Urban Environmental Sustainability Assessment of city Maniitsoq, Greenland

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ABSTRACT: The urban environmental sustainability assessment is an essential step in sustainable development as it provides an overview of environmental conditions and supports decision making in planning and development of a city. The aim of this study was to assess the environmental dimension of sustainability of isolated harbor city of Maniitsoq, Greenland. Environmental sustainability assessment model targeting Arctic region was developed considering local features of the city. Results indicated a low performance in urban environmental sustainability. It was found that number of activities in the city are not monitored and it hinders the evaluation process. Also, it was argued that existing challenges are associated with social, institutional and economical dimensions in the city. That led to a conclusion that the harbor area, marine resources, education prospects, image and identity of the city should be seen as the most important assets of the city in order to assist progress. Lastly, the findings suggest that there is a possibility of obtaining urban environmental conditions from the assessment model and recommends that more in depth research of urban sustainability appraisal in Arctic regions should be carried out.

KEYWORDS: environment, sustainability, model, urban, decision making.

1. INTRODUCTION

Urban Sustainability became a broadly used concept and term in planning and development of cities. Many examples of attempts to achieve sustainability exist within neighborhoods, communities, towns, cities and municipalities all over the globe (Graymore, 2014; Tanguay *et al*., 2010; Wallis *et al*., 2007). Usually, when decision to act and move towards sustainability is made, then a baseline «where are we now?», trends «where we are headed?» and a vision are determined. It is commonly accepted that community's current condition and a progress towards urban sustainability has to be monitored and evaluated. Researchers support the idea and concluded that, the sustainability evaluation benefits society in a number of ways (Rashed-Ali *et al*., 2012; EPA, 2014). Firstly, the evaluation provides planners and policy makers in the city and municipality with information about areas which are in need of improvement. Secondly, urban sustainability assessment creates an ability to develop an urban sustainability tracking system, which is updated on a regularly basis and shows changes in conditions over time. Thirdly, the results of the assessment allow governance to impartially evaluate the efficiency of completed projects in the city. Fourthly, the assessment outcome can increase public interest in their city and issues they encounter and strengthen participation in bringing a sustainability vision. Lastly, it assists in a creation of a competitive environment between other cities and municipalities.

Generally, the assessment methodology is based on developing framework with set of indicators at its core. The set of indicators differ together with geographical location of the area that is subjected for evaluation. There is a strong evidence in literature that

such frameworks and indicators for assessing urban sustainability exist in urban areas varying from city to municipality in United States, Canada, Europe, India, *etc*. (Hiremath, 2013; Sullivan *et al*., 2014). Yet, a country like Greenland has no previous experience in executing urban sustainability vision and its appraisal. Nevertheless, Qeqqata municipality in Greenland has set a goal to become sustainable community by 2020 and therefore has carried out the sustainability vision (Qeqqata, 2014). Moreover, as it is mentioned previously, it is of importance that the monitoring and evaluation have to take place in order to observe progress direction and efficiency. Hence, this research focuses on assisting to Qeqqata municipality's sustainability vision 2020 by applying current knowledge about urban sustainability appraisal to one of the municipality's cities, namely Maniitsoq.

Due to limited resources the study aim was to asses and report only on environmental dimension of urban sustainability in Maniitsoq. Particularly, an urban sustainability assessment model was developed and existing condition of the city with respect to environmental pillar was appraised, also existing and missing data was identified and lastly current and future environmental challenges were determined.

2. THEORY, PROCESS AND METHODOLOGY

This section provides a summary of the theory, process and methodology used to report the sustainability of urban environment of Maniitsoq. The section begins with an explanation of the Qeqqata municipality and city of Maniitsoq.

Qeqqata municipality is comprised from area of Maniitsoq and Sisimiut municipalities in 2009. According to Statistics Greenland (2013) its population is 9600. The administrative center is located in Sisimiut. The municipality consists of 5 settlements and 3 cities, respectively Atammik, Itilleq, Kangaamiut, Napasoq, Sarfannguit, Kangerlussuaq, Maniitsoq and Sisimiut (Qeqqata, 2014).

Maniitsoq is a harbor city situated in an inland with a population of 2670. The harbor is seen as a main factor driving city's economy by accommodating fisherman and hunters, fish processing factories, goods delivery and passengers' transportation company (Qeqqata, 2014; Statistics Greenland, 2013). Also, there are plans to establish aluminum smelting plant at Maniitsoq. The plan has been investigated by municipality and Greenland Self Rule Government, yet there is no consensus over the status of the project (Hermansen, 2014; Løgstrup, 2014). Therefore, the project is mainly excluded from this study.

2.1 Used terminology

Urban Sustainability it is an ability which refers to how urban systems, design, governance together with citizens remain diverse and productive without jeopardizing environment they inhibit.

The Environmental Dimension of Sustainability "concerns an organization's impacts on living and non-living natural systems, including ecosystems, land, air, and water. Environmental Indicators cover performance related to inputs and outputs. In addition, they cover performance related to biodiversity, environmental compliance, and other relevant information such as environmental expenditure and the impacts of products and services" (Global Reporting Initiative, 2014).

2.2 Data collection

For the purpose of this study a field trip to Greenland took place in 2014 August. The first step of the research included the collection of relevant data for the study from a variety of sources in Maniitsoq and Sisimiut. This process aimed to identify available data for evaluating sustainability indicators within the study. Also input about sustainability vision from multi-stakeholders was acquired through continues interviews with organizations. Sources which have contributed data include:

- Qeqqata municipality in Maniitsoq and Sisimiut;
- Hunting and Fishing association M.P.P.;
- Citizens of Maniitsoq;
- Companies such as Royal Greenland A/S, Royal Arctic A/S, Lilleholm ApS.

2.4 Urban sustainability assessment model development

A. A literature review was conducted of recent researches, reports and projects in Greenland to recognize the significant issues in planning and development of cities and settlements (National Planning Department, 2010; Josefsen I. *et al*., 2014; VOITH, 2012; Grontmij A/S, 2013). Also, similar sustainability assessments were analyzed in a variety of cities, towns and communities located in US, Alaska, Europe and Russia to determine indicators consistently used in assessing urban environmental sustainability (Atterbrand, 2005; Parkinson, 2009; Arctic Institute of North America, 2014). Moreover, sustainability vision of Qeqqata municipality was investigated to clarify municipality's ambition to become a sustainable community. The approach based on the review of literature, sustainability assessments and sustainability vision 2020 was chosen for the reason that no previous assessment attempts exist in Greenland.

B. Indicator selection process has been intensively investigated area in a last 20 years. Yet, not in the Arctic region, hence for the purpose of the study in Maniitsoq a template proposed in article of Maclaren (2007) was used for indicator selection process It was chosen because of its general nature and freedom flexibility to use city of Maniitsoq as a case. Also, it consists of several loopbacks, thus the assessment model can be improved over time. The process, which is illustrated in Figure 1, consists of eight steps, which are briefly explained in the rest of the section.

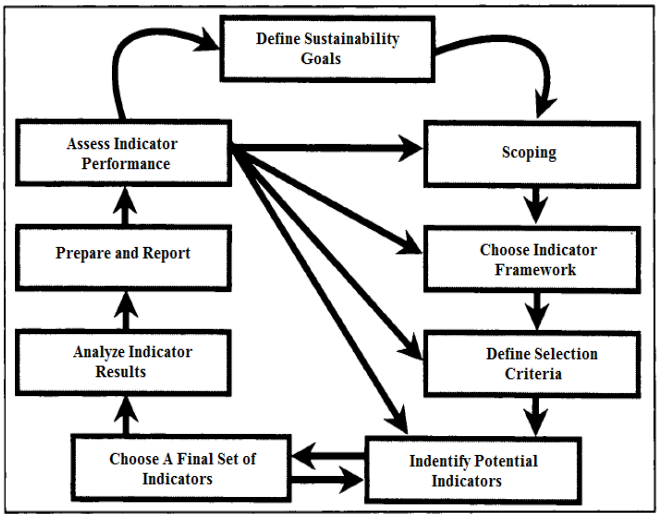

Figure 1: Steps in reporting urban sustainability (Maclaren, 2007)

Step 1 was used to define environmental sustainability goals of the city. Usually, initial aims of a city are defined when the need for sustainability is realized and later are described during the envisioning process. Also, it is a common understanding that only the way how environmental sustainability is reached differs from country/sector to country/sector, when in fact the overall goal continue to be the same – reduce or eliminated negative impact on environment (Goodland, 1995). In case of Maniitsoq, objectives were found in Qeqqata (2014) and were used as a departure point, since they complied with general knowledge.

In the **Step 2** the scope of the study was identified. Firstly, the target audience was determined by setting a purpose for which the indicators will be used. In this way communication between the results of the research and the audience are of importance throughout the period of reporting the sustainability (Locantore, 2001; Educational Portal, 2014). Secondly, a format for presenting indicators was chosen on the grounds of numerous investigations on the topic of graphical tools for data representation in sustainability. Authors concluded that the format has to be enough detail, easy to understand and most importantly comparable (Munda, 2005; OECD, 2008). Thirdly, traditionally a core set of indicators are developed at this step. The task was not performed, since it is the first attempt to determine sustainability indicators for a Greenland city whereas identification of core indicators in the first iteration is not important. Finally, the period over which indicators are to be measured in the future of Maniitsoq was set and spatial bounds were considered. In such a way, the next assessment time is defined and known, also the progress of the city in specific areas can be monitored over time.

At the **Step 3** indicator framework was chosen from the existing frameworks in practices (Shen *et al*., 2011; Kristle *et al*., 2008). The key interest when adopting the framework was that the structure of set of indicators had to be directly linked to sustainability goals. Such a decision is made in the interest of supporting current sustainability vision of municipality. Lastly, an initial set of indicators has been defined.

Step 4 was applied to evaluate sustainability indicators on criteria which were compared and selected from the latest reviews of existing literature on criteria of sustainability indicators (EPA, 2014).

During the **Step 5** a potential indicators were identified using data acquired from organizations mentioned in the beginning of the section. Few indicators describing local fishermen and hunter working environment were introduced in the set of indicators. The potential indicators allowed to single out uniqueness of local environment.

In **Step 6** the final set of indicators were evaluated against criteria defined in Step 4.

Finally, in **Step 7** the data was collected for each of the indicators and indicators were evaluated. Indicators were presented in a format chosen in Step 2.

3. RESULTS

3.1 Literature review

The information from the literature review revealed that the terminology used in sustainability visions in cities around the globe in comparison with Maniitsoq in

Qeqqata municipality differs on a matter of scale. Meaning that a city in Greenland refers to approx. 2000-5000 human settlement, whereas elsewhere such population is perceived as a village, urban village or urban neighborhoods. Therefore, in this study Maniitsoq is seen as a city in Greenlandic context and an urban village in international.

Another finding was that sustainability vision statement in Qeqqata municipality and sustainability vision statements elsewhere are formulated very differently. Practices indicate that a sustainability vision for any populated area is usually to become more sustainable on different levels then they are at the moment. In case of Qeqqata municipality - they want to become sustainable Arctic community in 2020 (Qeqqata, 2014). The vision which has not been achieved yet by anyone.

3.2 Environmental sustainability goals

Environmental sustainability goals for the municipality as well as for cities and settlements including Maniitsoq were stated in Qeqqata (2014) which was produced by Qeqqata municipality. The following goals, presented in Table 1, were found in the document and overall aim is to achieve reduction of impact on environment.

Table 1: Environmental sustainability structure

Purpose/Goal	Mission	Vision
Improve handling of waste and waste water	Reduce environmental impact	Sustainable 2020
Reduce CO_2 emissions		
Create sustainable business development		

3.2.1 Scope

The purpose of indicators was set to provide planers and policy makers in Maniitsoq with vital information about the city. Therefore, the research target audience was chosen to be Qeqqata municipality personnel in Maniitsoq as well as in Sisimiut. Nevertheless, simplified form of the study could benefit general public such as citizens of Maniitsoq and other cities' residents in municipality. The graphical representation format of the environmental sustainability was decided to be Circles of Sustainability, which definition is found in a briefing paper by Melbourne Critical Reference Group (2008). Six years period of measuring the set of indicators and possible sustainable development is intended, which is reasonable taking into consideration that vision ought to be realized in 2020.

3.2.2 Indicator framework

The goal based indicator framework was decided to be used in the environmental sustainability assessment of Maniitsoq. The set of indicators were developed around the sustainability goals by addressing environmentally sensitive areas of the city that are mostly affected by the human activity. Additional indicators were developed in order to monitor and evaluate specific local issue in the harbor area in Maniitsoq. Namely, indicators *31B Percentage of existing facility area for storing and maintaining fishing and hunting equipment, 32C Percentage of useable harbour front (quay) which is not or cannot be used* and *00A Existence and productivity of local harbor stakeholders associations.* The framework together with several indicators created around the goals are presented in table.

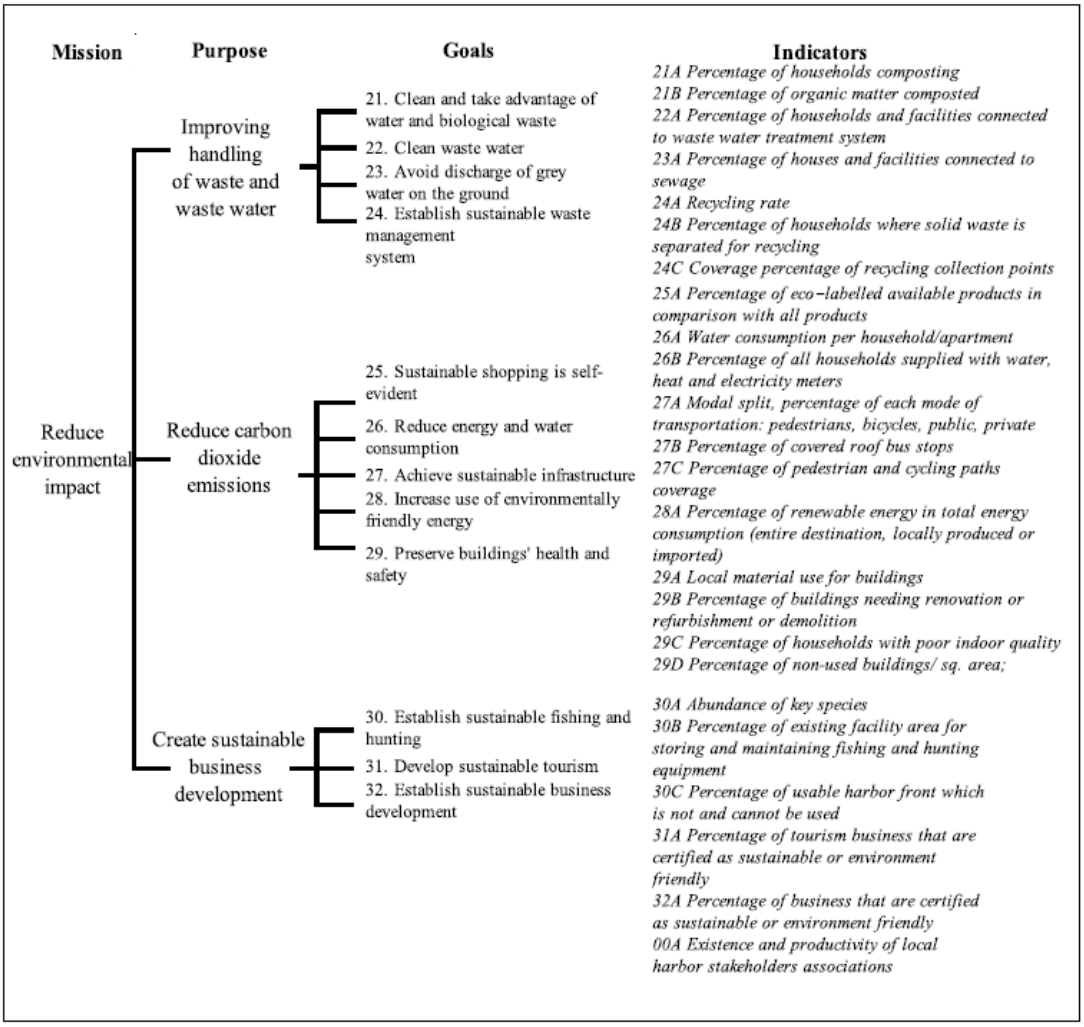

Figure 2: Goal based indicator framework

3.2.3 Criteria for indicators

Each indicator from the set of indicators was evaluated on criteria selected from the literature mentioned in methodology section. Each indicator had to conform to next seven criterions: *ease of availability, ease of understanding, measurability, significance, speed of availability, pattern of incidence* and *comparability* (European Commission, 2004). Yet, not all measures were satisfied. The result of the evaluation uncovered significant unavailability of data in Maniitsoq as number of indicators have not been monitored in the city. Also, during the evaluation became apparent that speed of data availability for several indicators is insufficient for tracking local progress or regress using the cause and effect concept (EuropeAid Co-Operation Office, 2006). Still, all indicators were included in a resulting graphical representation of the Maniitsoq urban environmental sustainability, even though handful of them did not comply with criterions. Reasoning behind the decision was to highlight missing links and information which hinder process of perceiving entire perspective of environmental dimension of the city.

3.2.4 Evaluation of indicators

Indicators were evaluated using data acquired from the interviews with different parties, existing reports in regards to the city and information gathered during the field work.

However, not only some data to perform the evaluation was missing, but also the target values for several goals were unclear and/or not defined in the vision of the Qeqqata municipality. Thus, an ideal outcome scenario for the goals was set as a target in order to execute the evaluation. The result of the set of indicators analysis is shown in Figure 3.

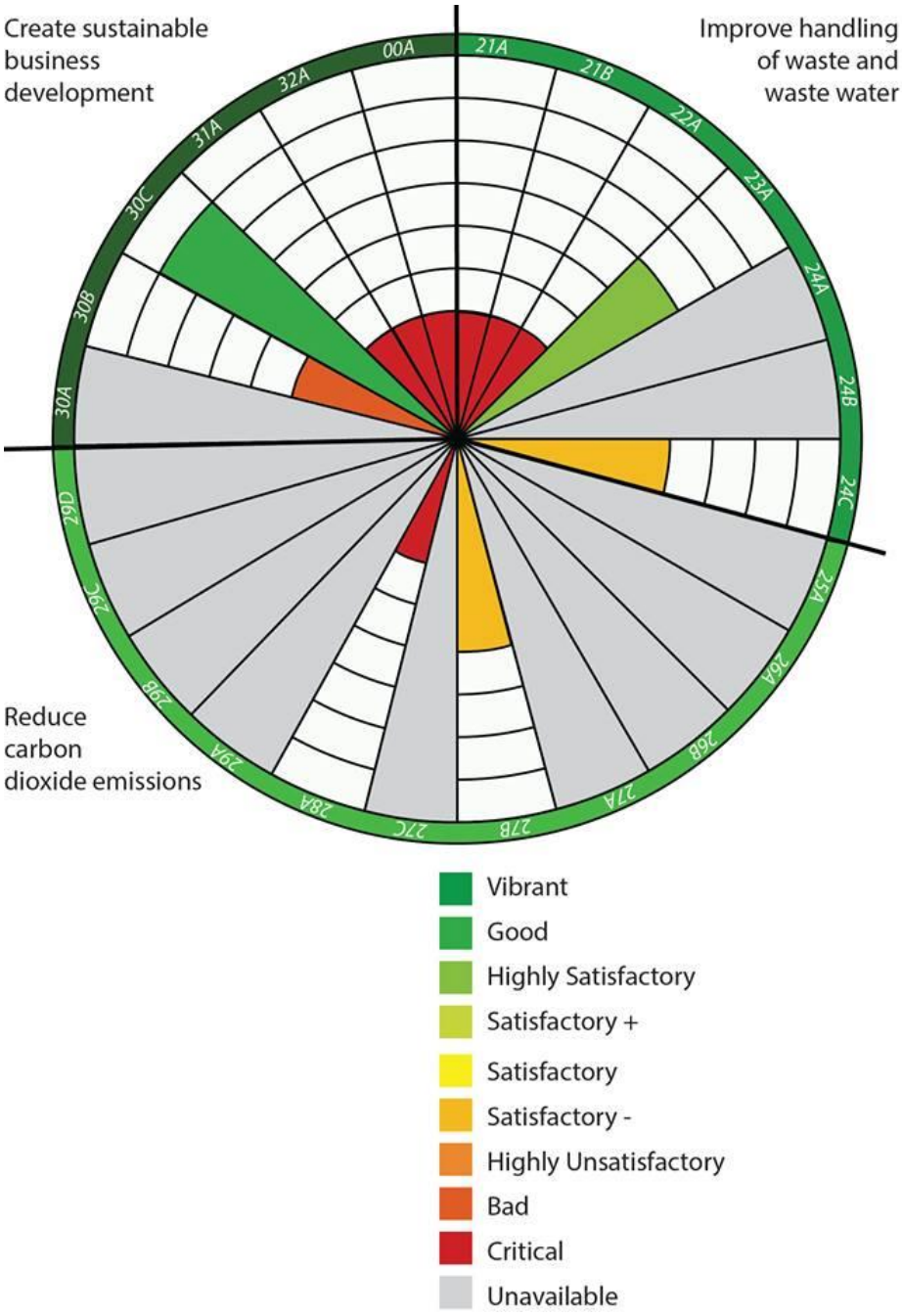

Figure 3: Maniitsoq urban environmental sustainability

3.2.5 Existing environmental conditions

i. Figure 3 shows that existing environmental conditions in the city do not comply with conditions described in the sustainability vision. Yet, the overall conditions in Maniitsoq are very similar to urban areas in Qeqqata municipality, around the

Greenland and in the Arctic region (Hermansen, 2014; Løgstrup, 2014). The overall result agrees with the Qeqqata municipality's mission to reduce the environmental impact, since all investigate areas can be and need to be improved.

ii. One part of the evaluated indicators reveal a very low performance or an absence of the activities such as harbor stakeholders association, composting, consumption of renewable energy, existing facilities for fisherman and hunters, and certification of environmentally friendly tourism and other businesses. However, the city is not an exception and similar situation is seen around Qeqqata municipality (Hermansen, 2014; Løgstrup, 2014).

iii. Another part of indicators uncover acceptable performance in household connectivity to sewage and usage of the harbor front. A satisfactory performance in coverage of collection points and percentage of roof covered bus stops.

iv. Availability of data is not sufficient to have a detailed assessment of the environmental dimension. Specifically, in the purpose area of reducing CO_2 emissions the required data to evaluate indicators is missing, unclear or never were monitored, even though the evaluated activities exist (Hermansen, 2014).

v. The developed assessment model for the assessment proved to work only when data for input was available. Also, as it was intended, the unevaluated indicators in the model indicate areas of the city which has not been subjected to detailed investigation.

3.2.6 Existing and future challenges

i. As mentioned earlier, Qeqqata municipality has committed itself to achieve sustainability by 2020. Yet, Figure 3 indicates that there are many environmental areas of the city that are in need of improvement. Therefore, the municipality faces challenge that requires a great deal of resources and a notable citizen's habit change.

ii. It is apparent, that some of the areas in Maniitsoq are more important than others e.g. indoor air quality versus water consumption per household, facilities for fishing and hunting equipment versus modal split. So, a priority question should to be answered in order to allocate available resources within the municipality. Also it is noteworthy, that the prioritization should include social, economic and institutional dimensions of sustainability, as they play essential role in conditions of the city.

iii. The results show that number of inputs and outputs of the city are not monitored. It means that at the moment real conditions of the city cannot be recognized and tracked over time. Hence, Maniitsoq city planners lack of complete information about the city to observe performance of completed projects and to base their decisions on up-to-date facts.

It could be concluded that acquired results, about Maniitsoq from the urban environmental assessment, indicate low environmental sustainability of the city. However, this study represents only a first endeavor to evaluate current state of Maniitsoq. The actual conditions and challenges may be slightly different and closely linked to other pillars of sustainability. These results nevertheless suggest that the monitoring and the evaluation may provide valuable guidance for existing condition assessment.

4. DISCUSSION AND CONCLUSIONS

In this study, the developed sustainability assessment model and acquired information about Maniitsoq allowed to assess current environmental conditions and challenges in the city. The assessment model covered three environmental purposes of the vision, namely improvement of waste and waste water handling, reduction of CO_2 emissions and establishment of sustainable business development. In addition, findings pinpoint an array of the missing data and issue areas in the city.

The results of indicators under the waste and waste water handling reveal current state of evaluated activities. Firstly, recycling in the city is still in an emerging state. At the moment only few metal and glass collection points are available in the city and as the field work revealed barely used. Also, a moderate sorting is done at the dump area to separate combustible materials for incineration. Secondly, composting of an organic matter has not taken place. Realization of these assets, for such an isolated place as Maniitsoq, would mean smaller land field and lower import expenses (Eureka Recycling, 2008), but would increase waste sorting cost and require a change in citizens' behavior. Thirdly, the connectivity of households to sewage in Maniitsoq is at acceptable level and exceeds other cities of Greenland (Hermansen, 2014). However, no water treatment system exists and waste water is discharged into the sea. The problem has been under a research for a couple of years, looking for a most convenient approach to handle the wastewater in cold environment and the solution is still to be find (Gunnarsdóttir, 2012).

Next set of indicators deals with monitoring goal to reduce CO_2 emissions. According to the sustainability vision (Qeqqata, 2014) the goal would be fulfilled by decreasing the need of fossil fuels through renovating houses, increasing alternative electricity production, usage of alternative transport modes, environment friendly products and local materials. Yet, only few of the listed activities are occurring and none are being monitored. Also, a focus on reducing CO_2 emissions seems hardly to be achieved in a near future, since most of the CO_2 is emitted from heating, fishing industries, geological surveys and transport sector between cities and settlements. At the moment, these activities have an established functioning systems in place and an advancement may not be economically feasible. On the other hand, the ambition to reduce CO_2 emissions may provide benefits such as reduction of fossil fuel dependency, it may create recognition among other municipalities and world widely as a modern society, where people think globally, act locally and are aware of human activity influence on a global climate change. Moreover, if gains of the reduction of CO_2 are properly communicated to the public, it may create an economic activity and spur the technological advancement of Maniitsoq community.

Third set of indicators provides an overlook of creating sustainable business development environmental conditions, specifically of fishing and hunting, tourism and entrepreneurship. At the moment, city's economy is sustained by Danish Grant and income from fishing and hunting sector, whereas tourism sector has not generated any significant outcome (Josefen, 2014). Notably, the economy driven by local activity is greatly supported and dependent on cities infrastructure, specifically the harbor area. It allows city to exploit marine resources around the island of Maniitsoq and together with the airport creates a traffic network. Thus, it is particularly important to monitor and evaluate these activities in order to be able to answer following questions what is the capacity of the marine resources and tourism sector? What is the optimum harvesting of living marine resources? Is the harbor area used in a most efficient way? How can we

better it? Finally, can economy of the city be based and sustained only by local businesses? Stakeholders of these matters are companies operating in the harbor, businesses in the city, citizens, individual fisherman and hunters, Qeqqata municipality and Greenland Self-Government. Practices show (IMO, 2014) that usually stakeholders form a harbor/ port association, which addresses and solves vital challenges concerning harbor areas. In case of Maniitsoq, such organization has functioned in the past, but due to unclear reasons it ceased to exist (Hermansen, 2014). Therefore, it is speculated that the existing concerns such as duty of deicing of inner harbor areas, unavailability of facilities for fishers and hunters and usage of existing quay may be a result of a lack of communication between stakeholders, since interviewed parties were not fully aware of these matters (Hermansen, 2014; Løgstrup, 2014).

It is well known that urban development and citizen activity impact degree on environment is closely linked to social, institutional and economical aspects of a city (sustainable development document). In case of Maniitsoq the last two decades has brought number of changes around these aspects e.g. decrease in population, unstable income from fishing and hunting sector, increase of unemployment, merger of Maniitsoq and Sisimiut municipalities, insufficient educational capacity and communication capacity between government institutions and the public and possibility of an aluminum smelter project (Josefen, 2014; Hermansen, 2014; Løgstrup, 2014). These local challenges together with global ones are addressed by sustainability vision. Yet, it is of importance that basic modern life needs would be fulfilled first, thus sustainability vision should prioritize and target areas which ensure an optimal exploitation of resources and desired quality of life through facilitating adequate training, improving housing conditions and creating positive city's image. Additionally, it may be advised to investigate a following question: what is the optimal population of Maniitsoq (Camagni, 2013)? The answer together with monitoring and assessment of all sustainability dimensions may provide basis for legitimate decision making in planning and development of the city. Further, recent studies show that seeing city as a harbor city together with creating positive city identity and image by highlighting uniqueness of a city helps to differentiate it from other cities, thus increasing competitive advantage and sustainable development possibilities (Daamen, 2007). The center city of the Qeqqata municipality Sisimiut has defined their image, whereas image and identity of Maniitsoq is not clearly stated, especially after the aluminum smelter project has slowed down. Yet, the image and identity of Maniitsoq may be adopted as a template from the aluminum project and used as a basis for developing new one.

This research is Arctic urban environmental sustainability assessment, which was carried out by developing a model of sustainability assessment. The study revealed that many challenges have to be overcome in order to achieve higher city performance on environmental sustainability. Obviously, this study has tackled only a small part of the complex urban system in Greenlandic context and more in depth research has to be conducted in order to have a complete picture of a city. Also, urban environments in the Arctic region stand out with their unique set of factors, which stresses the need of a different approach to develop a holistic sustainability assessment model. Thus, further research in this field, should focus on optimization of the model, especially indicators and their goals, establishment of urban activities monitoring, investigation of sustainability definition in the Arctic region and lastly exploration of possibilities and benefits of Greenland's cities positioning.

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