakeholders' collaboration is limited because the officials also don't understand the importance of climate change adaptation. They only think within their specific working scopes. Several coordination issues were raised at community-level projects. "**The stakeholders who are not directly part of the project find this as a new concept; this message needs to be conveyed to the stakeholders. Ex: officers are unaware of the cascade system, climate adaptation, its practices, background, etc. It needs to be understood by the stakeholders. These organizations need to identify the indirect impacts of climate change adaptation, ex: the human-animal conflict. People don't have much awareness of this.**"

Considering the skills and knowledge gaps of the community, their knowledge is limited on climate change adaptation measures. One community member mentioned that topics related to climate change should be included in the school curriculum so that children would get an idea about climate change adaptation, and it would have embedded successfully. Considering the community, people from the "X" area voluntarily refused coastal sand mining because they are vulnerable to coastal erosion. They emphasized that such actions should be prohibited by the government for the country's coastal protection.

2.1.4 Civil Organisations (non-government organizations and inter-governmental organization)

Engagement of local and international civil organizations in climate change adaptation and mitigation processes is very important as they support in building a good relationship between governments and local communities. Local and international non-government organizations and green movements are very influential in climate change policy making and implementation of climate change adaptation and mitigation measures when considering the conditions in Sri Lanka. Majorly these organizations impact climate change adaptation by means of knowledge sharing with the Climate Change Secretariat during

policy planning occasions. In addition, they excel in creating awareness and contributing with ideas to make reforms in laws and policies. In order to complete these mentioned tasks, they use educational, collaboration and litigation approaches. These organizations conduct workshops, conferences and symposiums to increase the knowledge of the community as well as to share expertise and experiences with government bodies. Social media campaigns, school programmes and community programmes are also conducted (Hettiarachchi. V,2020). In the context of Sri Lanka, different NGO organizations have different influential power when engaging with policy making processes. For an example, the government of Sri Lanka utilized the ideas of non-government organisations when developing the National Adaptation Plan (2016-2025). Further, some organizations were used in the reviewing stage of the National Adaptation plan. In addition, CCS Sri Lanka has mentioned the importance of Civil Organizations in the implementation of climate adaptation projects. For example, some NGOs provide funds for climate adaptation and mitigation initiatives. Funding from large scale international organizations is also very important for a country like Sri Lanka. Nongovernment organizations conduct their own green environment projects and adaptation implementations in the country. Based on the activities of such initiatives, NGOs share results, recommendations and lessons learned to relevant ministries of the government of Sri Lanka. When considering litigation activities, some NGO organizations intervene when collaborations and negotiations are unsuccessful. Local non-governmental organizations such as World Vision Lanka, Environmental Foundation Lanka, Wilderness, and Wildlife Conservation Trust, Sevalanka, Thuru Foundation, IUCN Sri Lanka, Rainforest Alliance, Sri Lanka Wildlife Conservation Society, Rainforest Protector Sri Lanka and Foundation for Environmental Climate and Technology etc. have made a considerable contribution to climate change adaptation and mitigation initiatives (Hettiarachchi. V,2020). In addition, inter-governmental organizations such as UNICEF, UNDP, World Bank, World Food Programme perform their duties to address climate change issues.

Primary data collection Findings

Representatives from intergovernmental and nongovernmental organizations were considered here. These organizations are responsible for implementing adaptation measures, financing climate change adaptation strategies, and building capacities of officials and the community that works with climate adaptation. They contribute significantly to climate adaptation both locally and internationally.

Officials in these intergovernmental and Nongovernment organizations receive good training at the beginning of their careers. In addition, they receive opportunities to engage in foreign training on climate-related issues. This fact is confirmed by the statement: "**I received training from different organizations at different intervals. On the other hand, there are different elements at our regional bureaus where we build several capacities as well, for example, working with the Department of Meteorology and the Climate Change Secretariat, working with the Ministry of Environment, the Ministry of Agriculture, etc. These are key avenues which are based on hands-on training**." Therefore, they receive good training compared to other stakeholders. That is very important since they work mostly with all stakeholders. Further, solid training and exposure are needed to train other parties. However, when questioned about CPD courses, these are not conducted. They mentioned that it is important to have such courses for every stakeholder category. Considering vacancies, no shortage of posts was reported, and they are satisfied with the expertise that they receive from their training. They also confirm that training opportunities and the education system related to climate change adaptation should be restructured. Most of the respondents highlighted that universities in

Sri Lanka should produce good practitioners. They mentioned that Universities only conduct research and do not take any advantage of research. Research findings are not taken into consideration in practice. This is a greater drawback in this country. It is confirmed through the statement, **"Research is done at the university level and local level or may be by different organizations. But it is kept elsewhere, they are kept in the library without any dissemination…. But we blame always the planners and administrators. But we own have our own duty and mandate so where Universities should come into different ways. That they need to produce the young generation, of professionals that we call practitioners. We don't need practitioners who is being teaching and practicing. We need practitioners for this."**

Also mentioning their experience, one respondent confirmed that there were no community-based organizations that worked with communities in terms of climate adaptations. Further, other respondents mentioned that the voice of the community is not being represented at the local level, creating a great barrier when conducting development projects at the local level. The same issue persists with climate adaptation projects as knowledge and decisions that are taken at the top are not trickled down to society. This reveals several coordination issues in the current system. The same respondent mentioned that some built environment professionals give less consideration to climate adaptation. **"We don't have such capacity; especially in the government sector planners, administrators, environmentalists, technical officers' engineers, and so forth. But thinking in a holistic manner which has never been taught in our universities which never taught in our secondary education also in tertiary education and nowhere in the government sector being practiced as well."** Also, this quotation reiterates that there must be a restructuring of the education system in the country. The education system should emphasize the collaboration of different stakeholders. Considering all facts then there is a huge gap in knowledge related to climate adaptation. The attitudinal gap and holistic thinking approach cannot be identified among the government sector officials and education also should be strengthened too much to have such opportunities.

2.1.5 Academia and research organisations

Sri Lanka is frequently affected by floods, landslides, and long-lasting droughts. Past researchers clearly indicates that climate change is occurring in Sri Lanka in terms of rainfall variability, increased climatic extremes, and warming (Esham & Garforth, 2013). Therefore, most of the government and private universities of the Sri Lanka are focusing on climate change related research in their relevant disciplines. Over 8,000 research articles can be found on Google Scholar related to climate change and built environment in Sri Lankan context. Also, Sri Lankan universities have collaborated with international universities in different projects such as Building Resilience in Tropical Agro – Ecosystem (BRITAE), Rebuilding after displacement (REGARD), Capacity Building in Asia for Resilience Education (CABARATE) to improve the knowledge of climate change, disaster resilience and management aspects. Further, many Sri Lankan universities, including the Universities of Moratuwa, Peradeniya, Colombo, and Ruhuna are already making steps to incorporate climate change education into their curriculum. Also, many international and local conferences and research symposiums on the theme of climate change have been conducted by academia and research institutions in Sri Lanka. For Examples, Sri Lanka Next – "Blue Green Era Research and Exhibition" -2019, Recognizing Climate Change Risk of Dry Zone Farmers – 2017. Also, major conference conducting by Sri Lankan universities such as Moratuwa Engineering Research Conference and Kandy Conference are giving special opportunities for the climate change related studies. Apart from the universities, government organisations, such as National building research organization (NBRO) (Ex: Climate Resilience Improvement Project, Technical support for mitigation of natural disasters due to climate change in

Sri Lanka), Climate Mitigation Action Support Projects, Sri Lanka's Third National Communication (TNC) on Climate Change projects were conducted by Ministry of Environment. Also, Climate net Policy Discussion Forum are just a few of the climate change-related studies and projects that the Natural Environment Research Council of Sri Lanka has been conducted (Institute of Policy Studies Sri Lanka, 2021). Apart from that, National Aquatic Resources Research and Development Agency doing their research on the climate change impacts specially on aquatic environment.

Primary data collection Findings

According to primary data, the stakeholder category; 'academic and research organization' is very important since they are the responsible body for teaching, training, disseminating, consulting works and finding new knowledge. Therefore, the training and expertise of academics and research organizations in climate adaptation are significant to perform their responsibilities.

In the Sri Lankan context, these academics do not require a special license to perform their duties. There is a professional hierarchy in the system which begins with the post of probationary lecturer at the base and extends to the post of professor in respective disciplines. Academics receive various kinds of training from different government and non-governmental organizations. However, such training sessions are not conducted on a regular basis, and in most cases, they do not focus on climate adaptation. This is apparent by the statement **"No. Training is not given to universities in general. However, some foreign opportunities would be given, but not on a regular basis."** Therefore, there is a lacuna related to climate adaptation training among academics. The situation related to training is the same for individual academics and their groups. According to the responses, almost all respondents in the category of academia and research organizations have expressed that they do not receive regular training on climate change adaptation. In terms of CPD courses, there are no CPDs on climate change adaptation both institutionally and nationally. However, the respondents mentioned that certain workshops, forums, and discussions where some aspects of climate change are discussed are held. Furthermore, a few of the lecturers said that they were used to attending other training activities not only in the local context but also on international platforms as well. Therefore, most academics mentioned the importance of introducing a CPD program. One respondent proposed the CDP course concerning the time beam and the climate change impacts **:"The first one is the IoT (Internet of Things) sphere of the invention. Concerning how do we incorporate new technologies, such as Artificial Intelligence (AI) and machine learning, with climate change and the built environment? The second is that we mostly learn about the basic modulus of climate science and that its practical components must make it resilient (specific components fall under the city, such as water-related and agricultural items that will be very important"**. In addition to that, one other respondent stressed that the CPD should be connected to the promotion schemes or salary increments of academics. Nevertheless, more academics would not tend to follow the CPD courses. This is confirmed through the statement: **"No. such CPD courses are not held right now. However, such a move is important. It should be done with a particular force; this would be a success- it would help with salary increments or promotions in the profession."** Further, another respondent emphasized that a Master of Science degree program in the subject of climate change adaptation should be introduced to provide proper training while another academic mentioned that Sri Lanka does not have experts with expertise on climate change adaptation coupled with foreign exposure. The respondent further stated that there should be a mechanism to send local experts overseas and to provide more opportunities for training such as PhD opportunities to improve their knowledge and skills. Some respondents mentioned that expertise in climate change adaptation is not of a satisfactory standard. Further, though most Arts Faculty academics began their teaching on climate change they

do not have sufficient experience and expertise in the subject. One of the respondents mentioned that the main reason for this is the marginal connection with other organizations and other senior academics in the field. Unwillingness to be in such a network would undermine climate adaptation education in the country. When it comes to academics in engineering and architecture, they stated that they have appropriate knowledge and experience that is not limited to the local environment, but also international catastrophes, but they still have an issue with resources (tools and instruments). Further one respondent mentioned that available courses in the universities consist of climate-related phenomena. But they do not touch climate mitigation and adaptation adequately. Further same respondent mentioned that the available 45 hours per course unit is inadequate to cover all the things. Though academic institutions do not have a shortage of vacancies, potential applicants do not apply for posts due to inadequate salary schemes in the country. They stated that if a shortage occurs, they will rely on overseas collaborations. The reason for this shortage is the lack of professionals who are capable of working in multi-disciplinary teams. In terms of building codes, the majority of responses were from academics from a social science background who stated that the practical implementation of those codes and climate change adaptation measures are very poor as they appear only during the planning stage.

Concerning climate change-related skill shortages, it was mentioned that there is a deficiency in climate change modelling and its localization. The following quotation describes how they have tackled these skill shortages. **"The majority of our time is dedicated to receiving online tutorials and help via Online. Furthermore, we do not undertake periodic reviews. However, we attempt to address and then incorporate those expectations into the curriculum by obtaining foreign and local knowledge from outside the organization, such as when developing the curriculum. We make our staff train and then, they would be able to finish these gaps**." Considering skill gaps, most respondents' intention was divided; officials at every level had different skill levels, and those levels were subject to change according to their experience and age. Technological skills, knowledge of climate law and justice, analytical skills, and knowledge and skills on computer modelling were identified as major skill and knowledge gaps within academic and research institutions.

2.1.6 Professional bodies

To make decisions regarding a variety of issues, decision-makers in the public and private sectors generally turn to skilled specialists including planners, biologists, engineers, and foresters. They look to professional bodies for strong leadership, technical guidance, and ethical guidance since they are tightly connected to climate action. As the leading professional organizations in the country Institute of Engineers Sri Lanka (IESL), Sri Lanka Institute of Architects (SLIA), Institute of Town Planners Sri Lanka (ITPSL), Institute of Quantity Surveyors Sri Lanka (IQSSL), Institute of Environmental Professional Sri Lanka (IEPSL) are conducting professional development sessions such as presentations, roundtable discussions and the climate change adaptation related articles are featured in the official newsletters of the organizations. The development of net zero professional networks has not yet received enough attention, funding, or venues to move ahead. The professionals bodies charter offers a practical forum for multi-sectoral professionals to collaborate on climate change as a remedy for this. A several professional bodies for the different professionals can be found in Sri Lanka. These professional bodies have been discussed further on the later part of this report.

According to the data gathered from the interview series based on professional bodies, they have major roles and duties in key sectors in the context of climate change.

When concerning the training and CPD courses related to climate change adaptation in Sri Lanka, has been conducting different kinds of training, at national level and also institutional level as well, but not regularly. Rather than focusing on climate change adaptation, most of them are focusing on the climate change mitigation aspects: **"I don't have training special in climate change adaptation activities. We do research activities. Not major concern on climate change adaptation It's almost like climate change mitigation aspects".** Most of the interviewees mentioned that they have adequate knowledge related to climate change and that their teams should have proper training when dealing with climate change adaptation. Some professionals said that they had CPDs from their professional bodies, but the main topics were not mainly related to climate change adaptation. Various responders indicated that some organizations have their own climatic data sources with limited access, and as a result, they proposed having a proper platform to access all climate-related data with easy access. Some of them revealed that to have proper international training programs should have to implement related to CCA. Some of them mentioned that there should be a proper way to update the available CPD programs within organizations: **"More training programs are required related to climate change adaptation and mitigation as well. Some of these programs are available but have not been updated by the organizations. We require more frequent reviews of available training and the incorporation of some of the knowledge that coming up continuously. There is room for improvement".**

When it comes to vacancies related to climate change activities concerning professional bodies, some institutions are struggling to find qualified applicants for a variety of reasons, while others are not. The main reasons for these vacancies are low salaries in local institutions, a lack of professionals capable of working in multi-disciplinary teams, current government regulations that limit government recruitment in government institutions, frequent transfers of officials, and personal matters of officials.

By analyzing the responses based on skill shortages, it was determined that both junior and middle management professionals have skill gaps in climate change adaptation. Some of them have no exposure to the context of climate change adaptation, while others have a theoretical understanding of climate change but no real-life experience with this. According to the interview replies, several governing factors affecting climate change adaptation have been revealed. Some of these governing factors include a lack of knowledge about technology and modelling, such as ARC-GIS, programming knowledge to run the models, climate change mitigation and adaptation knowledge (sea level rise, global warming, greenhouse effect, coastal disaster vulnerability, coastal water quality, heat island effect, alternation of ocean currents/difference related to climate effect), global frameworks on climate change and rules, regulation, policies, and legislation. **"There is a huge gap in the application side of the climate change adaptation techniques and tools. Not based on the theoretical background. When it comes to dealing with the real case problem related to climate change, we don't have sufficient exposure."** This quote identifies the skills and knowledge gaps related to the respective institute. Findings indicate that CPD courses and training programs should be undertaken to overcome skill and knowledge gaps.

3 Role and Responsibilities of the built environment stakeholders in climate change adaptation

No	Stakeholder Description	Key role in climate change	Responsibilities related to climate change adaptation				Any remarks on the current status
			Planning and designing	Construction	Occupancy /Usage	Retrofitting	
1	Local and National Governments	• Developing policies and coordinating climate adaptation and mitigation initiatives according to global standards • Implementing adaptation measures	• Drafting adaptation and mitigation policies, strategies and national plans on climate change • Providing approvals and technical,	• Funding and implementing initiatives prescribed under the National Adaptation Plan (2016-2025) and Nationally Determined Contributions	• Organizing programmes to improve climate change awareness of professionals, students, and laymen • Providing approvals and technical, financial, and	• Organizing programmes to improve climate change awareness of professionals, students, and laymen	

		according to NDCs and NAPs	financial, and professional development assistance to stakeholders	• Providing approvals and technical, financial, and professional development assistance to stakeholders	professional development assistance to stakeholders		
2	Private Sector	• Providing funds to customers with loans and other services, if they are impacted by extreme weather due to climate change • Implementation of climate adaptation measures and mitigation strategies within the	• Concerning about the build environment, providing the designs for the constructions concerning the climate adaptation measures.	N/A	N/A	N/A	

		organizational level. • Providing products and rendering services for which can be used in the context of climate change adaptation and mitigation.					
3	Community	• Implementation of climate change adaptation measures and mitigation strategies at organizational level • Providing inputs to formulate national policies and regulations	• Protesting and agitating to compel organizations to change their policies and measures • Supporting policy makers to formulate policies by actively contributing to policy formulation	• Checking whether the measures to counter climate change at organizational levels such as the use of sustainable cultivation methods, awareness raising programmes,	• Implementation of measures to counter climate change at organizational levels such as the use of sustainable cultivation methods, awareness raising	• Act according to the given guidelines by the government or local government authorities. • Implementation of measures to counter climate change at organizational	

		• Agitating to improve the quality of measures employed by government, non-governmental and private organizations	• Advocating to update existing policies, guidelines and national plans. • Implementation of measures to counter climate change at organizational levels such as the use of sustainable cultivation methods, awareness raising programmes etc	other engineering solutions etc	programmes etc	levels such as the use of sustainable cultivation methods, awareness raising programmes and engineering solutions etc	
4	Civil Organisations	• Implementation of climate change adaptation measures and mitigation strategies at	• Obtaining funds from international and local donors to finance initiatives by organizations	• Implementing climate change adaptation programmes in selected regions.	• Organizing awareness raising programmes for all types of stakeholders	• Organizing awareness raising programmes for all types of stakeholders	

		organizational level. • Financing climate change strategies implemented by government agencies. • Building the capacities of government officials and raising awareness regarding climate change.	and government agencies. • Organizing awareness raising programmes for all types of stakeholders including community members.	• Obtaining funds from international and local donors to finance initiatives by organizations and government agencies. • Organizing awareness raising programmes for all types of stakeholders including community members.	including community members.	including community members.	
5	Academia and research organisations	• Teaching, training, and conducting research on climate change adaptation and mitigation measures • Contributing to the development of	• Teaching and training undergraduate, postgraduate students and professionals on climate change and related phenomenon.	• Dissemination and exploitation of research findings to all layers of society including laymen • Conducting several research works related to	• Dissemination and exploitation of research findings to all layers of society including laymen • Conducting several research works related to	• Dissemination and exploitation of research findings to all layers of society including laymen • Conducting several research works related to	

		national policies on climate change	• Developing and revising the curriculum of courses that explore CCA and mitigation. • Dissemination and exploitation of research findings to all layers of society including laymen • Conducting several research works related to climate change adaptation. • Offering consulting services. • Conducting experimental studio tests in the context of climate change adaptation. • Involving developing	climate change adaptation within the construction stage. • Offering consulting services. • Conducting experimental studio tests in the context of climate change adaptation related to the construction stage.	climate change adaptation within the construction stage. • Conducting experimental studio tests in the context of climate change adaptation related to the occupancy stage.	climate change adaptation within the retrofitting stage.	

			guidelines and codes related to climate change.				
6	Professional bodies	• Providing the early warnings of the landslides and floods. • Monitoring the construction works in high-risk areas for signs of damage caused by climate change effects. • Conduct research activities related to climate change aspects. (Ex: coastal water quality, sea level rise, coastal disaster	• Developing proper hydraulic models to identify the forecast and behaviour of the hydraulic profiles concerning climate change. • Developing the disaster management techniques, tools, and specifications for climate extremes. • Planning of the water-related structures concerning	• Provide some of the construction-related Support services related through Engineering consulting companies.	• Conducting the long term monitoring plans. • Provide some operational and maintenance training programs inbuilt within the projects. • Conducting programs related to catchment protection activities. • Conducting knowledge-sharing sessions for efficient drinking water management,	• After any type of disaster, processes will be implemented to assess the damage, identify the necessities, and seek funding sources. • Developing guidelines related to the retrofitting stages	

		vulnerability, etc.,) • Construct the coastal protection structures island wide. • Prepare the national coastal management plan, building regulations and other related national policy formulation concerning climate change. • Conduct Bathymetry surveys to identify the shore profile. • Provide technical and expert support to programs implemented in Sri Lanka related to	climate change (Coastal structures and other water-related structures) • Providing technical expertise through consultants (Conducting capacity-building programs). • Conduct programs to develop the design guidelines concerning climate change. • Providing mitigation measures concerning		especially focussing on the dry zone in Sri Lanka. • Conduct research to identify the climatic effects related to the use and occupancy stage.		

		climate change adaptation and mitigation, as well. • Providing financial support related to climate change-related programs. • Development of policies related to climate change adaptation. • Environmental impact assessments are conducted prior to the implementation of any type of construction project, taking into account the climatic	imposes gases and deforestation which mainly tend to impact the climate change effects. • Conducting research works.				

		effect (the effect of water bodies and forests, etc.,) and other factors containing the environment profile. • Make rules and regulations, as well as undertake multiple agricultural projects, to mitigate the consequences of climate extremes such as floods and droughts. • Conducting training programs related to climate change.					

4 Challenges faced by built environment stakeholders in implementing climate change adaptation

Organisational Challenges

No	Stakeholder Description	Challenges	Reasons for the challenges	Possible solutions
1	Local and National Governments	• Lack of dedicated financial assistance programmes to implement climate change adaptation and mitigation measures by the government • Neglecting climate change related legislation and policies (e.g. NBRO Act, UDA Act. National Environment Act and etc.) by	• Lack of political will to introduce government funded financial assistance programmes. • Non-existence of an agency with legal provisions to enforce climate change legislation. • Lack of willingness of officials and the public to improve understanding on climate change. • Lack of opportunities available to officials and the public to obtain knowledge on climate change. • Interference made by politicians when	• Taking measures to improve the awareness of the political leadership on the importance of funding climate change adaptation initiatives • Increasing the opportunities available for officials and the public to obtain greater awareness on climate change. • Introducing mechanisms to ensure data sharing among agencies and officials at different levels in the government service • Assigning legal provisions to an existing organization to enforce legislation relevant to climate change

		officials and the public. • Lack of awareness and knowledge on climate change adaptation and mitigation among government officials and the public • Lack of coordination among government agencies (National, Provincial and Local Level).	attempting to implement adaptation strategies (e.g. filling of wetlands, encroachment, illegal constructions, etc.). • Ignorance of government officials at different levels.	• Building capacities of agencies to independently source and apply for global funding and networking opportunities.
2	Private Sector	• Managing the government agency (which is time-consuming in Sri Lanka) • Due to Sri Lanka's economic situation, it is extremely difficult to import the	• Economic crisis of Sri Lanka • Insufficient recognition of the significant contribution private organisations to the policy development process.	• Integration of private sector organisations into policy formation • As soon as feasible, Sri Lanka should have a viable alternative for importing eco-friendly construction materials.

		luxurious and eco-friendly construction materials. • Inability to contribute to the formulation of national CCA policies.		
3	Community	• Lack of opportunities to contribute towards drafting and amending national policies • Lack of recognition of the valuable contribution that NGOs can make in drafting policies • Lack of recognition of the valuable contribution that NGOs can make in drafting policies	• Lack of recognition of the valuable contribution that community level organizations can make in policy formulation • Lack of recognition of the valuable contribution that NGOs can make in drafting policies • Lack of recognition of the valuable contribution that NGOs can make in drafting policies	• Integration of community level organizations in policy formulation • Lack of recognition of the valuable contribution that NGOs can make in drafting policies • Lack of recognition of the valuable contribution that NGOs can make in drafting policies

4	Civil Organisations	• Lack of opportunities to contribute towards drafting and amending of national policies • Inequitable opportunities granted to different types of non-governmental and intergovernmental organizations to contribute to climate change related activities • Lack of support extended by governmental organizations to implement climate change adaptation measures • Disturbances caused by pressure groups such as religious	• Lack of recognition of the valuable contribution that NGOs can make in drafting policies • Lack of recognition of the valuable contribution that NGOs can make in drafting policies • Lack of recognition of the valuable contribution that NGOs can make in drafting policies • Lack of recognition of the valuable contribution that NGOs can make in drafting policies • Lack of recognition of the valuable contribution that NGOs can make in drafting policies	• Integration of NGOs and Intergovernmental Organizations in policy formulation • Lack of recognition of the valuable contribution that NGOs can make in drafting policies • Lack of recognition of the valuable contribution that NGOs can make in drafting policies • Lack of recognition of the valuable contribution that NGOs can make in drafting policies • Lack of recognition of the valuable contribution that NGOs can make in drafting policies •

		leaders, members of armed forces and etc.		
5	Academia and research organisations	• Lack of local funding opportunities to conduct research • Reluctance of organizations engaged in climate change management activities to share data with academics and researchers. • Minimal support extended by government agencies to researchers in terms of granting approvals, participation and etc. • Lack of opportunities to	• Lack of significance given to the allocation of government funds to encourage research activities. • Lack of comprehension among government agencies responsible for climate change regarding the significance of conducting research activities to counter climate change through evidence-based initiatives • Restrictive regulations and policies on data sharing and long processes of obtaining approvals • Difficulties experienced by government officers to communicate in English • Prominence given to teaching over research activities within local universities.	• Taking measures to improve the awareness of political and academic leadership on the importance of funding climate change adaptation research initiatives. • Increasing the opportunities available to researchers and academics to obtain training on climate change. • Introducing mechanisms to ensure ease of data sharing with academics and researchers. • Building capacities of academics to independently source and apply for global funding opportunities. • Creating an academic environment that encourages research and innovation.

		engage in research activities. • Lack of academics and researchers that are well trained in areas of climate change adaptation and mitigation. • Legal and regulatory frameworks of quite strong in Sri Lanka	• Lack of training opportunities available to academics	
6	Professional bodies	• lack of data (while data is available in various institutes, there is no common platform for sharing it for research works or decision-making purposes). • Knowledge gaps related to climate change • The funding available for climate change	• Even though there are data available in various institutes, there have not a common centralized platform to get them shared for hour Research or any decision-making purposes. • Knowledge gaps related to climate change among professionals. • Lack of enough experience connected to climate	• Prepare the common platform to access the climate related data. • The establishment of measures to improve the competencies of professionals and their appointment to the appropriate positions within the organization. • Improving political leadership's understanding of the significance of funding CCA programs. • Involvement of non-governmental professionals in policy formulation, instead of the exclusive development of policies within government organisations.

		research is almost always limited. • Inability of organizational members to effectively address climate-related obstacles. • Professionals employed by non-governmental organizations do not receive sufficient support from government organizations to execute CCA measures. • Unwillingness to adjust their behavior is the cause of public conflicts. • There are gaps in technical capacity, problems with human resources, and some problems with policy (like policies that overlap and	change adaptation scenarios on organisational members to successfully address climate-related issues. • Lack of awareness about the climate change impacts among the general public. • Strict organisational policies regulating government organisations while contributing with other private organizations.	• Building capacities of agencies to independently source and apply for global funding and networking opportunities. • Increasing the general public's awareness of climate change.

		rules that aren't clear).		

Personnel / individual Challenges faced by the Professionals

No	Stakeholder Description	Challenges	Reasons for the challenges	Possible solutions
1	Local and National Governments	• Lack of dedicated financial assistance programmes to implement climate change adaptation and mitigation measures by the government • Lack of awareness and knowledge on climate change adaptation and mitigation • Complications created by Bureaucratic Red	• Lack of political will to introduce government funded financial assistance programmes. • Lack of opportunities available to officials and the public to obtain knowledge on climate change. • Several government regulations and practices. • Interference made by politicians when attempting to implement adaptation strategies (e.g., filling of wetlands, encroachment, illegal constructions, etc.).	• Taking measures to improve the awareness of the political leadership on the importance of funding climate change adaptation initiatives • Increasing the opportunities available for officials obtain greater awareness on climate change (through trainings and CPD courses.) • Introducing mechanisms to ensure data sharing among agencies and officials at different levels in the government service

		Tape (in recruitment, promotions, transfers, funding and etc.) • Lack of resources (Office space, transport, equipment and etc.) • Difficulties in enforcing climate adaptation		
2	Private Sector	• Public conflicts are caused by people's • Lack of climate-related data for conduction research works and modeling.	• Lack of awareness of the public people related to climate change.	• Increasing the general public's awareness of climate change. • Establish a central portal where users can download climate-related data for free.
3	Community	• Lack of opportunities to contribute towards drafting and amending national policies	• Lack of recognition of the valuable contribution that community-level organizations can make in policy formulation • Lack of climate change awareness and education	• Integration of community-level organizations in policy formulation • Introducing mechanisms to enhance the capacities of members of community-level organizations

		• Lack of support extended by governmental organizations to implement climate change adaptation measures locally • Decline in the participation of community members in the implementation of programmes	among community members • Lack of coordination among the local-level officials • Busy lifestyle of community members and traditional beliefs with the people • Poverty and other economic factors	• Building capacities of government officials and broadening their comprehension regarding the importance of multisectoral partnerships and collaborations • Create good coordination among government officials • Provide solutions to other affiliated social issues which hinder the climate change adaptation
4	Civil Organisations	• Lack of opportunities to contribute towards drafting and amending of national policies • Inequitable opportunities granted to different types of non-governmental and intergovernmental organizations to contribute to	• Lack of recognition of the valuable contribution that NGOs can make in drafting policies • Special treatment of larger and financially well-endowed Intergovernmental Organizations and NGOs • Lack of climate change awareness and education of government officials • Lack of a government organization to enforce	• Integration of NGOs and Intergovernmental Organizations in policy formulation • Granting equitable access to all types of NGOs and Intergovernmental Organizations to engage in climate change related activities • Introducing mechanisms to enhance the capacities of government officers • Assigning legal provisions to an existing organization to enforce legislation relevant to climate change

		climate change related activities • Lack of support extended by governmental organizations to implement climate change adaptation measures • Disturbances caused by pressure groups such as religious leaders, members of armed forces and etc.	regulations and legislation relevant to climate change • Lack of training opportunities available to academics and government officers	• Building capacities of government agencies to independently source and apply for global funding and networking opportunities.
5	Academia and research organisations	• Lack of local funding opportunities to conduct research • Minimal support extended by government agencies to researchers in terms of granting approvals, participation etc.	• Lack of significance given to the allocation of government funds to encourage research activities. • Lack of comprehension among government agencies responsible for climate change regarding the significance of conducting research activities to counter climate	• Taking measures to improve the awareness of political and academic leadership on the importance of funding climate change adaptation research initiatives. • Increasing the opportunities available to researchers and academics to obtain training on climate change.

		• Reluctance of organizations engaged in climate change management activities to share data with academics and researchers. • Lack of academics and researchers that are well trained in areas of climate change adaptation and mitigation. • Lack of opportunities to engage in research activities, with the teaching responsibilities.	change through evidence-based initiatives • Restrictive regulations and policies on data sharing and long processes of obtaining approvals • Prominence is given to teaching over research activities within local universities. • Lack of training opportunities available to academics	• Introducing mechanisms to ensure ease of data sharing with academics and researchers. • Building capacities of academics to independently source and apply for global funding opportunities. • Creating an academic environment that encourages research and innovation.
6	Professional bodies	• Public conflicts are caused by people's unwillingness to modify their behavior.	• There are limited sources for data on climate change. There is no centralized platform.	• Prepare the common platform to access the climate-related data. • Increasing the general public's awareness of climate change

		• There is less awareness of climate change techniques among team members. • Lack of climate-related data. • During the execution of a project, the organization has a knowledge gap about climate change. Then, personally, you should then go outside the organization to find and hire the needed professionals.	• The public's understanding of climate change is quite limited. • The lack of climate related professionals within each organizations.	• Enhance the qualifications of experts and their placement in the correct roles within the organization. Join the specialists who have the appropriate climate-related knowledge to implement the initiatives.

5 Educational Training Framework

5.1.1 Training required to become a professional

No	Professionals (Provide where applicable and additional)	Formal Education in Climate Change Adaptation	Educational Institute / Provider	Link	Strengths acquired from Formal Education Received on Climate Change Adaptation	Challenges and Gaps Experienced due to lack of Formal Education in Climate Change Adaptation	How would you address these challenges and gaps through formal education?
1	Architect	AE1010: Climate and Comfort AE2010: Solar Geometry and Heat Transfer in Buildings AE 3010: Principles of Tropical Design	University of Moratuwa	https://uom.lk/sites/default/files/archi/files/B.Arch%20Student%20Handbook%202022_1.pdf	• Several sections relevant to climate change are discussed within mentioned modules. However, appropriate	• There was lack of training opportunities related to climate change adaptation.	Conducting several workshops related to climate change

		AE4010: Introduction to Green Architecture AE 4020: Urban Design and Environment AE4030: Advanced Climate-Sensitive Design AE4050: Low Energy Architecture AD 4020: Orientation Design Project AD4040: Demonstration Design Project			resources should be necessary for addressing climate change adaptation, and there should be sufficient funding options for climate change-related research.		adaptation.
2	Engineer	CE 6207: Climate change impacts and	University of Peradeniya	Https://eng.pdn.ac.lk/civil/pdf/PgWaterandEnvironmentEngineering.pdf	• More sections preliminary relevant to	• Local and international trainings	Conducting several

		adaptation in water sector (Optional)- Postgraduate programmes in Environmental & Water engineering CE 6208: Coastal Engineering and Coastal Zone Management (optional)- Postgraduate programmes in Environmental & Water Engineering CE 5275 - Climate Change & Disaster Management	University of Peradeniya University of Moratuwa	https://eng.pdn.ac.lk/civil/pdf/PgWaterandEnvironmentEngineering.pdf https://uom.lk/sites/default/files/Faculty/Graduate-	climate change are discussed within mentioned modules. However, appropriate resources should be necessary for addressing climate change adaptation modeling parts, and there should be sufficient funding options for climate change-related research.	were conducted but whole programmes were not related to climate change adaptation.	workshops related to CCA.

		CE5570 - Meteorology & Climate Change CE 5830 - Climate Change Impacts and Adaptation Options for Water Management	University of Moratuwa University of Moratuwa	Studies/files/Civil%20Engineering.docx_0.pdf https://uom.lk/sites/default/files/Faculty/Graduate-Studies/files/Civil%20Engineering.docx_0.pdf https://uom.lk/sites/default/files/Faculty/Graduate-Studies/files/Civil%20Engineering.docx_0.pdf			
3	Town Planner	PU 5103: Planning for risk and uncertainty Postgraduate programmes in town & country planning SP2305: Environment assessment 1	University of Moratuwa	https://uom.lk/sites/default/files/tcp/files/MSPMD Handbook 2021_0.pdf https://uom.lk/sites/default/files/tcp/files/Student%20Handbook%202021_0.pdf	• Can be learned about the consequences of climate change • Information on climate change adaptation alternatives, tools, and approaches	There was lack of training opportunities related to climate change adaptation.	Conducting several workshops related to CCA.

		SP3505: Disaster management SP4709: Environmental management systems		https://uom.lk/sites/default/files/tcp/files/Student%20Handbook%202021_0.pdf https://uom.lk/sites/default/files/tcp/files/Student%20Handbook%202021_0.pdf	can be obtained.		
4	Surveyor	No	Not found	Not found	Not found	Not found	Not found
5	Anthropologist	No	Not found	Not found	Not found	Not found	Not found
6	Economist	Economics of Sustainable Development Environmental Economics ECN 3047 Natural Resource Management ECN 4027	University of Colombo-Department of Economics University of Peradeniya-Department of Economics	https://arts.cmb.ac.lk/econ/special-courses/ https://arts.pdn.ac.lk/econ/ug.html	Some aspects of the environment related are covered through the education. But that is insufficient.	Their major focus is not directly about climate change adaptations. They receive different kind of trainings within irregular time gaps. Those trainings are majorly not about CCA.	Providing a comprehensive training on CCA is important.

		Energy Economics ECN 4047 Environmental Economics ECON 3204.3 – Resource Economics ECON 4107.3– Environmental Valuation ECON 4108.3 Environmental Policy ECO 414 Environmental Economics	University of Sri Jayawardanepura- Department of Economics Sabaragamuwa University of Sri Lanka	http://fhss.sjp.ac.lk/econ/bachelor-of-arts-honours-degree-in-economics/ https://www.sab.ac.lk/fssl/department-economics-statistics-bahons-in-economics			

7	Sociologist	SOC 2232 Environmental Sociology SOC 3157 Sociology of Environment & Disaster Management SOC 3270 Urban Development and Relocation SOC 2144 Environmental Sociology SOC 3011 Environmental Sociology	University of Colombo-Department of Sociology University of Kelaniya-Department of Sociology University of Peradeniya-Department of Sociology	https://arts.cmb.ac.lk/sociology/index.php/our-objectives/undergraduate/special-degree/second-year/ https://arts.cmb.ac.lk/sociology/wp-content/uploads/2018/11/Applied-3rd-Year.pdf https://arts.cmb.ac.lk/sociology/wp-content/uploads/2018/11/Applied-3rd-Year.pdf https://ss.kln.ac.lk/depts/sociology/index.php/courses/under-graduate/ba-special-degree https://arts.pdn.ac.lk/socio/ac/under.php	Some aspects of the climate change adaptations are covered. Further focus should be given.	The climate change adaptation training is insufficient.	Providing a comprehensive training on CCA.

		SOCI 41053 Environmental Sociology SOCI 3103.3 Environmental Sociology SOSW 3104.3 Social work for Environmental Studies SOC 313 Environmental Sociology	University of Rajarata-Department of Sociology University of Sri Jayawardanepura-Department of Sociology University of Sabaragamuwa-Department of Sociology	Bachelor of Arts Honours in Sociology – Department of Social Sciences (rjt.ac.lk) http://fhss.sjp.ac.lk/soc/social-work/ https://www.sab.ac.lk/fssl/department-social-sciences-ba-hons-sociology			
8	Geographers	GYG2231 Meteorology & Climatology	University of Colombo-	Special Degree | Department of Geography (cmb.ac.lk)	More aspects of the climate change are covered. Further	Local and international workshops and	Provide good training

		GYG 3150 Past Climates & Climatic Changes GYG 4283 Applied Meteorology & Climatology GYG 3265 Disaster Management and Preparedness GYG 2236 Environmental Hazards	Department of Geography	https://arts.cmb.ac.lk/geo/index.php/study-stream/	focus should be given to the technical skills related to climate change education. However, climate mitigation and adaptations are less concerned through the courses.	trainings are held. They don't directly focus on climate change adaptation. Also they are not conducted in a regular basis.	programmes in regular basis.
		GYG 2022 Climatology GYG 4016 Climatology	University of Peradeniya-Department of Geography	https://arts.pdn.ac.lk/geography/ac/Bachelor%20of%20Arts%20Honours%20in%20Geography.pdf			

		GYG 4077 Disaster Management GYG 4042 Urban Planning GEOG 21443 Climatology GEOG 41433 Disaster Management	University of Kelaniya, Department of Geography	https://ss.kln.ac.lk/depts/geography/index.php/component/sppagebuilder/?view=page&id=32			
		GEOG 2103.3 Climatology GEOG 4111.3 Green Industrial Planning GEOG 4112.3 Land use analysis and Planning	University of Sri Jayewardanepura, Department of Geography	http://fhss.sjp.ac.lk/geog/b-a-honours-degree-in-geography/			

		GEO 22673 Natural Hazards GEO 22653 Disaster Management GEO 31613 Land use planning GEO 21623 Climatology GEO 41653 Climate change and human response GEO 42613 Global Climate Changes GEO 42653	University of Ruhuna, Department of Geography	https://www.hss.ruh.ac.lk/degreedet/13			

		Management and Conservation of environmental Systems GEO 222 Climatology GEO 412 Natural Hazards and Disaster Management	University of Sabaragamuwa, Department of Geography	Department of Geography & Environmental Management | Faculty of Social Sciences and Languages (sab.ac.lk)			
		EMGT 11022 Natural Environment EMGT12022 Environmental Hazards EMGT21032 Environmental	University of Rajarata, Department of Environmental Management	Not available			

		Policy and Governance EMGT22052 Disaster Management EMGT31032 Climate Change Science EMGT31072 Poverty and Environment EMGT41092 Climate Change Management					
9	Lawyers	Environmental Law LAW 3003: Environmental Law	University of Sabaragamuwa, Department of Geography Department of Law,University of Peradeniya	https://law.cmb.ac.lk/academic/ll-b-degree/subjects-offered/#1490261184566-9b3f25f7-02d1 https://arts.pdn.ac.lk/law/assets/pdf/Revised%20LLB%20Program%20Structure%202020 19%20.pdf	Not sufficient as climate change law and policies are subject to constant changes. regular training is essential.	Not sufficient as climate change law and policies are subject to constant changes.	Periodical reviews and coaching as well as mentoring program

		ALELC 41024	Department of Law- University of Jaffna	https://sites.google.com/univ.jfn.ac.lk/law/academic/courses			mes with the senior executive researchers
10	Environmentalists	BT 3009Environment & Biodiversity Related Legislation I in Sri Lanka EN 3013Natural Hazards and Disaster Risk Management BT 3901Fundamentals of Landscaping	Faculty of Science, University of Colombo	https://science.cmb.ac.lk/academic/undergraduate-programs/honours-general-degrees/bsc-honours-in-plant-biotechnology/ https://science.cmb.ac.lk/academic/undergraduate-programs/honours-general-degrees/bsc-honours-in-environmental-science/	Received trainings, but not in regular basis.	Training opportunities are insufficient due to its irregular basis.	Providing training for the team member.

		BT 4901Landscape Maintenance and Management EN 3019 Climate Change EN 3061 Environment Resource Management I EN 3014 Natural Disaster Risk Reduction and Resilience EN 3002 Current Environmental Issues EN 3062 Environment Resource Management II					

		EN 4001 Greener cities and sustainable livelihoods EN 4003 Sustainability Tools for Greening Industry ZL 4021 Tools of Environmental Management and Assessment FS 4008 Environmental Economics EN 4005 Pollution and Environmental health					

		EN 4023 Environmental Policies, Legislations and Administration EN 4009 Waste and Wastewater Management EN 3904 Adapting Business for Climate Change EN 3905 Sustainable Tourism EN 3903 Sustainable Development and Business					

		MSc in Environmental Science		https://science.cmb.ac.lk/academic/postgraduate-programs/msc-pg-dip-programs/postgraduate-diploma-in-climate-change-and-environmental-management/			
		MSc in Climate Change and Environmental Science		https://science.cmb.ac.lk/academic/postgraduate-programs/msc-pg-dip-programs/msc-in-environmental-science/			
		B.Sc. in Environmental conservation and management	Faculty of Science, University of Kelaniya	https://science.kln.ac.lk/index.php/academic/undergraduates			
		B.Sc. in Zoology					
		M.Sc. in Environmental Management		Department of Zoology and Environmental Management - Master of Environmental Management (kln.ac.lk)			

		Master of Environmental Management ENS3052 Environmental Law and Environmental Impact Assessment ENS4012 Cleaner Production in Industry ENS4022 Sustainable Development and Green Technology ENS4032 Environmental Economics	Faculty of Science, University of Peradeniya	https://science.kln.ac.lk/depts/zem/index.php/academic/postgraduate/master-in-environmental-management https://sci.pdn.ac.lk/docs/Student-Handbook-2020-2021_v1.3.pdf			

		ENS4212 Air and Noise Pollution ENS4233 Waste and Waste Management ENS4422 Basic Environmental Engineering APS4152 Biodiversity Conservation and Sustainable Development APS4332 Industrial Waste Management APS4632 Energy; Sources, Use					

		and Conservation ZOO3252: Environmental Impact Assessment ZOO3272: Environmental Pollution and Toxicology BOT2221: Environmental Science BOT3242: Advanced Environmental Science BOT4142: Advanced Environmental Science	Faculty of Science University of Ruhuna	https://www.ruh.ac.lk/index.php/en/student-handbook-faculty-of-science			

		CHE3212: Environmental Chemistry ZOO3252: Environmental Impact Assessment ZOO3272: Environmental Pollution and Toxicology ZOO4034: Ecosystem Structure and Function ZOO4164: Conservation and Management of Environment		https://www.bot.jfn.ac.lk/index.php/4x/			
		ESNRM 31102 Legal Framework for	Faculty of Applied Science	https://www.agri.ruh.ac.lk/students/HANDBOOK%202019.pdf			

		Environmental Management ESNRM 31208 Waste Management ESNRM 32201Cleaner Production and Green Productivity ESNRM 32202 Energy Resource Management ESNRM 32206 Tools for Environmental Management ESNRM 41212 Climatology and Meteorology	University of Ruhuna	https://agri.pdn.ac.lk/undergraduate_program			

		BOA402X2 : Environmental Microbiology ID 1101 Environment and Pollution ID 1102 Atmospheric Pollution and Prevention EN 1203 Renewable Energy I EN 1204 Climate Change and Carbon Balancing EN 2104 Renewable Energy II	Faculty of Applied Science University of Jaffna Faculty of agriculture University of Ruhuna	https://www.bot.jfn.ac.lk/index.php/4x/ https://www.agri.ruh.ac.lk/students/HANDBOOK%202019.pdf			

		EN 2202 Applied Green Technologies in Agriculture EN 2205 Sustainable Solid Waste Management ID 2201 Green Buildings Designing ID 2202 Cleaner Production ID 3204 Green Productivity ID 3206 Environmental Evaluation ID 4101 Disasters and					

		Green Solutions AS 2203 Sustainable Livestock Production Systems CS 2202 Sustainable Crop Production Technology SS 4105 Land Use and Environmental Quality AE 3203 Energy and Waste Management					

		SS 4102 Land Degradation and Conservation SS 4103 Soil and Environmental Quality SS 3204 Sustainable Soil Fertility Management	Faculty of agriculture University of Peradeniya	https://agri.pdn.ac.lk/undergraduate_program			

The courses mentioned above often discuss the environment, ecosystems, climate change, and other factorial components of climate change. However, limited emphasis is given to climate mitigation and adaptation. According to primary data, respondents from Arts faculties mentioned that climate adaptation and mitigation components are less addressed in their courses as it is difficult to teach everything due to limited time in the semester system. Therefore, it is important to allocate a separate course for climate mitigation and adaptation or revise existing syllabuses by including these aspects. However, the Master of Science degree in climate change and Environmental Management considers climate mitigation and adaptation.

5.1.2 Continuing Professional Development Opportunities

No	Professionals (Provide where applicable and additional)	CPD in Climate Change Adaptation	Educational Institute / Provider	Link	Strengths acquired from CPDs Received on Climate Change Adaptation	Challenges and Gaps Experienced due to lack of CPDs in Climate Change Adaptation	How would you address these challenges and gaps through CPDs?
1	Architect	Not always related to climate change adaptation Yes	Institute of Architech Sri Lanka Green Building	https://www.architectssrilanka.org/#projects https://www.srilankagbc.org/education/associate-professional-training-course/	Can learn about the ways for adjusting architectural techniques related to buildings and landscape designs to the effects	• Lack of climate change adaptation analysis tools. • Inexperience with climate change adaptation approaches and	Conducting a international training to have a international exposure to the professionals.

			Council Sri Lanka		of climate change. It is possible to learn about new eco-friendly building materials.	instruments.	CDP module were introduced to provide information based on modern technology, tools, and techniques related to CCA.
2	Engineer	Yes	IESL University of Moratuwa Green Building Council Sri Lanka	https://iesl.lk/index.php?option=com_content&view=article&id=85&Itemid=171&lang=en https://uom.lk/elect/cpd https://www.srilankagbc.org/education/associate-professional-training-course/	Dealing with climate related tools and techniques (Software)	• Lack of climate change adaptation analysis tools. • Inexperience with climate change adaptation	Conducting a international training to have an international exposure of climate change adaptation to the

						approaches and instruments.	professionals. CPD module were introduced to provide information based on modern technology, tools, and techniques related to climate change adaptation.
3	Town Planner	Yes	Institute of Town Planners Sri Lanka	https://itpsl.lk/event/	It is possible to learn about the impact of climate	Lack of knowledge about modern technologies and	Conducting a international training programs

			Institute of Architech Sri Lanka	https://www.architectssrilanka.org/#projects	change and about how to adapt in the built environment.	techniques used in the world related to CCA. Lack of knowledge about climate-related modelling work, particularly in the hydraulic sector.	Provide new modelling tools for climate-related modelling activities.
4	Surveyor	Yes	IQSSL		Not found	Not found	Not found
5	Anthropologist	No	No	No	NA	-	-
6	Economist	No	No	No	NA	-	Introducing such CPD programme is important
7	Sociologist	No	No	No	NA	-	Introducing such CPD

							programme is important
8	Geographer	No	No	No	NA	-	Introducing such CPD programme is important
9	Lawyers	No	No	No	NA	-	Introducing such CPD programme is important
10	Environmentalists	Provide CPD courses	IEPSL	https://www.iepsl.lk/services/ https://www.iepsl.lk/news-events/	Received CPD courses, short courses, and training on Environmental related phenomena.	They do not always directly discuss climate change adaptations. Therefore, a refreshment of knowledge can't be expected from	Restructure the CPD programmes according to the need of climate change adaptation and provide chances to other officials to

						available CPD courses.	follow the courses in a regular basis.
11	Geologists	Provide CPD courses	IGSL	https://igsl.lk/ws_cap/	Received CPD courses and they address professional development requirements such as personal grooming, procurement process, etc.	Available CPD courses do not discuss about climate change adaptations. Therefore, a refreshment of knowledge can't be expected from available CPD courses.	Restructure the CPD programmes to address climate change adaptation with collaboration of universities.

6 Assessment of the regulatory framework for built environment professionals related to climate change

No	Professionals (Provide where applicable and additional)	*Is there a regulatory framework for the professionals related to climate change?*	*Licensing Requirements*	*Mutual Recognition Framework*	*Number of Registered Professionals*	*Employment Statistics*
1	Architect	Yes	Yes	Institute of Architects in Sri Lanka		Institute of Architects in Sri Lanka
2	Engineer	Yes (But not aware about it which is related to climate change or not)	Yes	IESL		IESL
3	Town Planner	Yes (Parliamentary act) (But not aware about it which is related to climate change or not)	Yes	IPPSL		IPPSL
4	Surveyor	YES (RICS / IQSSL code of conduct)	Yes	IQSSL		RICS / IQSSL
5	Anthropologist	No	No	-	-	No accredited professional body
6	Economist	No	No	-	-	No accredited professional body

7	Sociologist	No	No	-	-	No accredited professional body
8	Geographer	No	No	-	-	No accredited professional body
9	Lawyers	Yes	Yes Attorney at Law	In 1974, pursuant to the enactment of this Law, the Bar Association of Sri Lanka was established as the apex body and organization for all Attorneys-at-Law in Sri Lanka.	Over 21000 members	-
10	Environmentalists	Yes	Yes	Incorporated by the Act of Parliament No. 01 of 2020, the INSTITUTE OF ENVIRONMENTAL PROFESSIONALS, SRI LANKA is the premier organization for Environmental Professionals in Sri Lanka.	Chartered Environmental Professionals= 90 Members=289 Associate Members=93 Student Members=20 Honorary Fellows =1	-

7 Identification of skill gaps

Where relevant refer to state of the industry report for the respective country, with reference to climate change adaptation.

7.1.1 Anticipation of skills needed for climate change adaptation

Currently, the industrial sector is facing profound changes due to digital transformations, sustainability, climate change, and energy efficiency. The construction sector has a significant impact on many countries around the world because the construction value chain encompasses a wide range of economic activities, from the extraction of raw materials to the distribution and sale of construction products, up to the design, construction, management, and control of construction works, their maintenance, renovation, and eventual demolition. In addition, the recycling of construction and demolition waste is a critical part of the chain (Akyazi et al., 2020). Buildings, infrastructure and construction products have a significant impact on energy resource efficiency, climate change and environment (Study on the involvement of the private sector in financing climate Adaptation Action, 2016). In order to improve the competitiveness and productivity of the construction industry, it is important to develop new skills related to sustainability and measures about climate change and energy efficiency (Akyazi et al., 2020) in addition to the basic skills of built environment professionals. This would help to increase the climate resilience. Therefore, having competencies related to sustainability, green infrastructure, climate adaptation and etc. to achieve such skills are also very important. In 2017, UNESCO has identified, eight competencies to advance sustainable development. They include systems thinking competencies, anticipatory competencies, normative competencies, strategic competencies, collaboration competencies, critical thinking competencies, self-awareness competencies and integrated problem-solving competencies.

7.1.2 Actions to avoid labor shortages

Only the construction industry's workforce shortages were evaluated here.

1. **Skilled labor shortage**

The scarcity of skilled labour has been noted as a significant disadvantage in the local construction industry, and it has a direct influence on worldwide competition. On the other hand, several aspects have been recognized as the causes of this issue, and mitigation of the problem is also becoming critical in order to keep the building sector moving forward. Due to the impact of the COVID 19 epidemic, industry is facing its most difficult period yet, and progress is slowing due to a lack of labour, among other things (Pathirana, 2021).

Reason for the shortage

i. People have to work hard to get paid better
ii. There is no proper structure in workforce – hierarchy of designation are not constant and defined.
iii. Women has the capabilities to be in the industry on certain work, but the industry has not done enough homework to really align women talents in the industry growth.
iv. Procedures on career progression, recruitment, termination are not standardized
v. There is no proper structure in workforce – hierarchy of designation are not constant and defined.

vi. No proper policies related to construction on the way forward of the industry and the growth avenues
vii. The industry wastage is very high. So, the Waste Management processes should be established and train the team
viii. Product storage systems, BIM – Building Information Modelling, are few other areas to focus in Sri Lanka
ix. This profession is very tough and there is an uncertainty about the job security. They have to work from site to site
x. Students who come to construction sector consider these professions as their last option when it comes to the job category, if they get a better job opportunity, they tend to leave this industry-No exist barrier set for employees (no promotions or a career that they are going to lose if they leave the industry)
xi. People in the construction sector don't have the identification to these jobs and they lack the social recognition because of that.
xii. People consider the construction industry is not the glamoured one and hence youth do not like to associate themselves with the industry related jobs.
xiii. There is no recognition, no social acceptability, no paper qualification necessary, no stability, no assurance/security, and no career advancement in skilled/ unskilled construction employment. Unlike professional employment in the building industry.

7.1.3 Incentives in training for climate change adaptation

Several programs and policies have been implemented in Sri Lanka, mostly in agriculture. Agriculture is the backbone of the rural economy of Sri Lanka. Given the diversity of the country's agroecological conditions and geographies, Smallholder farmers, who constitute the vast majority of many of the country's 1.7 million farmers, have long sought methods to improve their livelihoods. Strengthen the food system's resilience in the face of growing change, and Climate change is unpredictable. Farmers and local government officials, particularly those involved in agriculture, are unaware of the effects of climate change on their livelihoods in agriculture extension and water management. As a result, farmers are not assisted in adapting to changing rainfall patterns and seasons by effective crop selection, water-conservation practices, or livelihood diversification to reduce reliance on rainfall. In order to adapt the agriculture sector into climate change, there can be found many training programs at the local level with the help of government officials, NGOs, and other stakeholder. In this program they have been provided technical knowledge, financial support, and training to the community to adapt to climate change (Coping with Climate Change and Variability: Lessons from Sri Lankan Communities | United Nations Development Programme, 2016). Some reported community projects include,

- Rehabilitation of Imbulgodayagama Village reservoir through community participation
- Climate related disaster management in Thoduwawa Lagoon in Barudelpola
- Minimizing land degradation in the Serupitiya Village to facilitate community based adaptation to climate change
- Developing community-led strategies and infrastructure to ensure adaptation to drought Conditions
- Community based adaptation to floods in the Elapatha DS Division of the Ratnapura District / provincial governments as key barriers

These projects employed adaptation methods such increasing understanding of slope management and soil conservation, conducting drinking water projects, creating irrigation canals, restoring historic tanks, developing a green belt, using rainwater gathering technologies, etc. When analyzing the outcomes of the aforementioned projects, it became evident that there were problems when collaborating with government entities, particularly in terms of openness. Community organizations were able to reduce costs because they were given complete control over transparent financial management. Volunteering alongside the other villagers improved community cohesion and cut labor costs. Apart from above mentioned outcomes, communities were trained to adapt to the current climate change during the implementation of the above projects.

7.1.4 Skill shortages

According to literature, there is a gap when attempting to identify literature on skill shortages related to climate adaptation in Sri Lanka. "Skills development and climate change plans enhancing TVET `s contribution" report has mentioned about Specific skills gaps and needs in relation to mitigation and adaptation in the areas of agriculture, forestry, ecosystems and biodiversity, water, health, disaster management, energy, and waste, through research done incorporating Sri Lanka. Further, the same project has identified adaptation and mitigation skills gaps of communities. The following table illustrates detailed skill gaps related to climate change and adaptation which was identified by the "Skills development and climate change plans enhancing TVET `s contribution".

Perceived skill/ technological gaps	
In climate change mitigation	In climate change adaptation
Farmer communities lack skills on: • sustainable/ low carbon agricultural practices • irrigation management • crop management for low greenhouse gas emissions • fertilizer application	Farmer communities lack skills on: • rainwater harvesting • flood meadows • buffer strips • crop management • soil management to prevent soil erosion (plant winter cover) • cultivation of drought- resistant seeds • pest control • use of brackish water, line canals, drip irrigation to improve water use and avoid erosion.
Communities lack skills on: • sustainable use of timber • sustainable use of forest services • sustainable use of ecosystems.	Communities lack skills on: • tree nursery management • rehabilitation after forest fires • forest fire early warning systems • commercial forestry • bee keeping • fruit tree management • indigenous forest management techniques • eco system defense.
Communities lack skills on:	Communities lack skills on:

• efficient use of water • wastewater treatment and discharge.	• pump and pumping equipment manufacture • development and manufacture of water filtration and reuse technologies • supporting efficient water management actions in urban areas • sewer water system construction and rehabilitation • irrigation engineering • sustainable/climate-proof water use management • rainwater management • reverse osmosis technologies
Communities lack skills on: • pollution prevention technological implementation	Communities lack skills on: • vaccinations • vector control • hygienic behavior • resource-efficient hospitals • air-conditioning.
	Communities lack skills on: • coastal and marine defense • early warning system development and utilization • landscape design • urban planning (sustainable drain management).
Communities lack skills on: • energy audits • energy-efficient equipment installation and maintenance • renewable energy-equipment installation and maintenance	Communities lack skills on: • climate-resilient energy equipment installation and maintenance • adaptive hydropower plant design and maintenance • designing small-scale energy technologies • design and maintenance of waste to energy technologies • energy-efficient technologies
Communities lack skills on: • waste minimization • waste reuse and recycling • waste-to-energy techniques	Communities lack skills on: • waste entrepreneurship • waste-to-energy design and maintenance.

Source: Enhancing TVET contributions to climate change action plan implementation. Discussion Paper

In addition, the “Collaborative Actions towards Disaster Resilience Education” (CADRE) project has identified 13 knowledge gaps related to disaster resilience. Hence disasters are also a result of climate

change, these knowledge gaps also could be related to the climate issues. These skills gap which are outlined below could be incorporated in the field of climate change adaptations.

1. Governance, legal frameworks, and compliance
2. Business continuity management
3. Disaster response
4. Contracts and procurement
5. Resilience technologies, engineering, and infrastructure
6. Knowledge management
7. Social and cultural awareness
8. Sustainability and resilience
9. Ethics and human rights
10. Innovative financing mechanisms
11. Multi stakeholder approach, inclusion, and empowerment
12. Post disaster project management
13. Understanding disaster risks

Further, the National adaptation plan 2016-2025, has mentioned five key gaps in the Sri Lankan climate adaptation process such as information gaps, technological gaps, policy and governance gaps, institutional and coordination gaps, and resource mobilization gaps.

During the semi-structured interview series, several skills gaps and knowledge gaps related to climate adaptations were identified. They are given below.

- Skills gaps
    1. Communication skills
       This includes gaps in negotiation skills related to climate adaptation projects with international organizations and skills related to conveying messages to different kinds of audiences by various stakeholders.
    2. Technical skills
       This consists of skills related to computer modelling, mapping, programming etc. They are important in decision-making in the climate adaptation process.
    3. Language skills
       Language skills, especially English Language proficiency is lacking among most professionals. This ability is important since most conventions, protocols and other decision-making duties are performed using the English language. Also, new knowledge related to the climate adaptations are in English. Therefore, language skills play a key role to make a competent expert.
    4. Integrated working skills
       Climate adaptation is a task that requires the active participation of different stakeholders. Individual actions are not successful since climate change adaptation is, directly and indirectly, connected to different sectors. Therefore, skills related to working as a team/group, team management, decision making are very important.

- Knowledge gaps
    1. Application of theoretical knowledge practically or vice versa

There was a gap in the practical usage of theoretical knowledge related to climate adaptations and some theories are used inappropriately without considering the practical applications.

2. Green building concepts
   Gap of knowledge in the areas of radiant floors, water recycling, solar power, energy efficient window systems, municipal waste management were identified.
3. Climate change, mitigation, and adaptation knowledge
   Knowledge gaps on climate financing, sea level rise, global warming, greenhouse effect, heat island effect, alternation of ocean currents/difference between adaptation and mitigation etc. exist among different stakeholder categories.
4. Research and investigation
   This consists of knowledge gaps in ethics/research methodology, sample selection, data collection methods and techniques, data analysis /analytical tools/ data presentation/ academic writing, etc.
5. Localization of mitigation, adaptation measures and strategies
   Application of mitigation and adaptation should be localized considering different settings. Adaptation measures in other countries can't be applied directly to the Sri Lankan context. Therefore, this contextualization knowledge is important.
6. Legislation, policies, and national plans on climate change
   Knowledge of legislation, policies, and national plans are very important when practically implementing adaptation measures.

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