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Making Environmental Data Meaningful to Civil Society Organizations in Trinidad and Tobago

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Author's declaration

No portion of the work referred to in this thesis has been submitted in support of an application for another degree or qualification of this or any other university or other institute of learning.

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ABSTRACT OF THESIS submitted by:
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The use of community indicator systems has seen a rise in recent years with the data revolution, the SDGs, and the greater call for participatory methods in decision-making. This study investigated the core of community indicator systems, that is, the translation of data to information, using the case study of Trinidad and Tobago. It specifically examined how to make environmental data meaningful to civil society organizations (CSOs) in Trinidad and Tobago, in order to meet local and global sustainable development goals. In order to accomplish this, surveys were distributed to CSOs in Trinidad and Tobago to identify common environmental priorities and to map the data ecosystem for CSOs. With these, environmental information and data of relevance to the CSOs were determined. Following this, a gap analysis was conducted to see what factors can be addressed to create an environmental information system that is meaningful to CSOs in Trinidad and Tobago. Based on the findings, the common environmental priorities for CSOs were environmental governance and management, climate change, and natural resource management. Within the data ecosystem, the institutional dimension of data was the weakest and needs to be significantly improved to create a more meaningful data ecosystem. Greater environmental data availability, accessibility, coordination, policies and standards, and measures to track overall environmental transparency and accountability are the most meaningful to CSOs for tracking and achieving environmental sustainability in Trinidad and Tobago.

Keywords: data for development, civil society organizations, information systems, information value chain, information communication, indicator systems, environmental indicators, SDGs

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List of Abbreviations

BSES	Basic Set of Environment Statistics
CBO	community-based organization
CANARI	Caribbean Natural Resources Institute
CSO	civil society organization
D4D	data for development
EMA	Environmental Management Authority
ESSAT	Environment Statistics Self-Assessment Tool
EU	European Union
FAO	Food and Agriculture Organization
FBO	faith-based organization
FDES	Framework for the Development of Environment Statistics
GIS	geographic information system
GoRTT	Government of the Republic of Trinidad and Tobago
GPS	Global Positioning System
ICT	information and communications technology
IDB	Inter-American Development Bank
IISD	International Institute for Sustainable Development
IMA	Institute of Marine Affairs
LAC	Latin America and the Caribbean
MDGs	Millennium Development Goals
NDS	National Development Strategy
NEP	National Environmental Policy
NGO	non-governmental organizations
P3DM	participatory 3-D modelling
REDD+	Reducing Emissions from Deforestation and forest Degradation in developing countries
SDGs	Sustainable Development Goals
UN	United Nations
UNEP	United Nations Environment Programme
UNSD	United Nations Statistics Division
VABs	values, attitudes, and behaviours

1. Introduction

1.1 Background and Problem Description

In 2015, the 2030 Agenda for Sustainable Development was passed by the United Nations (UN). At the core of the 2030 Agenda are the Sustainable Development Goals (SDGs). These goals aim to support the three pillars of sustainable development: economic viability, social prosperity, and environmental protection.

Figure 1 Sustainable Development Goals, Source: SCVO 2019

Compared to their predecessor, the Millennium Development Goals (MDGs), the SDGs are more comprehensive and integrate the social and environmental domains more fully. This is seen in the expansion of goals, targets, and indicators. While the MDGS had 8 goals, 21 targets, and 63 indicators (Kumar *et al.*, 2016), the SDGs have 17 goals, 169 targets, and 232 indicators (IAEG-SDGs 2017). The SDGs include 7 goals that are directly related to the environmental pillar, compared to only 1 goal dedicated to the environment in the MDGs. The SDGs are also more socially inclusive than the MDGs, with an overarching goal of leaving no one behind, which was missing from the MDGS. The increased comprehensiveness of the SDGs is an improvement to the MDGs in terms of defining a more holistic, systemic approach towards sustainable development. However, there are still gaps that need to be addressed to ensure that progress is being made toward a more sustainable world. One of the gaps lies in measurement of progress. For the MDGs, it was only in 2015 that a report was published on overall progress, for which data limitations were a prominent issue (Pinter *et al.* 2015). For sustainable development in

a rapidly changing world, progress needs to be measured on a continuous basis; and in order to do so, evidence is needed.

Tracking progress for the SDGs requires a vast amount of data to be produced regularly. As a result of the data revolution, data is now available in new forms, at greater volume, and at greater speed. Mobile phone data can be used to understand disaster response and to assess credit worthiness of the unbanked; remote sensing data can be used to gain insight to access to roads and electricity usage via night time luminosity; satellite data can be used to monitor drought; social media data can be used to gauge increase in food prices; geospatial data can be used to map informal urban settlements (Lokanathan *et al.* 2017; Firth 2017). These technological advances present great potential to obtain the large amount of data that is needed to achieve the SDGs.

Despite the abundance of new ways to collect, process, analyse, and disseminate data, only 30% of indicators were reported to have sufficient data in the UN's *Sustainable Development Goals Report 2016* (Winkler and Satterthwaite 2017). Furthermore, within the set of data that is available, data related to environmental sustainability is the most sparse (Agrawal 2017; UNSD 2016; Quiroga 2016). This points out the necessity for better data collection and analysis across the world, especially for environmental data. It is important to not only fill the data gaps related to the SDG indicators but to also critically examine the implications behind the data gaps. Is the data gap related to the infrastructure needed to collect the data? That is, should attention be paid to the technical data foundations, data institutions, and data literacy? Or should it be for the design of the indicators and measurement process itself? Perhaps some indicators are not suitable or relevant for certain populations, such as those whose voices are often left out of traditional datasets, including Indigenous communities; migrant communities; and ethnic, religious, and linguistic groups (Winkler and Satterthwaite 2017). In order to fully measure progress for the SDGs to ensure its implementation, it is necessary to collect information in a way that is suitable

to the actors directly affected by particular development challenges, across all three sustainability pillars.

The actors that face the realities of development are communities. It is thus crucial to engage communities in implementing sustainable development in their communities, which can play a part of the larger global sustainability agenda. Civil society organizations (CSOs) are in a particularly good position to drive this engagement. As defined by the UN Guiding Principles Reporting Framework, CSOs are "non-state, non-for-profit, voluntary entities formed by people in the social sphere that are separate from the State and the market" (Shift and Mazars LLP 2015). CSOs consist of non-governmental organizations (NGOs), community-based organizations (CBOs), and faith-based organizations (FBOs). They are in a unique position to serve as a bridge between the community and the public and private sectors. CSOs have a better idea of what happens on the ground and can give voice to the issues and communities that are not seen from the public or private sectors (Thinyane 2018). This is important for identifying relevant issues for sustainable development and for designing effective indicators to measure progress. Furthermore, CSOs can help empower communities to take action where the public and private sectors cannot and to hold the public and private sectors accountable for their actions (Thinyane 2018). CSOs can help communities take charge of their own development.

One country whose SDG data ecosystem is worth investigating is Trinidad and Tobago. For 2018, Trinidad and Tobago's overall SDG index score was 67.5, which was slightly above the Latin America and the Caribbean's (LAC) regional average score of 66 (Sachs *et al.* 2018). Trinidad and Tobago is on track for SDG 1; but has only slightly improved for SDGs 3, 5, 7, and 9. Furthermore, it has made negative progress for SDGs 13 and 16; and SDGs 6, 10, and 17 do not have sufficient data to measure progress. Overall, the SDGs that are in most critical condition are SDGs 2, 3, 13, 14, and 16 (Ibid.).

Despite having a slightly above average SDG performance in the LAC region, Trinidad and Tobago ranks below average in statistical capacity, with a Statistical Capacity Indicator score of 47.8/100 in 2018, compared to the region's average score of 75.7 (WBG 2019a). Trinidad and Tobago lagged behind the region in all categories used to determine statistical capacity: methodology, source data, and periodicity (Ibid.). In a 2016 report by the UNDP that maps the data ecosystem of Trinidad and Tobago, this low statistical capacity has been attributed to lack of knowledge of available data at all levels; duplication of data resources low data literacy amongst stakeholders; lack of adequately trained staff in statistical capabilities; lack of data specialists (GIS, ICT, data analysis, statisticians) in public service; lack of data champions in government; absence of frameworks and systems for monitoring, accountability, and transparency; and lack of authority to coordinate data ecosystem development (Ramlal 2016). The environmental data ecosystem as related to the SDGs shares the qualities of the overall data ecosystem.

Trinidad and Tobago has made some efforts to bridge the data gap. The national government has participated in various regional workshops to identify important environmental indicators and has collaborated with international and local stakeholders to provide data training to different groups. Furthermore, Trinidad and Tobago's newest national policy, *Vision 2030*, is aligned with 81% of relevant SDG targets and includes 5 key transformations, including "mov[ing] to more evidence-based decision making" and "engender[ing] greater care for the environment" (Ministry of Planning and Development 2017b). A roadmap for SDG implementation has also been in the works, and in its most recent draft, "innovation and partnerships for data generation" was a recommendation to improve the country's monitoring capacity (Ministry of Planning and Development 2017a).

Despite these efforts at the international, regional, and national levels, there is still a significant data gap for environmentally-related SDGs in Trinidad and Tobago. As such, I propose we turn to actors at the community levels to see if there are any opportunities for community involvement in strengthening the data ecosystem, and conversely, for the data ecosystem to benefit communities.

1.2 Research Aim

The aim of this research is to determine how an environmental information system can be designed to be meaningful for civil society organizations in Trinidad and Tobago, so that it can be extended to effectively tracking environmental progress for the Sustainable Development Goals.

1.3 Research Objectives

The research aim will be met by addressing the following objectives.

1.3.1 Objective 1: Identify common environmental priorities for CSOs in Trinidad and Tobago

In order for information to be meaningful, it must be relevant. Relevance will be determined by identifying the common environmental priorities of civil society organizations in Trinidad and Tobago. These priorities will also be compared with environmentally-related SDGs to determine any interlinkages between community goals and the international agenda.

1.3.2 Objective 2: Map environmental data ecosystem for CSOs in Trinidad and Tobago

In order to effectively design environmental indicators, it is important to understand the system in place for producing and using data related to the indicator. For this objective, the environmental data ecosystem for civil society organizations will be mapped by following the flow of data in civil society organizations. The following will be identified: the type of data used,

where it comes from, what it looks like; the procedures to obtain the data and to process it; and what happens to it afterwards. The interactions between users and data will also be mapped.

1.3.3 Objective 3: Analyse and address gaps for a meaningful environmental information system

Two types of analyses will be made. The environmental data ecosystem of civil society organizations in Trinidad and Tobago will first be analysed based on its technical, institutional, and human capacity. Then, existing environmental data will be analysed based on its placement on the information value chain and the potential for its translation to meaningful information. From these analyses, recommendations will be made to address any gaps that need to be filled to create a meaningful environmental information system for civil society organizations in Trinidad and Tobago.

1.4 Thesis Structure

This thesis consists of 7 chapters. Chapter 1 is the introduction, which is the current chapter. Chapter 2 is the methodology overview. Chapter 3 is the literature review, which provides an overview of data for the SDGs, data and the environment, and data and civil society organizations. It then provides background information on Trinidad and Tobago, as related to its environmental status, environmental data, and civil society. Chapter 4 describes the theoretical framework, which discusses how data produces value via the Information Value Chain and through information communication models. Chapter 5 presents the environmental priorities and the environmental data ecosystem for civil society organizations in Trinidad and Tobago. Chapter 6 provides a gap analysis of the environmental data ecosystem from the results presented in Chapter 5. Finally, Chapter 7 proposes recommendations for addressing the gaps highlighted in Chapter 6.

2. Methodology Overview

The methods used for this study are explained in the figure below.

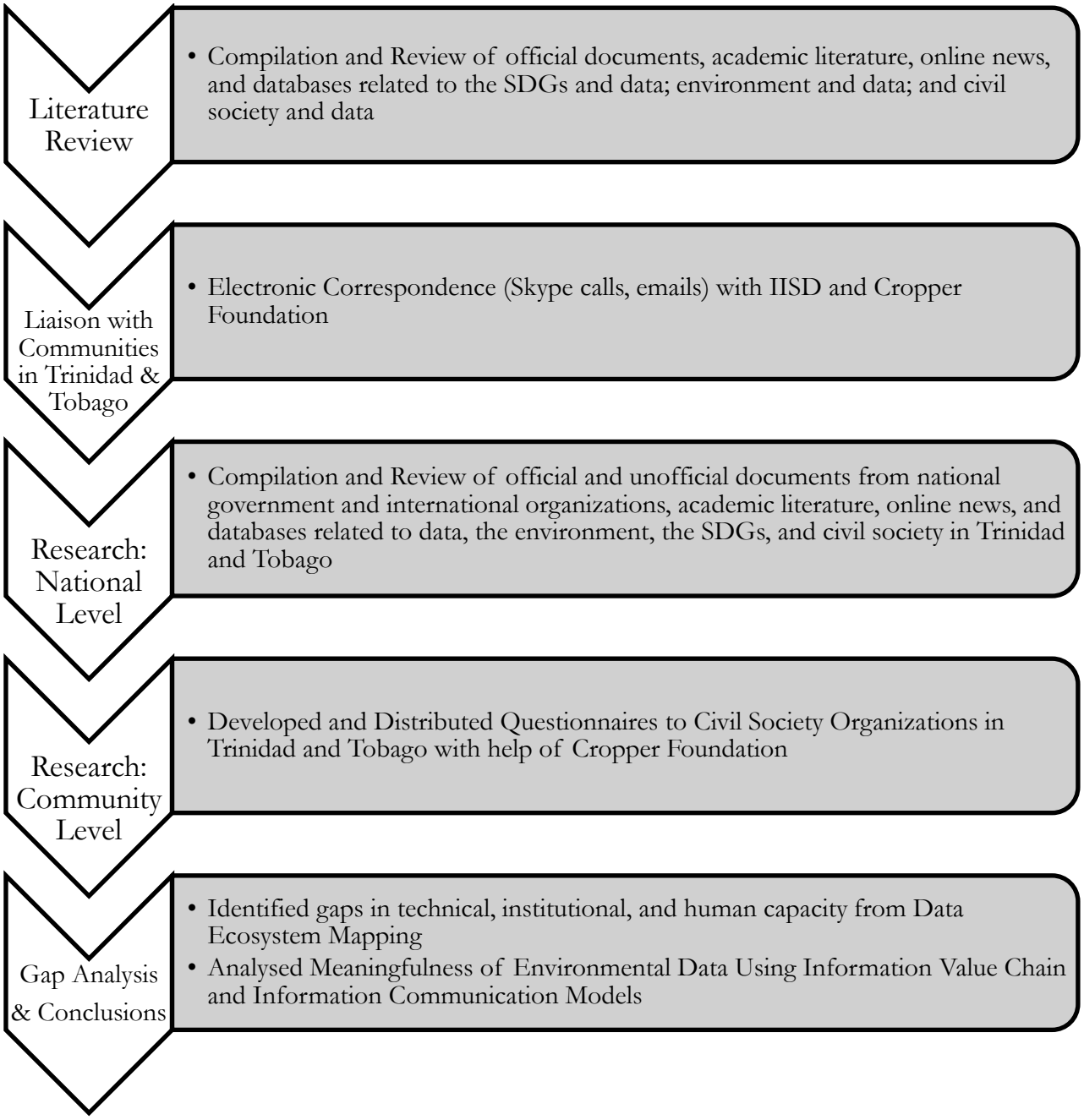

Figure 2 Methodology Structure and Research Steps

2.1 Literature Review

The literature review consisted of reviewing official and unofficial reports, academic journals, news articles, webpages, and databases. The literature was found through suggestions provided by my supervisor and through key word searches that included a combination of "data ecosystem", "data for development", "information communication", "environment", "environmental data", "environmental SDGs", "SDGs", "Caribbean", "Trinidad and Tobago", "civil society", and "civil society organizations".

2.2 Survey

The survey was a 10-item questionnaire designed to identify the environmental priorities and level of data engagement of civil society organizations in Trinidad and Tobago. The questionnaire consisted of three parts, with both open-ended and closed questions. The first part is related to the perception of environmental priorities in Trinidad in Tobago. In this section, participants were asked to rank environmental priorities in numerical order and to provide examples of the relevant environmental themes. The second part is related to how civil society organizations interact with environmental data and indicators. In this section, participants were asked to describe the type of data, source of data, use of data, and challenges of data for the relevant environmental themes identified in the first part of the survey. The third part is related to how civil society organizations perceive data in general. Participants were asked to rate the general data ecosystem of the country, and to identify opportunities to improve the data ecosystem for communities in Trinidad and Tobago. The questionnaire used can be found in Appendix I.

2.3 Scope and Limitations

While the study focuses primarily on environmentally-related SDG targets, the others are also influenced by the environment. Various interactions exist between the SDGs, including synergies,

trade-offs, and ripple effects among different targets (Weitz *et al.* 2019; Le Blanc 2015; Pradhan *et al.* 2017).

This research focuses on environmentally-interested civil society organizations in Trinidad and Tobago. A total of 34 civil society organizations were invited to participate in the questionnaire to gauge environmental interests and to map the environmental data ecosystem for CSOs in Trinidad and Tobago.

Given restraints on time and financial resources, this study was completed remotely. Connection to the communities in Trinidad and Tobago was established via the Cropper Foundation by way of connection through the International Institute for Sustainable Development (IISD). All communication was conducted electronically, via email or Skype.

For the research design, a comprehensive study on indicators understanding was not conducted. Civil society organizations were asked to broadly identify what they viewed as important for environmental data, instead of doing a thorough review of existing official environmental indicators. Additionally, only a current snapshot of the environmental priorities and data ecosystem for CSOs in Trinidad and Tobago is provided for this study. The research does not delve into how previous environmental priorities have been addressed, and how data and information systems were or were not a part of that transition.

On a broader level, this study does not capture the views of all civil society organizations in Trinidad and Tobago, and thus, cannot reflect the views of all communities. Even with the sample of civil society organizations available, the view of civil society at large cannot be fully represented. Additionally, given that this study focuses primarily on civil society organizations, it does not deeply investigate the other actors in the environmental data ecosystem of Trinidad and

Tobago. This affects how the data ecosystem is ultimately mapped, thereby affecting the recommendations proposed to address the gaps in the data ecosystem and to identify where civil society organizations would be effective for local implementation of SDGs through a data-driven approach in Trinidad and Tobago.

3. Literature Review

3.1 Data for the SDGs

The SDGs consist of 232 indicators to help track progress towards its achievement. These are classified into three tiers based on methodology, standards and data availability at the global level (IAEG-SDGs 2019). The three tiers are elaborated on below.

Table 1 SDG Indicator Tier Classifications, Source: IAEG-SDGs 2019

Tier Classification	Criteria/ Definitions
Tier I	Indicator is conceptually clear, has internationally established methodology and standards, and data is regularly produced for ≥50% of countries and relevant populations
Tier II	Indicator is conceptually clear, has internationally established methodology and standards, but data is not regularly produced
Tier III	Indicator does not have internationally established methodology or standards

As of 4 April 2019, there are 101 Tier 1 indicators, 91 Tier 2 indicators, 34 Tier 3 indicators, and 6 indicators with multiple tiers (IAEG-SDGs 2019). This is an improvement from previous years, but more work needs to be done.

Most indicators currently rely on traditional household survey and administrative data (Winkler and Satterthwaite 2017). Using newer forms of data, including geospatial data or Big Data can help to fill in some of the existing data gaps. Other issues to address in the global SDG data ecosystem include: interoperability of data, data disaggregation, institutional cooperation, multi-stakeholder engagement, and funding (Agrawal 2017).

In order to determine where to concentrate data efforts, national data ecosystem reviews and strategies are necessary. Some tools and frameworks that can help with assessing and developing data ecosystem strategies include the Cape Town Global Action Plan for Sustainable Development Data, the Global Partnership for Sustainable Development Data's "Robustness of

Data Ecosystem Evaluation Matrix" and Data4SDGs Toolbox, and the World Bank's Open Data Readiness Assessments (Agrawal 2017; UN 2018). A Statistical Data and Metadata Exchange standard is also currently being developed to facilitate data sharing and consumption across countries and international agencies (UN 2018). However, more resources and political will are needed to utilize these tools.

3.1.1 Environmentally-Related SDGs

In the SDGs, 7 goals are directly related to the environment, and 5 are partially related to the environment. The 7 directly related to the environment are highlighted below.

Figure 3 The 7 Environmentally-Related SDGs, Source: ISGlobal 2019 (with amendments)

The 6 goals that are partially related to the environment are presented on the following page.

Table 2 Partially-Environmental SDGs, Data Source: IAEG-SDGs 2017

Goal	Target
SDG 1: No Poverty	1.5 By 2030, build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to **climate-related extreme events** and other… **environmental shocks** and **disasters**
SDG 2: End Hunger	2.4 By 2030, ensure **sustainable food production systems**… implement **resilience agricultural practices**… that help **maintain ecosystems**… strengthen capacity for **adaptation to climate change**, **extreme weather**, **drought**, **flooding** and other **disasters**… progressively improve **land** and **soil quality** 2.5 By 2020, maintain the **genetic diversity of seeds**, cultivated plants and farmed and domesticated animals and their related wild species…
SDG 3: Good Health and Wellbeing	3.9 By 2030, substantially reduce the number of deaths and illnesses from **hazardous chemicals and air, water** and **soil pollution** and **contamination**
SDG 8: Decent Work and Economic Growth	8.4 Improve progressively, through 2030, **global resource efficiency** in consumption and production… decouple economic growth from **environmental degradation**…
SDG 9: Industry, Innovation and Infrastructure	9.4 By 2030, upgrade infrastructure and retrofit industries… with increased **resource-use efficiency**… greater adoption of **clean and environmentally sound technologies** and **industrial processes**…
SDG 17: Partnerships for the Goals	17.7 Promote the development, transfer, dissemination and diffusion of **environmentally sound technologies** to developing countries…

The UN Environment Programme (UNEP) further identifies 93 environmentally-related indicators across all the goals, based on a looser interpretation of what is considered "environmentally-related". These indicators will be collectively referenced throughout this document. In the UNEP's (2019) analysis of these 93 indicators, it was found that good progress was made for 22 indicators. This progress was obtained through policy changes, improved reporting, and increased funding effort, including "increase[d]… terrestrial, mountain and marine protected areas…effort to combat invasive species…sustainability reporting and mainstreaming in policy… [and] development assistance for climate change and the environment" (UNEP 2019).

However, this is a fairly incomplete picture of progress. Of the environmentally-related indicators, 68% lacked sufficient data, and more than 30% lacked agreed terminology or methodology (UNEP 2019). Within the data types, significant gaps lie in geospatial and disaggregated data, both of which are needed for several SDG indicators (Ibid.). As of April 2019, most of SDG 12 and 13 indicators are classified as Tier III (IAEG-SDGs 2019). This is especially concerning, as SDG 12 is key to the attainment of the other goals (UNEP 2019). Lack of complete and quality data limits the ability to track progress on environmental sustainability.

The barriers to data availability for environmental SDG indicators are a result of several factors. One factor is the gap in understanding definitions and methodology, of the ones that do exist. Countries have sought assistance from the United Nations Statistics Division (UNSD) to help clarify definitions and methods, including what "hazardous waste" entails, what the differences are between "incineration", "incineration with energy recovery" and "open burning", and how to calculate volume of precipitation (UNSD 2017). Other factors include lack of appropriate data institutions (e.g. national statistical office capacity, single-entry point for accessing environmental data) and legal frameworks, lack of data coordination, and lack of financial resources (UNEP 2019; UNSD 2017). Furthermore, where data is available, some goes unreported due to a reporting burden that comes from a country's having to report to several global entities (UNEP 2019).

Several internationally-agreed frameworks and tools for environmental data exist, including the Framework for the Development of Environment Statistics (FDES 2013), the Basic Set of Environment Statistics (BSES), the Environment Statistics Self-Assessment Tool (ESSAT), and the System of Environmental Economic Accounting (UNSD 2016; UNEP 2019). These can help to determine the scope of environment statistics and assess the state of environment statistics;

provide an organizing structure and a prioritization of environment statistics based on relevance, availability, and methodology; and propose data collection methods (UNSD 2016). However, as for all SDG data, greater awareness and political will for improved environment statistics is needed in order to utilize these existing tools.

Furthermore, these tools may not be effective for capturing environmental nuances at the city or community level. For this, additional frameworks are necessary. It is important that the environment is monitored at all levels of society in order for SDG implementation to be fully effective.

3.2 Data and the Environment

Environmental data is data related to the biophysical space, along with its interactions with socioeconomic spaces. The way that environmental data is collected, processed, analysed, and disseminated comes in different forms. Environmental data can be direct measurements, such as through field measurements of immediate indicators like weather; or they can be indirect measurements, conducted via estimates and modelling, such as a model for sea-level rise (UN DESA 2017; Heeks 2018). Following its input into an information system, the data can be presented through different formats, including a publication or report, an excel file, a database, a website, or individual records (UNSD 2018).

Based on the previously mentioned FDES 2013, the five components of environmental topics are environmental conditions and quality, environmental resources and their use, residuals, extreme events and disasters, and human settlements and environmental health (UN DESA 2017). The related categories of measurements include mass, degrees (temperature), energy unit, number, length, height, depth, area, volume, density, concentration, pH level, pressure, speed, description, location, intensity, data, time period, and currency (Ibid.).

Sources of data can be from statistical surveys, administrative records, ground observation (including notebooks, logs, photographs, videos, audios, oral tradition), sample collection, remote sensing, field instruments and sensors, scientific or laboratory research, (Kingsley and Pettit 2014; UNSD 2018; ICEDM 2017). Often times, these sources are combined. Air quality estimations usually combine statistical surveys and laboratory research, for example (UN DESA 2017). Less common sources of data, although still relevant as tools, include ones that have existed for centuries, including oral tradition; and ones that have been developed more recently, like mobile phones and social media.

While surveys and administrative records are heavily used in other disciplines, remote sensing and monitoring systems are more commonly found within the environmental discipline. Remote sensing involves gathering information from a distance, such as through aircrafts, satellites, buoys, ships, and balloons (UN DESA 2017). It is useful for collecting data from inaccessible or dangerous areas and to preserve the site from which the data is collected (Ibid.). It has been used in various ways, including to view changes in disaster areas, in land cover, in surface water, in population estimates of animal species; to estimate electricity usage from night time luminosity; and to monitor drought and illegal logging and fishing (UN DESA 2017; Lokanathan *et al.* 2017; Heeks 2018). When integrated with geographic information systems (GIS), the data can be combined with a spatial component, enabling greater visualization and mapping of the data. Monitoring systems include field instruments that can determine various characteristics of different environmental media, such as air, water, or soil. For example, sensors can be used to measure arsenic in groundwater or the flow of electric power across a grid. Monitoring systems can often be supported by models and calculations.

With the rise of big data, information can now be collected through sources such as mobile phones and social media. While not yet heavily used in the environmental discipline, there is potential for its usage. Mobile phone data can be used for transport planning purposes, such as determining origin-destination flows, population hot spots, social events and home locations; and for disaster response, such as through tracking human mobility (Lokanathan *et al.* 2017). Social media data can also be used for disaster response, including identifying damaged infrastructure or food or shelter needs through Twitter posts; and to crowd-source garbage pick-up (WBG 2018).

In addition to tapping into new sources of data, it is important to not discount older ones, like oral history, as a data source. This is especially relevant where there are no pre-existing data sources for which to derive a baseline for measuring progress (Phelan 2003). Oral history has been useful for governance of marine environments, such as in the case of the Palau Islands, in which native fishers were able to provide knowledge of fishing activities and patterns, for which they were local experts but whose views were often not counted (Williams and Riley 2017). It has also been useful for monitoring. In the High Arctic communities of eastern Canada, the ivory gull has been reported to be in decline by local residents, which also matched up with the results from aerial surveys (Ibid.). Oral history also provides nuances and linkages that are not captured in the measurement of a single factor. For example, oral history can describe the cultural motivations for sea turtle exploitation (Ibid.). This can be helpful in informing indicator development.

3.3 Data, Civil Society, and Civil Society Organizations

The first wave of interest in data for indicator systems occurred at the national and subnational level after the Rio Conference in the early 1990s, when sustainable development became more integrated with policy-making (Pinter *et al.* 2005). This died down from 2005-2010, but has recently been revived with social networks and big data. In this second revival of interest in data

for indicator systems, there is greater uptake by other actors. The public and private sectors have been the primary actors involved with data revolution, but recently, there has been a greater push to include civil society, especially communities, to be involved in data for indicator systems. For example, one of the broader ambitions of the 2030 Agenda is to leave no one behind, for which those furthest behind would be reached first. It aims to include the voices of those normally left out of national government data. While civil society as a whole has often been left out, SDG 17 explicitly includes the participation of civil society, by calling for partnerships and collaborations across the public and private sectors and civil society. The participation of civil society has been deemed beneficial as a means of quick and cost-efficient data collection by external organizations and researchers; by improving data quality through incorporation of local knowledge; by being a way to include and empower local people; and a way to hold other sectors accountable for the information they disseminate via "ground-truthing" (Turreira-Garcia *et al.* 2018; Kingsley and Pettit 2014). It has been used for a variety of purposes: education, gathering baseline data, managing services and interventions, defining policies, community engagement, research, monitoring and decision-making (GPSDD *et al.* 2016). Reasons for local involvement is also varied, and can include wanting to support a cause (e.g. wildlife) in general, to contribute to scientific knowledge, to advance career prospects, to receive financial reimbursement, to be empowered in the community, to improve relationships with other stakeholders, and to obtain or retain rights to resources (Geoghegan *et al.* 2016; Turreira-Garcia *et al.* 2018). Understanding the motivations behind local participation is important to design a data project that is effective and sustainable for the stakeholders involved.

Local participation in data projects has been described as "research", "monitoring", "mapping", "policing", or "patrolling" that is "participatory", "locally-based", "community-based", or "community-led" (Turreira-Garcia *et al.* 2018; GPSDD *et al.* 2016). Other related terms include citizen science and citizen sensing. The data that comes out of these projects is called "citizen-

generated data". For the sake of consistency, I will use "community-based research" to include all of the aforementioned terms. Case studies of community-based research have risen in recent years. Citizens in North America have come together to organize their own information collection, analysis, and communication to support their protests against oil-carrying pipelines; local communities have participated in carbon monitoring for REDD+ (Reducing Emissions from Deforestation and forest Degradation in Developing Countries); and Indonesian citizens in the Humanitarian OpenStreetMap Team have used participatory mapping to identify disaster exposure in areas the national mapping agency lacked the capacity (Turreira-Garcia *et al.* 2018; GPSDD *et al.* 2016; Lämmerhirt *et al.* 2016). These cases of community-based research were met with different levels of success and different levels of involvement. Communities can be involved with data in numerous ways: data definition, production, enrichment, analysis, and dissemination (GPSDD *et al.* 2016). These are further elaborated in the table below.

Table 3 Citizen-Generated Data Tasks, Source: GPSDD et al. 2016 (with amendments)

Define	Produce	Enrich	Analyse	Disseminate
Consultation	On-site observation	Classifying/tagging	Triangulation	Action plans
Problem scoping	Sample collection	Compiling	Pattern recognition	Stakeholder meetings
Data point definition	Field survey		Enumeration	Campaigning
Data stock-taking	Audio-visual recording			
Group deliberation	Household survey			

However, most of local involvement is concentrated only in data collection, and not in ideation, design, evaluation, and the use of data (Turreira-Garcia *et al.* 2018). The more effective and sustainable data initiatives were the ones that were meaningfully framed and included citizens throughout the data project (Turreira-Garcia *et al.* 2018; GPSDD *et al.* 2016).

This meaningful framing and inclusion of citizens occurs throughout the entire data project. The procedures for monitoring, analysis, and use should be appropriate to the community and match their capacities and interests. The data revolution has called for a greater emphasis on technology in data projects, but the notion of appropriate technology should be heeded. Certain technology may be more useful than others, and it's not always the new, innovative tool that is most efficient. For example, indigenous peoples of Australia who were trained to monitor environmental services using the innovative CyberTracker Technology found it difficult to interpret and analyse the data (Ens 2012); whereas indigenous peoples of Ecuador who were trained to monitor freshwater turtles using simpler monitoring methods via direct observation and count and simple digital entry and analysis were able to petition to the government for the rights to manage their territorial lands (Townsend *et al.* 2015). In several Canadian case studies, traditional monitoring methods were deemed sufficient for local needs, and technology such as GPS was met with suspicion (Brammer *et al.* 2016). These case studies demonstrate that meaningful data management and infrastructure design, and thus further user research, is necessary for community-based data projects to be successful.

It is in this space that civil society organizations can help to shape the data ecosystem to be more meaningful to them and to development at large. As the bridge between local communities and the private and public sectors, civil society organizations can provide insight to broader development goals that is normally overlooked and can more efficiently determine and allocate resources that are needed at the community-level. Civil society organizations can identify the issues that are of greatest relevance and the methods with most resonance and utility. This enables civil society organizations to empower communities, raise awareness, and catalyse action. In order to do so, however, it is important that civil society organizations are involved at all project phases: from ideation to use of the data.

3.4 The Case of Trinidad and Tobago

Trinidad and Tobago is a twin island republic in the Caribbean. It is 5,100 square kilometres in size, with a population of approximately 1.4 million (WBG 2019b). It is the southernmost nation of the Caribbean region and is geographically an extension of the South American continent, separated from Venezuela by 7 miles (11 km) (GoRTT 2019). Trinidad is the larger of the two islands, and is where much of the economic development and business activities take place (Ministry of Tourism of Trinidad and Tobago 2016). It is rich in ecological and geographical diversity, with beaches, forests, and mountain ranges in the north; flat lands in the Central Plains; hillsides in the south; and wetlands and coconut palms to east (GoRTT 2019). Tobago is the smaller of the two islands, located 21 miles (33 km) to the northeast of Trinidad, and is where much of the tourism development occurs, as it is home to coral reefs, pristine beaches, and rainforests (GoRTT 2019; Hinds 2019).

Trinidad and Tobago has an abundance of natural reserves in oil and natural gas (Ministry of Tourism of Trinidad and Tobago 2016). Oil and gas plays a significant role in Trinidad and Tobago's economy, contributing to over 35% of the country's GDP (Ministry of Planning and Development 2017b). The wealth generated from the extractive industry makes Trinidad and Tobago among the wealthiest of the Caribbean island nations (Ministry of Tourism of Trinidad and Tobago 2016). However, this large dependency on the extractive industry places the nation's environment and overall development at greater risk.

In 2016, Trinidad and Tobago developed its National Development Strategy (NDS) 2016-2030, *Vision 2030*, which identified the main challenges of the nation and the key transformations [in values, attitudes, behaviours (VABs); institutional arrangements; and macroeconomic policy] that are necessary to address these challenges and improve performance on development. The main challenges and a few of the key transformations are presented in the following two figures.

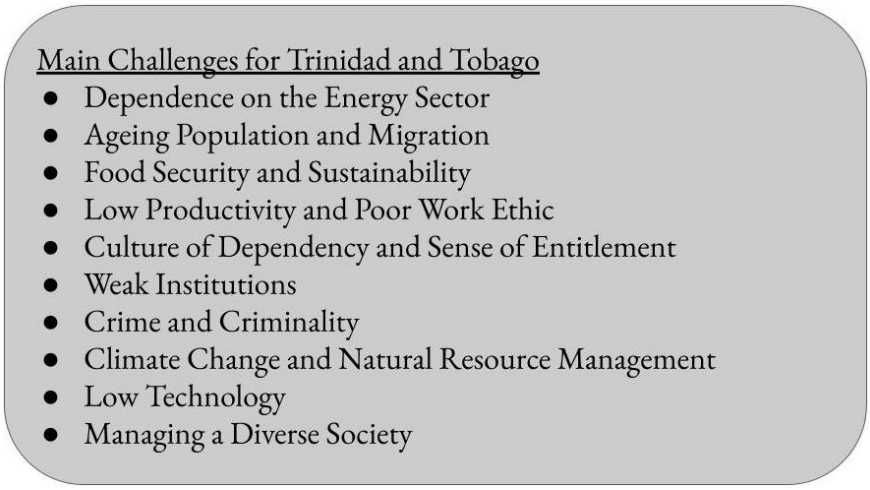

Figure 4 Summary of Main Challenges for Trinidad and Tobago, Source: Ministry of Planning and Development 2017b (with amendments)

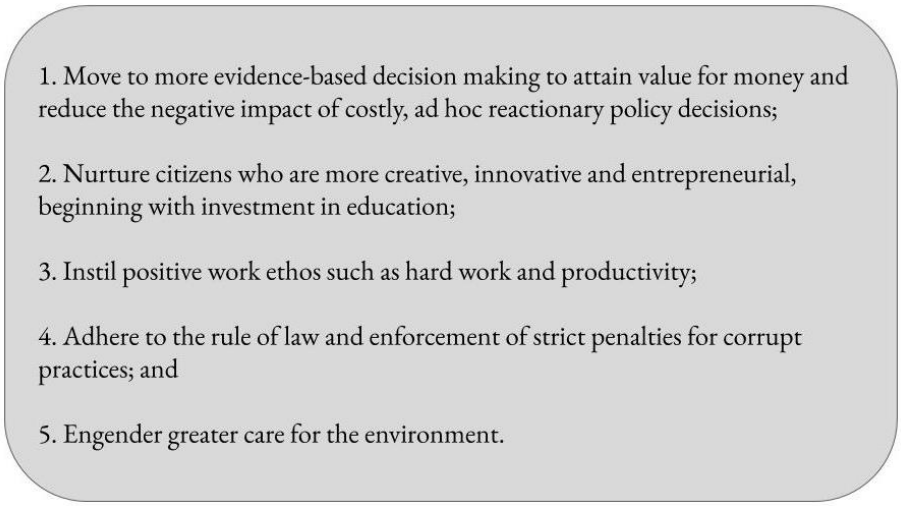

Figure 5 Key Transformations in Values, Attitudes, and Behaviours for Trinidad and Tobago, Data Source: Ministry of Planning and Development 2017b

The main challenges and transformations for Trinidad and Tobago are heavily centred on environment, societal norms, multi-stakeholder cooperation, and technology.

In the past few years, Trinidad and Tobago has made some advancement on these challenges, at least on the policy level. Several national policies have been created or updated. For environmental issues, the National Environmental Policy (NEP) of Trinidad and Tobago 2018, National Protected Areas Policy 2011, National Forest Policy 2011, National Wildlife Policy 2013, National Wetlands Policy 2002, National Climate Change Policy 2011, and Integrated Solid Waste/ Resource Management Policy 2012, and National Waste Policy 2015 have been created.

An integrated coastal zone management policy, ecotourism policy, and renewable energy policy are also currently in the works (Ministry of Planning and Development 2017b; GoRTT 2018).

Additionally, there have been efforts to draft ICT-related plans, policies, and standards (Menon 2017). Trinidad and Tobago has enacted several pieces of legislation, including those that cover "protection of human rights, privacy, personal information, intellectual property, private property, financial information, freedom of information, data dissemination, statistical data collection, e-commerce and computer misuse" (ibid.). A national ICT plan is also currently in the works, with strategies in its most recent 2018-2022 draft that include (i) improving connectivity, (ii) increasing human capacity in ICTs, (iii) creating a digital government, (iv) fostering economic development through ICTs, and (v) using ICTs in ways that protect the natural environment (Menon 2017; Ministry of Public Administration 2018). There have also been efforts to restructure the Central Statistical Office into an independent National Statistical Institute (Menon 2017). Additionally, a communications platform called GovNeTT has also been established to provide interconnectivity among government ministries and organizations (Ibid.). These centralization efforts intend enhance data coordination, as more than 65 government organizations are currently involved in the collection of statistical and geospatial data to inform that nation's development needs (Ibid.). Trinidad and Tobago has also established the National Spatial Data Infrastructure Council, which is responsible for developing national standards and policies for spatial data; hosting fundamental spatial data sets for Trinidad and Tobago; and supporting the establishment and operations of the National Spatial Data Infrastructure (Menon 2017; Ramlal 2015). However, significant challenges remain in the nation's data ecosystem, especially with regard to the lack of data sharing, lack of formal coordination between the different government organizations, and the general absence of culture of data use, as present in the lack of skilled data professionals in the public sector and the lack of readily available data to citizens (Menon 2017).

Response to institutional and cultural challenges has been embedded across policies in all domains. However, there is a lack of explicit policy for these challenges. While Trinidad and Tobago is pursuing a "Centre of Government" model to improve government coordination, there is no policy that outlines this. Furthermore, a performance management framework for the various ministries does not exist (Ministry of Planning and Development 2017b). Likewise, no policies have focused exclusively on engendering social transformations.

For the most part, Trinidad and Tobago's national planning documents are well aligned with the Sustainable Development Goals. An assessment of these documents demonstrated that the policies aligned with 81% of SDG targets (Ministry of Planning and Development 2017a), indicating that Trinidad and Tobago has aimed to align its national policies with the broader 2030 Agenda.

However, several critical challenges remain for effective implementation of the SDGs. These include financial barriers (lower government spending, lack of innovative financing mechanisms), monitoring and reporting barriers (need for "improved coordination, prioritization, standardization sensitization, innovation and partnerships for data generation"), and institutional barriers (lack of clear framework and apparatus to lead implementation and monitoring of the SDGs) (Ministry of Planning and Development 2017a).

In its efforts to reach sustainable development, especially for the environmental pillar of sustainability, Trinidad and Tobago must fill in significant gaps in the nation's data ecosystem as well as in the network of actors involved in sustainable development. The following sub-sections will elaborate on the environmental status of Trinidad and Tobago; environmentally-related SDG data for Trinidad and Tobago; and the nature of civil society organizations in Trinidad and Tobago.

3.4.1 Environmental Status of Trinidad and Tobago

Based on the Government of the Republic of Trinidad and Tobago (GoRTT)'s *National Environmental Policy of Trinidad and Tobago 2018*, *Vision 2030*, and their draft for the nation's SDG implementation roadmap, the following have been identified as the environmental priorities for Trinidad and Tobago:

- Water Pollution
- Air Pollution
- Solid/ Hazardous Waste
- Terrestrial Degradation
- Natural Resource Management
- Biodiversity
- Climate Change

The environmental issues vary for the two islands. In Trinidad, pollution of waterways from industrial activities, petroleum exploitation and exploration, and littering is a considerable issue, especially along the western coast and in the rivers of the south (Ministry of Planning and Development 2017a; 2017b). In Tobago, beach and ocean pollution from untreated sewage, seepage from waste dumps, livestock waste, and large-scale tourist development is of particular concern (Ibid.). For both islands, unsustainable land use has been a problem. Hillside clearing for settlements, unregulated quarrying activities, illegal logging, and unsustainable agriculture practices have led to deforestation, with an 18% decline in forest surface in Trinidad, and a 4% decline in Tobago from 1991-2010 (Ministry of Planning and Development 2017a; EMA 2010). Additionally, unsustainable consumption has increasingly become a problem for both islands, as populations become wealthier and purchase more goods, such as cars and disposable plastic (Ministry of Planning and Development 2017a). Increased car ownership has led to increased

greenhouse gas emissions; and increased disposable plastic use has led to significant littering (Ibid.). Making matters worse, landfill sites are at a point of saturation and do not meet international standards, so waste is poorly managed (Ibid.). Unsustainable consumption has also been seen in the food industry, as several species of fish have been fully exploited or overexploited (Ministry of Planning and Development 2017b).

There has also been greater recognition of the connection of the environment to society and the economy. These include the connections between the environment and poverty, economic growth, human health and well-being, disaster risk reduction, gender equality, and peace and justice. As such, Trinidad and Tobago has also aimed to make advancements in:

- Human Health and the Environment
- Water, Food and Energy Security
- Environmental Governance
- Environmentally Responsible Society
- Green Economy

As an island state, Trinidad and Tobago is vulnerable to the effects of climate change, including "rising sea levels; loss of coastal habitats; coral bleaching; increased flooding; drying out of wetland environments; harsher dry seasons resulting in susceptibility to forest fires; and increasing intensity of rainfall and storms" (Ministry of Planning and Development 2017b). These have a negative impact not only on the natural environment but also on food production and communities in low-lying areas (Ibid.). As part of its climate change mitigation strategy, Trinidad and Tobago has shifted its focus to reducing its dependency on oil and gas. This would also contribute to a green economy and help to reduce the impacts of global market changes to Trinidad and Tobago's development.

To address the nation's environmental issues, collaboration is needed at all levels of society. While the national government seems to prioritize environmental issues, there is a lack of interest in the environment in Trinidadian and Tobagonian society at large. This is evident in the public attitude of entitlement to resource provision (e.g. cheap gas and electricity) and management (Ministry of Planning and Development 2017a).

3.4.2 Environmental Data in Trinidad and Tobago

In Trinidad and Tobago, more than 65 government organizations are involved in statistical and geospatial data to inform development goals (Menon 2017). The official source of data is the Central Statistical Office. As the National Statistical Office of Trinidad and Tobago, the Central Statistical Office is responsible for collecting, processing, and disseminating official statistics related to the "commercial, industrial, agriculture, mining, economic, social and general activities and conditions of the people of Trinidad and Tobago" (Ministry of Planning and Development 2017a). However, the Central Statistical Office is seriously lacking in capacity and influence. According to a data ecosystem review by the UNDP, the Central Statistical Office has capacity to support statistical analysis but lacks the capacity for more in-depth analytical and visualization activities (Menon 2017). The Central Statistical Office also cannot require other statistics-generating organizations to report information to them, creating significant gaps in data.

With regard to environmental statistics, the Central Statistical Office released its publication for the *First Compendium of Environmental Statistics* in 2007. However, only a partial document is available on the Central Statistical Office webpage. A *Second Compendium of Environmental Statistics*, covering the period from 2005-2007, has also been conducted, but only the tables from this survey are openly available through the Central Statistical Office webpage (Ministry of Planning and Development 2009). In any case, these documents are compilations of data from other organizations. As such, primary sources of environmental data include the Environmental Management Authority, Ministry of Energy and Energy Industries, Ministry of Agriculture, Land

and Fisheries, and Water and Sewerage Authority (Ministry of Planning and Development 2017a; 2007). A comprehensive list of environmental data sources is attached in Appendix II.

Across all organizations, however, significant issues exist. One issue lies with data quality, as data generated by government organizations "[does] not typically conform to international classification standards" (Ministry of Planning and Development 2017a). Furthermore, there is a lack of human resources, particularly a lack of specialized personnel, statisticians, and data management professionals throughout statistics-generating organizations (Menon 2017). Data is also often not timely or not freely available, which goes against the *Freedom of Information Act* of 1999, which "give[s] members of the public a general right (with exceptions) of access to official documents of public authorities and for matters related thereto" (GoRTT 2013). The EMA, for example, has only published *State of Environment Reports* up until 2012, although they have been completed up for to 2017. Furthermore, some data comes at a cost (Menon 2017). This makes the quality of the data and readiness for SDG monitoring difficult to assess. The lack of data sharing and coordination

It is also apparent that data collection for the environment is less prioritized than for the other pillars of sustainability. The *Vision 2030* plan includes government expenditure according to various functions and socio-economic objectives (general public services, public order and safety, environmental protection, health, education, defense, economic affairs, housing and community amenities, recreation, culture, and religion; and social protection) (Ministry of Planning and Development 2017b). In this, the only expenditure without data was that for environmental protection.

In relation to environmentally-related SDGs, this is also seen in relation to the lack of environmental data compared to other data types in Trinidad and Tobago. Upon closer look at

the indicators used to assess SDG progress in Trinidad and Tobago through the *SDG Index and Dashboards Report 2018* (Sachs *et al.* 2018), most of the indicators for which data was missing entirely (grey rating) or for which trend data was missing but current performance indicated major challenges remained (red rating), were environmentally-related.

Table 4 Indicators Lacking Data to Measure Trend in Trinidad and Tobago. Data Source: Sachs *et al.* 2018

Indicators Lacking Data to Measure Trend			
Rating	Environmentally-Related	Total	% Environmentally-Related
	7	17	41.18%
	4	7	57.14%
	3	8	37.50%
	6	9	66.67%
	5	9	55.56%

The specific environmental indicators are presented in the following table.

Table 5 Environmental Indicators with Grey or Red Ratings. Data Source: Sachs *et al.* 2018

SDG	Indicator	Rating
2	Sustainable Nitrogen Management Index	
6	Population using safely managed water services (%)	
	Population using safely managed sanitation services (%)	
7	CO2 emissions from fuel combustion/ electricity output (MtCO2/TWh)	
11	Improved water source, piped (% urban population with access)	
12	Anthropogenic wastewater that receives treatment (%)	
	Production-based SO2 emissions (kg/capita)	
13	Energy-related CO2 emissions per capita (tCO2/capita)	
	CO2 emissions embodied in fossil fuel exports (kg/capita)	
14	Mean area that is protected in marine sites important to biodiversity (%)	
15	Mean area that is protected in freshwater sites important to biodiversity (%)	

There have been some efforts to address the data gaps for environmental SDG indicators. For example, the national government has participated in a workshop with the Latin America and the Caribbean Initiative for Sustainable Development to determine the indicators of highest priority

for the Caribbean. From this workshop, 13 indicators and related metadata were developed for climate change; ecosystems; policy related to land use planning, law enforcement, and vulnerability; water quality; waste; and energy (UN Trinidad and Tobago 2017). Some groups have also benefited from data training. For example, fisherfolks received training from the Food and Agriculture Organization (FAO) on data collection of the trawl sector to improve the health of the fishery ecosystem (UN Trinidad and Tobago 2017). Trinidad and Tobago also made advancements in its development of a Management Information System for national monitoring of protected areas, for which a website was also created (UN Trinidad and Tobago 2017). Finally, in its most recent 2018 NEP, the GoRTT has expressed its commitment to improving national environmental data and information management by (i) establishing a suite of baseline indicators aligned with the SDGs to be monitored; (ii) empowering government organisations and other stakeholders to collect and report on environmental indicators to the EMA; and (iii) establishing a National Environmental Information Management System that serves as a clearing house for all forms of environmental information" (GoRTT 2018).

3.4.3 Civil Society and Civil Society Organizations in Trinidad and Tobago

The role of civil society and civil society organizations in Trinidad and Tobago has been shaped by changing dynamics between civil society and the national government. Several factors, including racial and ethnic diversity, class division, power distances, attitude of the state, and limited budgets, have affected relationships between government and civil society (Hinds 2019; Carrington and Griffith-Charles 2013). Of particular importance is the racial and ethnic diversity in Trinidad and Tobago. The majority are of Indian (35.4%) or African (34.2%) descent, with the rest of European, Chinese, or Middle Eastern descent, distinguishing it from the majority black populations that comprise most of the other Caribbean countries (Central Statistical Office 2012; Hinds 2019; GoRTT 2019). Governmental power has been concentrated within particular ethnic groups at different times throughout Trinidad and Tobago's history and has spurred civil unrest (Hinds 2019). Among such incidences were the Black Power uprisings of the 1970s and the

attempted coup of 1990 by the Jamaat al Muslimeen group, which ascribed "the suffering of African people in comparison to the Indians in the country as among the reasons for their actions" (Ibid.). This ethnic hostility continues to be seen, even in consultative processes for development projects (Carrington and Griffith-Charles 2013). The diversity of Trinidad and Tobago has thus shaped overall cooperation and coordination in the country, especially among civil society and the public sector.

Despite these issues, the government of Trinidad and Tobago has been able to find avenues to engage with civil society. After the oil crisis of the 1970s, the GoRTT cut back on its involvement in community development and in provision of social services (Hinds 2019). The global economic crisis, coupled with the international demand for "good governance" after the Cold War, led to the increased involvement of CSOs in the nation's decision-making processes (Ibid). From the 1990s, the government of Trinidad and Tobago has included CSOs in its national consultations to nation's development, including in its development of national plans such as the *Vision 2020* and *Vision 2030* and in its attempt to create a Civil Society Board (Ibid.). However, these consultative efforts were not well received by the CSOs, as they were seen as an ad hoc activity, and as being more beneficial to the government than for CSOs (Hinds 2019; Carrington and Griffith-Charles 2013). Throughout the policy cycle ("dialogue, decision, conception/design, implementation and audit monitoring") and budget cycle, CSOs are often only involved in one aspect of it, if at all, indicating that their participation is limited (EU 2018). Furthermore, civil society and CSOs have become frustrated with the lack of implementation of plans, which further discourages them from participating in engagement efforts (Carrington and Griffith-Charles 2013).

While the language of the national government calls for inclusion, the voice of civil society and CSOs is widely ignored in practice. Development projects continue to take a top-down approach from the government or consultants selected by the government and continue to exclude civil

society from meaningful participation (Carrington and Griffith-Charles 2013). As such, there is a general mistrust of the government by civil society and CSOs, and citizens are often only finding themselves involved in engagement initiatives if there are direct financial benefits (Hinds 2019; Carrington and Griffith-Charles 2013). To further complicate these matters, there seems to be a lack of cooperation among CSOs themselves, due to issues such as completion for resources (Hinds 2019). Additionally, there is a lack of institutional framework for CSOs, leaving much of the efforts of these organizations invisible to society at large. It is informally estimated that some 5,000-8,000 CSOs operate in Trinidad and Tobago (EU 2018; UWTT 2018); however, most information on these CSOs and their works are unpublicized or out-dated (EU 2018; CANARI 2011).

Nonetheless, civil society and CSOs have played an important role in Trinidad and Tobago. Civil society has been involved in various movements. For example, in 2010, the residents of Cedros held protests against the construction of a smelter plant in Cedros, which ultimately halted its construction (Carrington and Griffith-Charles 2013). Civil society organizations have delivered services and provided support to communities and governance mechanisms (EU 2018). For example, the Caribbean Natural Resources Institute (CANARI) helped to build the capacity of forest managers and users in participatory forest governance; and also helped to build the capacity of rural communities to develop climate-change resilient sustainable forest-based enterprises (CANARI 2019). CSOs, especially NGOs and academic institutions, have also collected data where the national government was not able.

With respect to the Sustainable Development Goals, 7 civil society organizations are currently leading the EU-supported project "CSOs for Good Governance", which aims to hold the government accountable for delivering priority commitments under the SDGs (UWTT 2018). The objectives under this project are highlighted in the following figure.

Figure 6 Objectives of CSOs for Good Governance, Source: UWTT 2018

Through this project, the CSOs hope to establish a SDGs Catalysts Network to serve as a liaison between civil society and the government for SDG implementation; a Small Grants Facility to build the capacity of CSOs in advocacy action for the SDGs; and an online SDGs knowledge and advocacy platform, among other activities (UWTT 2018).

Where formal institutions have failed, civil society and civil society organizations in Trinidad and Tobago have supported the country's resilience. However, much work remains to be done to integrate the work and value of CSOs into the broader development agenda. Greater institutional frameworks need to be developed and trust between different members of society need to be fostered. At the core of this is recognizing the importance of CSOs and including them in a meaningful way, not as an afterthought to meet requirements of "good governance". Likewise, CSOs must become more cooperative with each other and build their capacity to highlight their strategic importance in order to be included in the overall governance of the nation's path to sustainable development (Hinds 2019).

4. Theoretical Framework

There has been a lot of emphasis on data for sustainable development, but data by itself is meaningless. What matters is not data itself, but the value it produces. This can be interpreted through various information and communication models.

4.1 Information Value Chain

A commonly used model is the Information Value Chain. The Information Value Chain is a value chain because data produces value only if it reaches certain points in the chain (Heeks 2018). For the purpose of this research, the final desired outcome is environmental sustainability results. Heeks' model of Information Value Chain has been reproduced in the figure below.

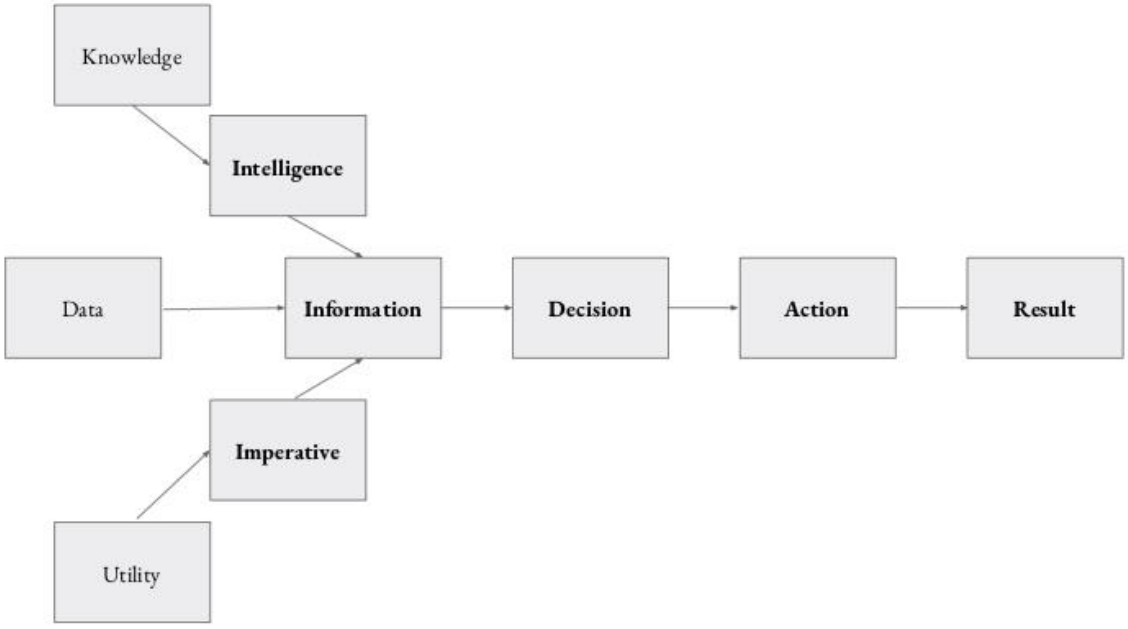

Figure 7 Information Value Chain, Source: Heeks 2014 (with amendments)

At the basis of the Information Value Chain is the transformation of data to information. Data is defined as raw, unprocessed information and consist of symbols, such as numbers or words, that are used to represent a particular phenomenon (Heeks 2018; Meadow and Yuan 1997). Information is data that has been processed to become useful to its recipient (Ibid.). It is often seen as a commodity or a resource (Meadow and Yuan 1997). It is important to note that what is

information for one person may be data to another person, depending on their existing knowledge. Knowledge is accumulated and synthesized information within a framework of understanding (Heeks 2018; Meadow and Yuan 1997). It is "capacity for social action" (Stehr 1994). Knowledge can be about a topic (know-what, know-why), or about how to do something (know-how, know-who) (Jöns *et al.* 2017; Meadow and Yuan 1997). These are either codified (explicit), which can be formally expressed in documents; or tacit (implicit), which cannot be expressed through formal mechanisms (Jöns *et al.* 2017).

The transformation from data to information takes several steps. First, data identification and specification must be defined. Then it must be collected from the source, input into a system, and stored in that system (Heeks 2018). Following that, the data can be processed for the intended recipient, by means of appropriate analysis and evaluation (Heeks 2018; Marcovecchio *et al.* 2018). From there, the recipient can make a decision to use the information or not (Ibid.). This could lead to inaction or some action with a possible impact (Heeks 2018; Meadow and Yuan 1997). In order to get from data to result, numerous factors are involved.

On the technical side, having the appropriate hardware, software, and data in place is necessary. Hardware consists of servers ("high-capacity computers that provide large-scale data storage and specific software and computing services over a network") and specific instruments that are used to collect data (e.g. sensors) (Heeks 2018). Software includes the instructions that make the hardware work and the more familiar applications (e.g. spreadsheets, word processors, social media) (Heeks 2018). Data is unprocessed information, and can be assessed on the following criteria: openness, completeness, granularity, interoperability, accuracy, trustworthiness, relevance, timeliness, appropriateness of presentation, and usability (Heeks 2018; Koltay 2016; GPSDD *et al.* 2016).

Criteria	Description
Openness	Availability of data and the extent to which it can be shared
Completeness	Breadth and depth of the data
Granularity	Resolution of datasets
Interoperability	Extent to which data meets data standards
Accuracy	Level of correctness and consistency in the dataset
Trustworthiness	Level of trust in data source
Relevance	Contextual value of the data
Timeliness	Frequency and age of the data
Appropriateness of presentation	Degree to which data is understandable to recipients (e.g. using local language; text vs. audio-visual data in areas with low literacy rates)
Usability	Level to which data can be used and applied

Table 6 Data Assessment Criteria, Data Source: Heeks 2018; Koltay 2016; GPSDD *et al.* 2016

On the institutional side, it is necessary to have in place appropriate data governance. This means having the "rules, policies, standards; decision rights; accountabilities and methods of enforcement" for various components of data, including its infrastructure, production and consumption, and impact (Koltay 2016). Examples of data governance include frameworks for data interoperability and sharing; regulations for data privacy, protection and monopoly; investments or subsidies to promote data development; mandates for data education to be embedded in education curricula; committees to oversee data production, aggregation, and verification (Heeks 2018).

Finally, on the human side, the appropriate motivations and skills are necessary. A simplified version of the Technology Acceptance Model by Davis *et al.* (1989) describes these motivations as values and norms, incentives, beliefs and motivations, plans and disposition, and behavioural intention and behaviour (Heeks 2018). The values and norms are set by the prevailing culture of a given society. These can include national culture or demonstrations of leadership and support for a data initiative (Ibid.). For example, a certain nation may view data as something to be kept among the elite, restricting its use to government officials, and thereby affecting the extent to which data is shared. Incentives are extrinsic motivations, and can include money or recognition. Beliefs and motivations are an individual's internal drives (Ibid.). For example, individuals may believe that sharing data is a violation of their privacy. Plans and disposition are specific goals

and objectives resulting from beliefs about data, such as the perceived usefulness of telecentres to find market prices (Ibid.). Behavioural intention and behaviour is what a person intends to do and the actions they take, which in turns affects the other motivation factors (Ibid.). By using ICTs more often, users can increase their self-confidence in their digital abilities, and thus can be motivated to use it more (Khasawneh 2009).

The skills needed for an effective data ecosystem require a suitable level of digital literacy that can be broken down into three steps: access, assess, and apply (Heeks 2018). Users must know how to access data, whether that's through an online search or by contacting the appropriate data provider. It also involves being able to sort and filter through large quantities of information to find the data (Koltay 2016). Users must also be able to assess the data, by determining whether or not the data is suitable for their needs and to interpret the data accordingly. This requires an understanding of data value, types, and formats (Ibid.); and data analysis methods, such as statistical analysis and data visualization. Finally, users must be able to apply the data, by understanding how to translate the data into decisions and actions. This involves knowing when data is needed; and the ability to organize and synthesize the data with other information sources and prior knowledge (Ibid.). All of these steps must also be done in a way that meets data quality standards and ethical standards.

It is through all these factors that an effective data ecosystem can be designed, and data can be translated from raw, unprocessed information to information of value. Once new knowledge has been established through the synthesis of new, meaningful information, several processes are necessary to form decisions and create action for development results. These processes are largely influenced by the knowledge environment, spatial context, and social environment (Meusburger and Werlen 2017). As with an effective data ecosystem, the appropriate technical,

institutional, and human capacities are also needed to translate knowledge into action, and thereby achieving sustainable development.

4.2 Information Communication and Knowledge Translation

Upon closer examination of the Information Value Chain and where efforts are concentrated in various data initiatives, however, there seems to be the least emphasis on the process in which information becomes useful and actionable (Heeks 2018). The following figure reveals the focus of several data-for-development (D4D) initiatives and highlights the gaps in translation of data to knowledge, and knowledge to decision and action.

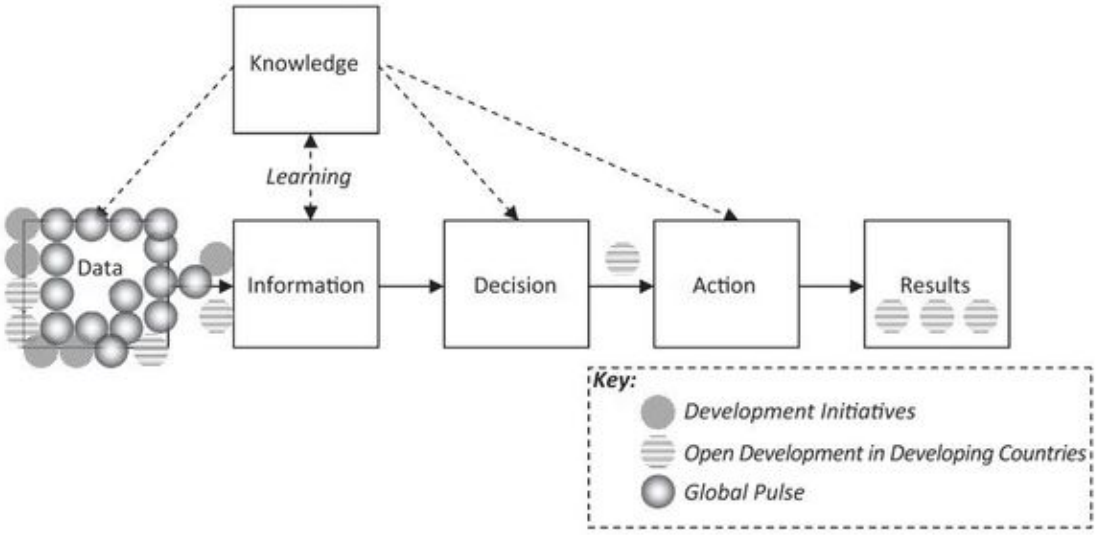

Figure 8 Heatmap of Focus for Key Data-for-Development Initiatives, Source: Heeks 2018

Most D4D initiatives place their focus at the earlier stages of the information value chain (in data prioritization, digitization, standardization) and not on the later stages of development impacts (Heeks 2014). There is an assumption that data alone can lead to better development (Heeks 2018), which leaves out the other underlying processes and structural changes that are necessary to drive development.

The lack of data initiatives in other areas of the information value chain prevents development results from being actualized. To unpack the transition from data to information to meaning and knowledge, information communication models are essential.

In Chandler's (1994) critique of Shannon and Weaver's (1949) transmissive model of communication, he stresses that communication is about meaning rather than the flow of information from source to destination. Meaning is constructed and is based on context. Situational, social, institutional, political, cultural, historical, and spatial factors shape the meaning that is constructed from information (Chandler 1994; Meusburger 2017). These include power relations in social systems, mutual trust, emotional and psychological aspects of communication, and symbolic interpretations (Meusburger 2017). Information communication may fail when "part of the information is withheld, not understood, distorted, or rejected as untrue or useless" (Ibid.). Its success depends on the interest of knowledge producers to freely relate knowledge and information and to create the necessary infrastructure for the transfer; as well as on the knowledge receivers' "prior knowledge, level of information, access to communication technologies… and their ability and willingness to accept received content that may conflict with their personal experiences, values, and cultural identities" (Jöns *et al.* 2017). Furthermore, knowledge producers and receivers must share common language, goals, interests, and "thought styles" (Meusburger 2017). Producers must be willing to share their knowledge (which may be inhibited by issues such as trust, reputation, and competitive advantage), and receivers must be willing to receive them. Producers must be able to codify their knowledge into languages and symbols that the receiver can understand, and the receiver must have the knowledge base to interpret such codes. Producers need to be able to disseminate knowledge through appropriate mediums (e.g. TV news, scientific journal, books, the Internet), and receivers must be able to access them. The various barriers to communication as described by Meusburger are further demonstrated in the figure on the following page.

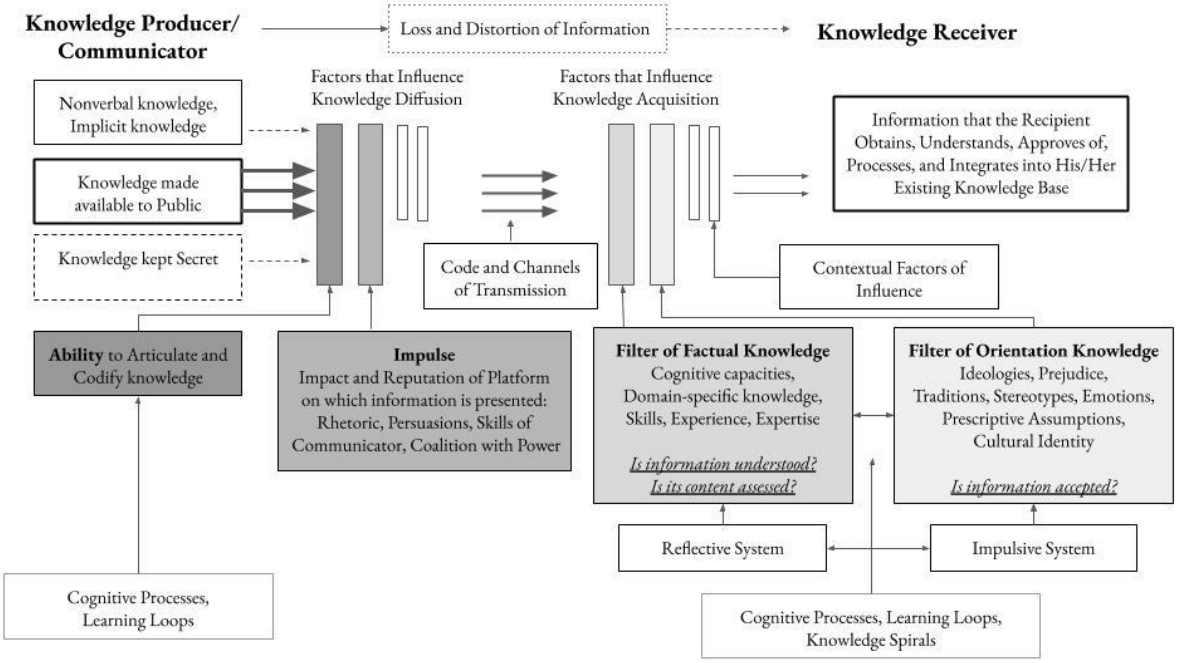

Figure 9 Factors Influencing Communication Process, Source: Meusburger 2017 (with amendments)

A mathematical equation published in an international journal may be understood by theoretical physicists, but not by the rest of the world; a doctor may be able to read a medical chart in a way that a hospital manager may not. These differences in understanding require prior knowledge to be developed, which requires varying levels of time and resources. High-grade knowledge may require years of study, research, professional training, and experience; whereas, low-grade knowledge would require less input to understanding the information.

In the landscape of burgeoning digital technologies, it is important to remember that new technologies are only a tool, and not a panacea for better development. In fact, "new information technologies have increased rather than decreased spatial inequalities in the access to knowledge", as the gap between low-grade knowledge that is freely accessible and comprehensible and high-grade knowledge which require greater specialization increases (Jöns *et al.* 2017). If introducing new information technologies, it is important to make sure that the existing knowledge base of their users are compatible (or have the potential to be compatible) with the technology.

When applied to utilizing environmental data, it is important that the meaning of the data, its implications for the desired development goals, and the processes involved to reach the goals are clearly defined for all actors and by all actors, at all stages of the information value chain.

5. Results

A total of 5 surveys were completed and returned, resulting in a response rate of 17%. The responses from the surveys are used to inform the following sections.

5.1 Environmental Priorities of Trinidad and Tobago

The surveys distributed to the civil society organizations in Trinidad and Tobago revealed that the most important environmental issue was that of environmental governance and management. This was followed by climate change, then natural resources management. These top three environmental themes will be further elaborated on in this section. The full ranking of the 8 environmental themes, which were identified as environmental priorities in several national policies, are displayed in the table below. For the full results and calculations, see Appendix III.

Table 7 Environmental Priorities According to CSOs in Trinidad and Tobago

Overall Rank	Environmental Theme
1	Environmental Governance and Management
2	Climate Change
3	Natural Resource Management
4	Biodiversity
5	Terrestrial Degradation
6	Water Pollution
7	Solid/ Hazardous Waste
8	Air Pollution

5.1.1 Environmental Governance and Management

For 60% of the CSOs that responded to the survey, environmental governance and management was ranked as the #1 environmental priority. Among the issues listed for environmental governance and management were low transparency and accountability, lack of coordination across the public-private sectors and civil society, and out-dated or slowly developed policies. Lack of coordination has led to overlap in responsibilities and authorities over protected areas in Trinidad and Tobago; and slowly developed policies have led to delays in important policies such

as the ban of polystyrene. Even where the policies are developed, there is a lack of enforcement of policies and significant corruption by those in power. This has led to destruction of habitats of rare, endangered, threatened, vulnerable, endemic, and environmentally sensitive species, including coral reef habitats, the Melajo Forest Reserve, and the Aripo Savannahs. It has also negatively affected the democratic process for environmental decision-making. One CSO noted that certain organizations often followed the requests of government, since they received funding from them and their board members were often selected by the government. Additionally, several CSOs commented on the abuse of certain policies, including those related to environmental information sharing and environmental finance mechanisms.

With respect to information sharing, many government organizations have found loopholes in the existing policies. Under the *Freedom of Information Act*, there is a 30-day wait after requesting the required information, after which the public entity can still deny access, given the many exempt clauses under the *Freedom of Information Act*. Additionally, certain copyright and intellectual property laws have enabled public bodies such as the Institute of Marine Affairs (IMA) and the Environmental Management Authority (EMA) to restrict the public's access to their documents by employing a 10% copying limit to their documents.

For finance mechanisms, the Green Fund has been misused. The Green Fund is used for conservation, remediation, and restoration activities, and can be used by NGOs and CBOs (Rawlins 2011). However, one CSO pointed out that there is a lack of project approvals and that the funds are used for other governmental activities. Under the current administration, no projects are funded, and the Finance Minister has openly stated that the funds have been used for other purposes outside of "green" initiatives.

All of these factors have led to another problematic issue in environmental governance and management, a lack of trust in authorities and decision makers.

5.1.2 Climate Change

80% of CSO respondents ranked climate change as being among the top three environmental priorities. Coastal erosion along the southern and eastern coasts, as well as extreme rainfall and floods in recent years were climate change impacts of concern to the CSOs. Several CSOs reported doing work related to climate change. These include promoting community-led natural and bioengineering tools for building climate resilience to extreme weather and using participatory modelling to collect information on the impacts of climate change and extreme events. One organization also specifically listed climate change data as necessary for meeting its objectives.

5.1.3 Natural Resource Management

80% of CSO respondents also ranked natural resources management as being among the top three environmental priorities. As Trinidad and Tobago is heavily reliant on the extractive industry, many environmental impacts come with it. This is interconnected with several other environmental issues, including water pollution, air pollution, and climate change, such as through oil spills caused by oil operations, and greenhouse gas emissions from oil and gas operations. Furthermore, there is a great deal of inefficiency around resources, including that of water and energy. One of the CSOs mentioned that more than 50% of water from the Water and Sewerage Authority (WASA) is lost via leaks. Extreme levels of energy efficiency is also an issue. The PowerGen Penal power plant, for example, has a 15-30% efficiency, which results in $100M dollars of natural gas wastage each year.

5.2 Data Ecosystem of Trinidad and Tobago

5.2.1 Data Ecosystem for CSOs in Trinidad and Tobago

The data flow for civil society organizations in Trinidad and Tobago can be summarized the following way: CSOs obtain their data mostly from secondary sources, including the IMA, EMA, Ministry of Planning and Development, Forestry Division of Planning and Development, other CSOs, and the IDB. This data is then used for raising public awareness, informing action (e.g. lobbying local authorities to take action, implementing projects), advocacy (e.g. for environmental justice, environmental accountability, sustainable energy transitions), project development (e.g. agricultural certification programme, pilot project testing, bioengineering technology solutions), monitoring/evaluation (e.g. effectiveness of national policies, waste accumulation), and to inform management.

As such, civil society organizations are primarily data users. Of the CSOs that submitted a response, only one reported generating any data of their own. The data collected by this particular organization is primarily qualitative and collected via stakeholder engagement via interviews, surveys, and focus group discussions. Beyond this, one CSO expressed interest in using data to produce more information. This information came in the form of developing land use cost benefit maps and valuation accounts for natural resources usage. However, the data to make such outputs are currently unavailable.

The general lack of available and accessible data was cited by all CSOs for all data types. This is caused by several institutional barriers to the data flow between CSOs and data producers, often preventing CSOs from meeting their objectives. Most government information is not publicly available online. The ones that are available are out-dated. The last annual *State of the Environment* report that is publicly available via the EMA website is from 2012. As a result, CSOs reported having to go to the government offices in person to get a hard copy of the report. This poses an

obstacle for those who are unable to make the long commutes to the relevant state authorities. Even then, a 10% photocopying limit is enforced by several organizations, including the IMA and EMA, both of which were heavily cited as being the source of environmental data for the CSOs. As a result of the 10% copying limit, a significant amount of time goes into reviewing the documents and selecting the portions to be photocopied for further use. Even in the case that CSOs and civil society are involved in collecting and producing data for larger research institutions or agencies, the analysis of this data is often not made available to them. The lack of available and accessible data makes transparency a significant issue for Trinidad and Tobago.

Other institutional barriers mentioned were the lack of coordination between the public-private sectors and civil society, leading to duplication of information, and lack of data policies.

Another challenge that has been noted, although to a lesser degree, is lack of technical capacity.

5.2.2 CSO Perception of Data Ecosystem at Large

The perception of CSOs regarding the technical, institutional, and human dimensions of the data ecosystem in Trinidad and Tobago is illustrated in the figure below.

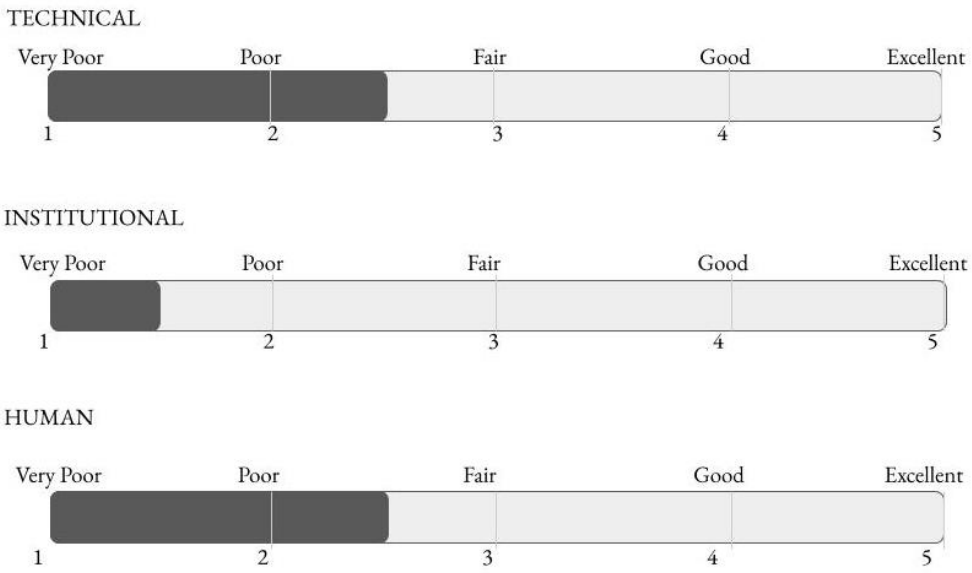

Figure 10 CSO Perception of Data Ecosystem in Trinidad and Tobago

The technical dimension of the data ecosystem had the least information from CSOs. It is unclear whether this is because the technical dimension is deemed as the least important, or if CSOs are unaware of the technical underlying of the data ecosystem. 40% of respondents rated the technical dimension as the highest among the three dimensions, with a "fair" rating. This could imply that the technical dimension may be slightly better than the others. However, no comments were made with respect to telecommunication centres, data centres, hardware, software, or ICTs.

The institutional dimension of the data ecosystem was the dimension with most information from the CSOs. All CSOs unanimously declared that this dimension lacked the most capacity, and rated it as either "very poor" or "poor". Establishment of a central agency to coordinate data, development of data policies and standards, creation of an open digital data platform, and increased funding for data production were called for by several CSOs.

The human dimension of the data ecosystem received some feedback from CSOs. 60% of CSOs rated the human dimension as "poor", however not much information was provided as to why. One CSO noted a lack of interest in the environment. Two CSOs mentioned the lack of technical capacity. One CSO touched on data literacy, expressing that people need a better understanding of data, its different forms, and how it can benefit them. The other CSO specifically listed data collection, measurement, and analysis as some of the challenges for water pollution data.

5.3 Connection to the SDGs

5.3.1 Environmental Priorities and Intersectionality with the SDGs

The environmental priorities and cases presented by the CSOs as seen in Section 5.1 are strongly linked to the SDGs. These linkages are listed in the table below. An expanded table of linkages to the specific targets is provided in Appendix IV.

Environmental Theme	**Specific CSO Objectives/ Interests**	**SDGs**
Environmental Governance and Management	Increasing transparency for environmental information across all levels Reducing corruption in environmental operations Influencing positions adopted by the GoRTT with regard to environmental management and sustainable development Promoting public participation in environmental decision-making Building alliances with national, regional, and international environmental NGOs Fostering public awareness of developmental challenges facing underprivileged communities and the environment	10, 16, 17
Climate Change	Promotion of tools for building climate resilience	13
Natural Resource Management	Advocating for sustainable energy transitions Promoting equitable participation and effective collaboration in the management of natural resources	7, 12, 16
Biodiversity	Promoting better understanding of environmental regime designed to protect communities and ecosystems from improperly planned, poorly regulated developments	14, 15, 16
Terrestrial Degradation	(same as above)	15, 16
Water Pollution	Tracking environmental management through verification of impacts of oil spills and cleanup mechanisms	6, 16
Solid/ Hazardous Waste	Tracking environmental health impacts (from hazardous waste) Promotion of organic agriculture	2, 3, 12, 16
Air Pollution	Tracking environmental health impacts (from toxic fumes)	3, 12

5.3.2 Environmental Data and Intersectionality with SDG Targets and Indicators

The information required or used by the CSOs has some connection to existing SDG indicators. These are outlined in the table below. An expanded table, including information not directly connected to SDG targets or indicators is provided in Appendix V.

Environmental Theme	**Environmental Data Required/ Used by CSOs**	**SDG Target(s)**	**SDG Indicator(s)**
Environmental Governance and Management	Existing policies, plans and programmes	12.6 Encourage companies, especially large and transnational companies, to adopt sustainable practices and to integrate sustainability information into their reporting cycle	12.6.1 Number of companies publishing sustainability reports
Climate Change	Proposed government policy for mitigating effects and planning ahead	13.2 Integrate climate change measures into national policies, strategies and planning	13.3.2 Number of countries that have communicated the strengthening of institutional, systemic and individual capacity-building to implement adaptation, mitigation and technology transfer, and development actions
Terrestrial Degradation	Maps with coordinates for areas of most severe cases of erosion, land slippage, property damage, etc.	15.3 By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation- neutral world	N/A
Water Pollution	Pesticide residues in water Contaminant information in water in Gulf of Paria Water Pollution Registers and Water Pollution Certificates Cause, volume, natures, potential risks of oil spills and cleanup mechanisms used	6.3 By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally	6.3.2 Percentage of bodies of water with good ambient water quality
Solid/ Hazardous Waste	Quantity of wastes generated per household/ per unit time	12.2 By 2030, achieve the sustainable management and efficient use of natural resources	N/A
	Contents of contaminants found in landfill leachates from	12.4 By 2020, achieve the environmentally sound management of chemicals and all wastes	N/A

	SWCOL landfill sites	throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment	
	Quantities of vegetal debris which is sent to landfills monthly/ annually	12.5 By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse	N/A
	Quantities and types of material being scavenged at landfill sites for sale/ recycling		
Other	Estimated chemical use in agriculture (quantities, geographic locations, cultural and social views surrounding chemical use)	2.4 By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen the capacity for climate change, extreme weather, drought, flooding and other disasters that progressively improve land and soil quality	2.4.2 Percentage of agricultural households using eco-friendly fertilizers compared to all agricultural households using fertilizers
	Farm size, location, etc. on persons experimenting or working with organic agriculture		2.4.1 Percentage of agricultural area under sustainable agricultural practices

6. Discussion

6.1 Resemblances and Discrepancies: Organizations, Data & Priorities

6.1.1 Civil Society, Civil Society Organizations, and National Government

The responses of the civil society organizations with regard to environmental priorities differed slightly from what is presented as national priorities. At the national level, pollution reduction and waste management are heavily emphasized, while these came last in ranking for civil society organizations.

While environmental priorities differed, the data ecosystem for CSOs and their general perception of the nation's data ecosystem was consistent with what was presented in Ramlal's mapping of Trinidad and Tobago's data ecosystem (2016). One interesting exception came from one of the CSOs, which ranked both the technical and human dimensions as "good", while all the other CSOs gave low ratings for all three data dimensions. This particular CSO, however, is the only one that explicitly reported engaging with the local community through its primary data collection in the form of participatory methods. This demonstrates that perhaps the capacity and potential for civil society to engage with data has been underestimated.

6.1.2 Data and Environmental Priorities

There was also a discrepancy between the environmental priorities and the data available to the CSOs and/or the data requested by the CSOs. CSOs were able to identify many case studies and data sources for the environmental priorities deemed as less important; but for the ones with greater importance, specific data needs were not clearly indicated.

The most clear data types (see Appendix V) were found for water pollution, solid/ hazardous waste, and terrestrial degradation (ranked 6, 7, and 5 respectively). These data types include

pesticide residues in water; cause, volume, and nature of oil spills; contents of contaminants found in landfill leachates; and coordinates for areas with most severe cases of erosion, land slippage. Natural resource management (ranked 3) also included clear data types, but they were not clearly linked to SDG targets. These data types include quantities of vegetal debris that is sent to landfills monthly/ annually; and quantities and types of material being scavenged at landfill sites for sale/ recycling. However, for the two highest ranked themes, environmental governance and management and climate change, the data needed to assess these is more vague. CSOs all referred to existing policies, plans, and programmes as data types for environmental governance and management, but not many specifications were made. One CSO included improved sense of participation, as well as improved ecosystem performance and improved human well-being, but the latter two do not directly measure environmental governance and management. For climate change, CSOs mentioned several examples of climate change impacts, but the data types mentioned were fewer in comparison. These include CO_2 footprint, estimated emissions, and proposed government policy for mitigating effects and planning ahead. This demonstrates a possible knowledge gap in climate change data design.

Another interesting finding was that environmental governance and management was the only environmental theme for which some of the data sources came from other CSOs (non-profit organizations and NGOs) or civil society. 80% of CSOs reported some level of engagement with the local community, in the form of promoting the development of participatory policy, conducting outreach programmes and campaigns to educate the public on the importance of public participation in consultation processes, facilitating equitable participation, and the promotion of community-led tools for building climate resilience. Given that many CSOs aim to integrate civil society into environmental decision-making processes, one would expect greater civil society involvement with data and information across all environmental themes. However, only one organization reported engaging with the community to collect data. This organization

explicitly advocated a process called participatory 3-D modelling (P3DM), which collects and incorporates scientific, local, and traditional knowledge on natural resource management and governance. The lack of involvement of civil society and other CSOs demonstrates a dependence on public and private institutions to generate data and leaves out the prospect of local knowledge.

6.2 What is Meaningful Environmental Data?

Significant work needs to be done first to make sure that data is available in the first place to be able to accurately assess how information is understood. However, from the responses from CSOs, a few insights can be gleaned from the type of data that is meaningful.

In terms of thematic relevance, it has been identified that environmental management and governance, climate change, and natural resource management are the most pressing issues. Within these environmental themes, information related to trends, new developments, on-going initiatives, and economic and social impacts were particularly useful. In terms of data format, it appears that CSOs find existing public reports, policies, and programmes and academic studies to be useful for meeting their objectives. As such, it can be drawn that information as currently presented in these reports and studies is relayed in an understandable way to the CSOs. Other data formats that were useful to CSOs included geospatial data (e.g. coordinates for areas of most severe cases of erosion land slippage, property damage; geographic spread of chemical use in agriculture), maps (e.g. soil maps, maps of quarrying), graphs (e.g. emissions over time), and quantities (e.g. quarrying, chemical use, vegetal debris, contaminants, waste). Furthermore, "breakdowns" of complex systems were useful (e.g. breakdown of legal and illegal quarrying, of energy flows to various users, of types of materials being scavenged at landfill sites). Where CSOs collected their own data, they benefited from qualitative data from interviews, surveys, and focus groups.

In the survey results, there were two references to understanding information. Both references were related to civil society. One response described how ecosystem services valuation and natural capital accounting could be a way to make environmental information more meaningful by enabling communities to understand the value of the environment in monetary terms. Another response described how analysis of data by larger research institutions and agencies is often not presented in a way that is useful to local communities. As such, while CSOs seem to be able to process information coming from public and private institutions through existing reports and studies, this does not seem to be the case for the rest of civil society. Data that is meaningful to CSOs is not necessarily meaningful for civil society, and thus, further transformation of data is required.

7. Conclusions and Recommendations

Much of the transformation from data to information in Trinidad and Tobago still remains in a black box. As data users, CSOs are, for the most part, able to assess and apply data in a way that enables them to meet their objectives, which indicates a basic level of digital literacy. However, their efforts to use data are often stopped due to lack of access to data. In between data production by the public-private sectors and data use among CSOs, there are several unknown variables. What normally reaches the hands of CSOs are publications in which some amount of data analysis and visualization has already been done. The quality of the data, analysis, and visualization (especially from the public sector) is not subject to a strong verification process, due to lack of data standards. By the time information from the public-private sectors reaches civil society, the information often reverts to being just data.

While several gaps still need to be filled to engage civil society in the environmental data ecosystem in Trinidad and Tobago, all CSOs expressed that there are opportunities for community environmental data engagement. The uptake of the Escazu Agreement, the Regional Agreement on Access to Information, Public Participation and Justice in Environmental Matters in Latin America and the Caribbean, can help to stimulate community action. Additionally, the push for and development of more digital data access platforms, including CANARI's Knowledge Hub and the UNDP NDC Support Programme's Knowledge Management System for National Climate Mitigation Monitoring, Reporting and Verification System in Trinidad and Tobago, can help support projects, programmes, and initiatives to facilitate community led data capture. Furthermore, increased use of participatory models of decision-making that meaningfully integrate local communities, such as P3DM, can provide opportunities for involving local communities in the design of information systems that will actually benefit them. Civil society has a lot of local knowledge to offer, and these can be further integrated with scientific knowledge in order to provide a robust information system.

Based on the information required by CSOs, a few potential environmental indicators are listed in the table on the following page.

Table 8 Potential Environmental Indicators

Local/ CSO Concern	Potential Indicator(s)	Related SDG(s)
Environmental Governance and Management	Percentage of updated government reports available online	16
	Number of water pollution registers/ certificates	6, 12, 14, 16
	Availability of Environmental Impact Assessments for the past 6 months	14, 15, 16
Natural Resource Management	Percentage of land being quarried legally and illegally	15, 16

However, as mentioned, further research is needed to more effectively determine the most appropriate indicators for tracking the environmental issues of greatest importance in Trinidad and Tobago.

The following topics should be further investigated:

- **Data producer motivation to share or not share data.** Given that much of the data flow in Trinidad and Tobago stops at major data producers (mainly governmental organizations), the values and norms, incentives, beliefs and motivations, plans and disposition, and behavioural intention and behaviour of data producers should be studied. In understanding the motivations to share or not share data, opportunities can be identified to promote a more open data ecosystem.
- **Civil society understanding of environmental data.** CSOs seem to have a decent understanding of environmental data, but as several CSOs have noted, this cannot be extended to civil society as a whole. Further user research on how local community members engage with environmental data can enable them to more actively participate in environmental decision-making processes.

- **Civil society/ CSO interest in self-generated environmental data.** There is heavy dependence from CSOs and civil society on other data producers. Further research should be conducted to identify and assess environmental CSO-generated and citizen-generated data efforts in Trinidad and Tobago; and to understand the motivations for producing or not producing data at the civil society level. This would identify opportunities for alternative means of producing data in Trinidad and Tobago.
- **CSO involvement in monitoring accountability.** Several CSOs have reported already monitoring environmental accountability. A synthesis of the different methods used by CSOs to do so can help to develop a local framework and set of indicators to monitor environmental accountability in Trinidad and Tobago. This can be extended to monitoring overall accountability and also SDG 16.

Taking the results of this study and that of additional research can help to identify opportunities to strengthen the environmental data ecosystem and to enhance capacity for local implementation of tracking the SDGs in Trinidad and Tobago.

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Appendices

Appendix I: Environmental Priorities & Data Engagement Questionnaire

Environmental Priorities & Data Engagement Questionnaire

You are invited to participate in this survey for a research thesis project on making environmental indicators meaningful to civil society organizations in Trinidad and Tobago. The survey should take between 15-30 minutes to complete. Your participation is voluntary. The responses collected from this survey will be used to inform the thesis results and will be shared with the Cropper Foundation and IISD. If you have any questions or concerns regarding how the responses will be used, or would like to know about the results of the research, you can contact me, Chelsea Phan, at baohan.phan@mespom.eu.

There are ***three parts*** to the survey. **Part (I)** is related to the perception of ***environmental priorities*** in Trinidad and Tobago. **Part (II)** is related to how your organization ***interacts with environmental data and indicators*** related to the environmental priorities listed in **Part (I)**. **Part (III)** is related to how your organization ***views data in general***.

Please fill in sections where you have experience and feel free to leave areas which do not apply to you. Thank you for taking the time to complete the survey.

What is the name of the civil society organization you represent?

What is your affiliation with the organization?

What are the main objectives of your organization related to the environment and sustainability?

Part (I). Environmental Priorities.

Based on document review of the EMA's 'National Environmental Policy of Trinidad & Tobago 2018' and the Ministry of Planning and Development's 'Trinidad and Tobago Roadmap for SDG Implementation: April 2017' and 'Vision 2030: National Development Strategy 2016-2030', the eight (8) thematic areas listed in the table below have been identified as Trinidad & Tobago's environmental priorities.

(i) If you think any important themes are missing, please add them to the bottom of the table.
(ii) Then, number the thematic areas (including any of your additions) in order according to importance in the first column. *There should be at least 8 distinct numbers (more if you add your own themes).*
(iii) Finally, please provide related examples of significance in the third column, as applicable to your organization.

TIP 1 for (i): *If 'terrestrial degradation' is the most important and 'climate change' is the least important, mark '1' next to 'terrestrial degradation', and mark '8' next to 'climate change'. Try not to assign the same number to multiple themes.*

Order (1 is most important)	Environmental Thematic Area	Significant Examples / Case Studies (e.g. Petrotrin's oil spill in La Brea in 2013) ***Please be as specific as you can in the examples, including the relevant issues, actors, location, and duration of issue, if possible.***
	Water Pollution (e.g. oil spill along river, ocean pollution from plastics)	
	Air Pollution (e.g. open burning of wastes)	
	Solid/ Hazardous Waste (e.g. littering, untreated sewage)	

	Terrestrial Degradation (e.g. deforestation, forest fires)	
	Natural Resource Management (e.g. food/water/energy security)	
	Biodiversity (e.g. coral reef protection, invasive species, endangered species)	
	Climate Change (e.g. sea level rise, rising temperatures, increased frequency of storms, coastal flooding, and droughts)	
	Environmental Governance and Management (e.g. issues related to coordination or transparency)	

Part (II). Environmental Data Interactions.

What kind of information does your organization need to fulfill its objectives related to the environment and sustainability?

Please complete the table on the following page about data use related to the environmental issues you listed in Part (I) of the survey.

The below provides guidance on the information you are requested to provide for the environmental data that your organization uses.

***Data Type**: What kind of data is it? What form does it come in? (e.g. employment in green industry from national survey, biodiversity hotspots from geospatial data, NOx concentration, pH recordings from field-instrument, land use change from satellite imagery, bird song recordings)*

***Date Source**: Where do you get your data? (e.g. self-generated, crowdsourced from social media, Central Statistical Office paper document, EMA, universities, World Bank online database)*

***Data Use**: What is the data used for? (e.g. awareness/ monitoring, to inform management, to inform action)*

***Data Challenges**: What are the greatest challenges related to using this particular data? (e.g. availability, access, funding, relevance, collection/measurement, quality, analysis, policies/standards, transparency, technical capacity, data skills, data visualization)*

Please feel free to leave areas which do not apply to you.

Issue	Data Type	Data Source	Data Use	Data Challenges
Water Pollution				
Air Pollution				
Solid/ Hazardous Waste				
Terrestrial Degradation				
Natural Resource Management				
Biodiversity				
Climate Change				
Environmental Governance and Management				
Other:				

Part (III). Data Views.

How would you rate the adequacy of the data ecosystem (technical, institutional, and human capacity) in Trinidad and Tobago?

Data Dimension	Very Poor	Poor	Fair	Good	Excellent
Technical (e.g. connectivity, storage, hardware, software)	☐	☐	☐	☐	☐
Institutional (e.g. data policies, coordination)	☐	☐	☐	☐	☐
Human (e.g. data awareness, interest, skills)	☐	☐	☐	☐	☐

What changes in the current data ecosystem would be most helpful to you in meeting your environmental or sustainability goals?

Do you see any emerging opportunities for collecting or using environmental data at the community level?

Is there anything else you would like to add related to information/data issues that have not been mentioned in this survey?

Thank you so much for completing this survey! Please let me know if you would be willing to be contacted for further questions.

❑ Yes ❑ No

Appendix II: Environmental Data Sources in Trinidad and Tobago

List of Environmental Data Sources (compiled from Ramlal's 2016 *National Report for Data Ecosystem Mapping of Trinidad and Tobago*, the Central Statistical Office's *First Compendium of Environmental Statistics 2004*, and CSO survey results)

- Agricultural Development Bank of Trinidad and Tobago
- Airports Authority of Trinidad and Tobago
- Buccoo Reef Trust
- Caribbean Industrial Research Institute (CARIRI)
- Caribbean Meteorological Organization
- CARICOM
- Central Bank of Trinidad and Tobago
- Central Statistical Office *
    - Agriculture Division
    - National Income Division
    - Trade Division
- Environmental Management Authority *
- Institute of Marine Affairs *
- Inter-American Development Bank *
- Ministry of Agriculture, Land and Fisheries
    - Forestry Division *
    - Fisheries Division
    - Survey and Mapping Division
- Ministry of Energy and Energy Industry
- Ministry of Finance
- Ministry of Foreign and CARICOM Affairs
- Ministry of Health
    - Insect Vector Control Division
- Ministry of Housing and Urban Development
    - Land Settlement Agency
- Ministry of Local Government and Rural Development
- Ministry of Planning and Development *
    - Town and Country Planning Division
- Ministry of Public Utilities
- Ministry of Trade and Industry
- Ministry of Works and Transport
- Office of Disaster Preparedness and Management
- Port Authority of Trinidad and Tobago
- Solid Waste Management Company Limited *
- Tobago House of Assembly
- Trinidad and Tobago Meteorological Service
- Trinidad and Tobago Postal Corporation
- United Nations Statistical Division
- University of the West Indies *
    - Centre for Caribbean Land and Environmental Appraisal Research (CLEAR)
    - Seismic Research Centre
- Water and Sewerage Authority

* Reported use by CSOs from survey results

Appendix III: CSO Environmental Priorities Results & Calculation

CSO	Water Pollution	Air Pollution	Solid/ Hazardous Waste	Terrestrial Degradation	NRM	Biodiversity	Climate Change	Environmental Governance and Management
The Cropper Foundation	6	5	3	8	7	4	2	1
Central Pathfinders Environmental Foundation	6	8	7	4	3	5	1	2
Fishermen and Friends of the Sea	4	7	8	6	2	3	5	1
CANARI	6	8	7	5	2	4	3	1
IAMovement	5	8	7	3	1	6	2	4
Total	5							

Environmental Theme	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Rank 6	Rank 7	Rank 8	Total	Overall Rank
Water Pollution	0	0	0	1	1	3	0	0	18	6
Air Pollution	0	0	0	0	1	0	1	3	9	8
Solid/ Hazardous Waste	0	0	1	0	0	0	3	1	13	7
Terrestrial Degradation	0	0	1	1	1	1	0	1	19	5
NRM	1	2	1	0	0	0	1	0	30	3
Biodiversity	0	0	1	2	1	1	0	0	23	4
Climate Change	1	2	1	0	1	0	0	0	32	2
Environmental Governance and Management	3	1	0	1	0	0	0	0	36	1

Environmental Theme	Overall Rank
Environmental Governance and Management	1
Climate Change	2
NRM	3
Biodiversity	4
Terrestrial Degradation	5
Water Pollution	6
Solid/ Hazardous Waste	7
Air Pollution	8

Coding

Rank 1	1
Rank 2	2
Rank 3	3
Rank 4	4
Rank 5	5
Rank 6	6
Rank 7	7
Rank 8	8

Calculations

Total (Column N): weighted score for each environmental theme
= (Rank 1)*8 + (Rank 2)*7 + (Rank 3)*6 + (Rank 4)*5 + (Rank 5)*4 + (Rank 6)*3 + (Rank 7)*2 + (Rank 8)*1

Overall Rank: use RANK function
=RANK(Total for Environmental Theme, Array of Total for All Environmental Themes)

Water Pollution	Frequency	Percent
Rank 1	0	0%
Rank 2	0	0%
Rank 3	0	0%
Rank 4	1	20%
Rank 5	1	20%
Rank 6	3	60%
Rank 7	0	0%
Rank 8	0	0%

NRM	Frequency	Percent
Rank 1	1	20%
Rank 2	2	40%
Rank 3	1	20%
Rank 4	0	0%
Rank 5	0	0%
Rank 6	0	0%
Rank 7	1	20%
Rank 8	0	0%

Air Pollution	Frequency	Percent
Rank 1	0	0%
Rank 2	0	0%
Rank 3	0	0%
Rank 4	0	0%
Rank 5	1	20%
Rank 6	0	0%
Rank 7	1	20%
Rank 8	3	60%

Biodiversity	Frequency	Percent
Rank 1	0	0%
Rank 2	0	0%
Rank 3	1	20%
Rank 4	2	40%
Rank 5	1	20%
Rank 6	1	20%
Rank 7	0	0%
Rank 8	0	0%

Solid/ Hazardous Waste	Frequency	Percent
Rank 1	0	0%
Rank 2	0	0%
Rank 3	1	20%
Rank 4	0	0%
Rank 5	0	0%
Rank 6	0	0%
Rank 7	3	60%
Rank 8	1	20%

Climate Change	Frequency	Percent
Rank 1	1	20%
Rank 2	2	40%
Rank 3	1	20%
Rank 4	0	0%
Rank 5	1	20%
Rank 6	0	0%
Rank 7	0	0%
Rank 8	0	0%

Terrestrial Degradation	Frequency	Percent
Rank 1	0	0%
Rank 2	0	0%
Rank 3	1	20%
Rank 4	1	20%
Rank 5	1	20%
Rank 6	1	20%
Rank 7	0	0%
Rank 8	1	20%

Environmental Governance and Management	Frequency	Percent
Rank 1	3	60%
Rank 2	1	20%
Rank 3	0	0%
Rank 4	1	20%
Rank 5	0	0%
Rank 6	0	0%
Rank 7	0	0%
Rank 8	0	0%

Appendix IV: CSO Environmental Priorities & SDG Targets

SDG	Target	Local/ CSO Relevance
2	2.4 By 2030, ensure **sustainable food production systems** and implement **resilient agricultural practices** that increase productivity and production, that help maintain ecosystems, that strengthen the capacity for climate change, extreme weather, drought, flooding and other disasters that progressively improve land and soil quality	Promotion of Organic Agriculture as CSO objective
3	3.9 By 2030, substantially reduce the number of deaths and **illnesses** from **hazardous chemicals** and **air, water and soil pollution** and **contamination**	Environmental Health (toxic fumes from landfill fires, Demerara Road squatting community exposed to lead poisoning after they using lead waste to repair roads and houses) as CSO focus Environmental impacts on underprivileged communities as CSO focus
6	6.3 By 2030, **improve water quality** by **reducing pollution**, **eliminating dumping** and **minimizing release of hazardous chemicals and materials**, **halving the proportion of untreated wastewater** and **substantially increasing recycling** and **safe reuse** globally	Contaminant information in water as CSO interest Oil spills and cleanup mechanisms as CSO interest for tracking environmental management
	6.4 By 2030, substantially **increase water-use efficiency** across all sectors and ensure **sustainable withdrawals** and **supply of freshwater** to address water scarcity and substantially reduce the number of people suffering from water scarcity	Major water wastage from Water and Sewerage Authority (WASA), 50% of WASA water lost via leaks
	6.6 By 2020, **protect and restore water-related ecosystems**, including mountains, forests, wetlands, rivers, aquifers and lakes	Illegal build developments of hillsides in Northern Range (largest watershed) affects water security
	6.b Support and strengthen the **participation of local communities** in improving **water and sanitation management**	Promote and facilitate the value and benefit of local knowledge into scientific processes as CSO objective
7	7.2 By 2030, increase substantially the share of **renewable energy** in the global energy mix	Awareness raising, advocacy and lobbying for transitions to sustainable energy solutions with renewable energy as CSO objective
	7.3 By 2030, double the global rate of improvement in **energy efficiency**	TT #1 most energy inefficient country in the world in 2017 (from the Economist, per IAMovement) Awareness raising, advocacy and lobbying for transitions to sustainable energy solutions with energy efficiency as CSO objective
10	10.2 By 2030, empower and promote the **social, economic** and **political inclusion of all**, irrespective of age, sex, disability, race, ethnicity, origin, religion or economic or other status	Promote and facilitate the value and benefit of local knowledge into scientific processes as CSO objective
12	12.2 By 2030, achieve the **sustainable management** and **efficient**	Extractive industries play a large part

	use of natural resources	in TT's economy
	12.4 By 2020, achieve the **environmentally sound management of chemicals** and **all wastes** throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment	Contamination from natural resource extraction operations Open fires at Beetham Landfill Landfill leachates from Forest Park, Guanapo and Beetham landfills Lack of e-waste disposal Medical waste dumping Lead waste used to repair roads and houses
	12.5 By 2030, **substantially reduce waste generation** through prevention, reduction, recycling and reuse	TT as heavy consumer, littering as major problem, landfill reaching saturation
	12.6 **Encourage companies**, especially large and transnational companies, to adopt sustainable practices and to **integrate sustainability information** into their **reporting cycle**	Greater environmental data transparency needed
	12.8 By 2030, ensure that people everywhere have the **relevant information** and **awareness** for sustainable development and lifestyles in harmony with nature	Greater environmental data transparency & availability needed
	12.c **Rationalize inefficient fossil-fuel subsidies** that encourage wasteful consumption by removing market distortions, in accordance with national circumstances, including by restructuring taxation and phasing out those harmful subsidies, where they exist, to reflect their environmental impacts, taking fully into account the specific needs and conditions of developing countries and minimizing the possible adverse impacts on their development in a manner that protects the poor and the affected communities Indicators	Awareness raising, advocacy and lobbying for transitions to sustainable energy solutions with unique subsidy and energy landscape led by government as CSO objective
13	13.1 Strengthen **resilience** and **adaptive capacity** to **climate-related hazards** and **natural disasters** in all countries	Promotion of community-led natural and bioengineering tools for building climate resilience to extreme weather as CSO objective
	13.2 **Integrate climate change measures** into **national policies, strategies** and **planning**	TT vulnerability to climate change as SIDS
	13.3 Improve **education, awareness-raising** and **human** and **institutional capacity** on **climate change** mitigation, adaptation, impact reduction and early warning	Awareness raising of environmental issues as CSO objective
14	14.2 By 2020, **sustainably manage and protect marine and coastal ecosystems** to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans	TT coastlines facing erosion due to climate change impacts
15	15.1 By 2020, ensure the conservation, restoration and sustainable use of **terrestrial** and **inland freshwater ecosystems** and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements	Illegal build developments of hillsides in Northern Range (largest watershed) Construction of highway in Aripo Savannas Environmentally Sensitive Area

	15.2 By 2020, promote the implementation of **sustainable management** of **all types of forests**, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally	Quarrying in Melajo Forest Reserve
	15.3 By 2030, **combat desertification, restore degraded land and soil**, including land affected by desertification, drought and floods, and strive to achieve a land degradation- neutral world	Sand/ Gravel Quarrying in Sangre Grande, Ravine Sable
	15.5 Take urgent and significant action to **reduce the degradation of natural habitats**, halt the loss of **biodiversity** and, by 2020, **protect and prevent** the **extinction** of **threatened species**	Construction of highway in Aripo Savannas Environmentally Sensitive Area (home to Ocelot Tiger Cat, carnivorous plants and endemic orchids) Proposed Toco Port, disrupt ecosystem home to >225 identified marine species (e.g. leatherback turtle)
	15.9 By 2020, **integrate ecosystem** and **biodiversity values** into national and local **planning**, development processes, poverty reduction strategies and accounts	Interest in natural capital accounting and ecosystem services valuation
16	16.3 Promote the **rule of law** at the national and international levels and ensure equal access to justice for all	Lack of enforcement of environmental policies
	16.5 Substantially **reduce corruption** and **bribery** in all their forms	Corruption in environmental operations
	16.6 Develop **effective, accountable** and **transparent institutions** at all levels	Lack of transparency for environmental information across all levels (especially from government and private sector)
	16.7 Ensure **responsive, inclusive, participatory** and **representative decision-making** at all levels	One-off/ ad hoc environmental data collection at community level Communities left behind in discussion involving environmental data (lack of information, lack of physical access) Education on importance of public participation in consultation process as CSO objective
	16.10 Ensure **public access to information** and **protect fundamental freedoms**, in accordance with national legislation and international agreements	Limited environmental information, many exempt clauses in Freedom of Information Act, 1999
17	17.17 Encourage and promote effective **public, public- private and civil society partnerships**, building on the experience and resourcing strategies of partnerships	Lack of coordination between government agencies, between agencies and NGOs, between agencies and public for environmental operations Building alliances with national, regional, and international NGOs as CSO objective

Appendix V: Full List of Environmental Data Used/ Required by CSOs

Environmental Theme	Environmental Data Required/ Used by CSOs	SDG(s)	SDG Target(s)	SDG Indicator(s)
Environmental Governance and Management	Existing policies, plans and programmes	12, 16	12.6 Encourage companies, especially large and transnational companies, to adopt sustainable practices and to integrate sustainability information into their reporting cycle	12.6.1 Number of companies publishing sustainability reports
	Improved sense of participation	16		
	Mannerisms to engage persons to participate in environmental activity	16	N/A	N/A
	Contact information with lead community members or applicable organizations	16	N/A	N/A
Climate Change	Proposed government policy for mitigating effects and planning ahead	13	13.2 Integrate climate change measures into national policies, strategies and planning	13.3.2 Number of countries that have communicated the strengthening of institutional, systemic and individual capacity-building to implement adaptation, mitigation and technology transfer, and development actions
	CO_2 footprint	13	N/A	N/A
	Estimated Emissions	13	N/A	N/A
Natural Resource Management	Breakdown and depiction of legal and illegal quarrying	15	N/A	N/A
	Annual electricity usage	12	N/A	N/A
	Natural gas usage	12	N/A	N/A
	Total gas generation	12	N/A	N/A
	Economic/ social impacts of gas supply	12	N/A	N/A

Biodiversity	Breakdown and depiction of legal and illegal quarrying	15	N/A	N/A
Terrestrial Degradation	Maps with coordinates for areas of most severe cases of erosion, land slippage, property damage, etc.	15	15.3 By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world	N/A
Water Pollution	Pesticide residues in water Contaminant information in water in Gulf of Paria Water Pollution Registers and Water Pollution Certificates Cause, volume, natures, potential risks of oil spills and cleanup mechanisms used	6, 12	6.3 By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally	6.3.2 Percentage of bodies of water with good ambient water quality
Solid/ Hazardous Waste	Contents of contaminants found in landfill leachates from SWCOL landfill sites	12	12.4 By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment	N/A
	Quantity of wastes generated per household/ per unit time	12	12.2 By 2030, achieve the sustainable management and efficient use of natural resources	N/A
	Ongoing waste reduction initiatives by other NGOs and state agencies	12	N/A	N/A
	Quantities of vegetal debris which is sent to landfills monthly/ annually	12	12.5 By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse	N/A
	Quantities and types of material being scavenged at landfill sites for sale/ recycling	12		

Air Pollution	N/A		N/A	N/A
Other	Estimated chemical use in agriculture (quantities, geographic locations, cultural and social views surrounding chemical use)	2	2.4 By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen the capacity for climate change, extreme weather, drought, flooding and other disasters that progressively improve land and soil quality	2.4.2 Percentage of agricultural households using eco-friendly fertilizers compared to all agricultural households using fertilizers
	Farm size, location, etc. on persons experimenting or working with organic agriculture	2		2.4.1 Percentage of agricultural area under sustainable agricultural practices