

Report on the workshop for the participatory evaluation of earthquake risk and resilience in Addis Ababa, Ethiopia

Report produced in the context of the GEM Sub-Saharan
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ACRONYMS

AACG	Addis Ababa City Government
BOLSA	Bureau of Labour and Social Affairs
BCP	Business Continuity Plan
DRP	Disaster Recovery Planning
FEPR	Fire Emergency Prevention and Rescue Authority
GEM	Global Earthquake Model
GFDRR	Global Facility for Disaster Risk Reduction and Recovery
HAZMAT	Hazardous materials and items
HFA	Hyogo Framework for Action
IFRCRCS	International Federation of Red Cross and Red Crescent Societies
MTPD	Maximum Tolerable Period of Disruption
MBCO	Minimum Business Continuity Objective
DRMFSS	Ministry of Agriculture Disaster Risk Management and Food Security Sector
NIMS	National Incident Management System
NGO's	Non-governmental organizations
RPS	Resilience Performance Scorecard
SAR	Search and Rescue
SOP	Standard Operational Procedures
UNISDR	The United Nations Office for Disaster Risk Reduction
USAID	United States Agency for International Development.
WB	World Bank

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1 PARTICIPATORY EVALUATION OF EARTHQUAKE RISK AND RESILIENCE IN ADDIS ABABA

Addis Ababa is the capital and the largest city of Ethiopia. It is home to 25% of the urban population in the country. This city is urbanizing and growing in an accelerated way, and it is considered the growth engine for Ethiopia (WB & GFDRR, 2015). Ethiopia is one of the world's fastest growing economies, (IFRCRCS, 2013) but is affected by droughts, floods, landslides, epidemics, pests, earthquakes and forest fires (ISDR & WB, 2009), due to its geographical characteristics. These events could hinder the achievement of the development goals of the country, and usually, impact the poor more severely due to pre-existing vulnerabilities and usually impact the poor more severely due to pre-existing vulnerabilities. The economy of Addis Ababa is growing annually by 14%, and it contributes approximately 50% towards the national GDP. Although the strong economic growth trends of the city, Addis Ababa faces unemployment, high poverty levels, and problems to access basic services (WB & GFDRR, 2015), factors that, among others, affect the community's resilience to extreme natural events.

The East African Rift System, where Ethiopia is located, is the most seismically active region of Sub Saharan Africa and damaging earthquakes with magnitudes greater than 6.0M have been recorded in this region (Midzi & Manzunzu, 2014). Cities have been expanding and growing over the years within Africa, and this growth has been mainly attributed to urbanisation and the need for rural people to seek a better quality of life in larger cities. Seismic risk, in turn, is aggravated by the presence of highly vulnerable buildings and structures which are being constructed without taking into consideration the potential for ground shaking. The result is that even moderate sized events occurring near to a highly populated city with many vulnerable buildings have the potential to cause devastating damage to buildings resulting in great economic losses coupled with the severe loss of human lives.

Addis Ababa is located 75-100 km away from the western edge of the main Ethiopian Rift Valley (WB & GFDRR, 2015). Given a scenario where an earthquake's epicentre is located at least 27km from the city, 15% of the buildings are likely to suffer collapse resulting in a high number of fatalities (UNISDR, 1999). On the 10th September 2016, a M_w 5.9 earthquake struck the northwest part of Tanzania near the western shores of Lake Victoria causing approximately 200 injuries. Destruction was not confined to Tanzania alone, but spread across the Northern border to neighbouring Uganda where several buildings collapsed. The earthquake was also felt in Rwanda and Kenya. While these events might not cause large economic losses compared to those recorded for more developed countries, the population in the region has been increasing over the past decades resulting in higher human losses.

It is expected that Addis Ababa doubles its population by 2030 and turns into a megacity of almost ten million people by 2037. The rate of growth puts pressure on the housing sector, mainly in the lowest income segments. Poor quality housing built in *chika* (wood and mud mixture) represents nearly 70-80% of the housing stock. This kind of houses includes informal housing and government-owned housing known locally as *kebele housing*, which was built and extended informally before and while under government ownership (WB & GFDRR, 2015). Construction methods for buildings have also evolved with time from traditional wood and mud structures with straw roofs. This kind of structures have a larger inherent resistance to ground shaking due to them being lighter in weight and more ductile, to more modern architecture of unreinforced masonry, which is heavier and more rigid making them more vulnerable to earthquake shaking. There is a high concentration of poor quality housing in peri-urban

areas, and some city neighbourhoods are comprised of low-quality settlements. Informal and government-owned are usually overcrowded, constructed of inadequate materials, and located in relatively higher-risk areas like river banks. Under these circumstances, the impact of a plausible earthquake in Addis Ababa could be devastating (WB & GFDRR, 2015).

To measure, communicate and ultimately reduce earthquake risk, more needs to be undertaken besides hazard analysis and loss estimation for risk assessments. One way of taking it a step further is the development of disaster resilient communities by governments, researchers and stakeholders to enhance the capacity of those communities to recover from earthquake impacts within the shortest possible time. Resilience, for the purposes of this report is defined as “the ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, through the preservation and restoration of its essential basic structures and functions” (UNISDR 2009). It is becoming increasingly clear that the ability to measure resilience is a key step towards disaster risk reduction. While numerous communities have sought to explain the determinants of disaster resilience, differences in perceptions among the community on natural hazards, however, have been barely reported (Hajito, Gesesew, Bayu, & Tsehay, (2015).

The ten essentials for making cities resilient are (Molin, Rego, Scott, & Valdés, 2012):

- Essential 1: Institutional and administrative framework
- Essential 2: Financing and resources
- Essential 3: Multi-hazard risk assessment- know your risk
- Essential 4: Infrastructure protection, upgrading, and resilience
- Essential 5: Protect vital facilities: education and health
- Essential 6: Building regulations and land use planning
- Essential 7: Training, education and public awareness
- Essential 8: Environmental protection and strengthening of ecosystems
- Essential 9: Effective preparedness, early warning, and response
- Essential 10: Recovery and rebuilding communities

Overall, building resilient communities involves proper planning to avoid the generation of new risk and mitigation measures to reduce the existing risk and its long-term impact. For this to happen, active participation of all sectors of society, from the authorities to the public, is required.

1.1 Objectives

An essential step to understand and enhance the resilience of cities to earthquakes is to measure the concept. Measurement is vital not only to evaluate and benchmark the baseline conditions of what makes communities resilient but also to help communities to understand the factors that lead to losses and the differential ability of populations across and within communities to recover when damaging events occur. To address this, GEM and the United States Agency for International Development (USAID) collaborated to facilitate the Resilience Performance Scorecard (RPS) workshop in Addis Ababa, Ethiopia. The RPS is a multi-level and multi-scale self-evaluation tool that empowers stakeholders to assess earthquake resilience parameters based primarily on qualitative information. Here, an interactive voting system is used in a workshop setting to identify priorities where activities may be pertinent for earthquake risk reduction or where existing initiatives may be improved to increase earthquake resilience in different sectors of society. Six dimensions of earthquake resilience are encompassed to address key areas that mainstream risk reduction namely; planning and decision-making processes,

social capacity, awareness and advocacy, legal and institutional arrangements, planning and regulation, critical infrastructure and services, and emergency preparedness and response.

The purpose of the RPS is to provide a tool that can capture the key functional and organizational areas of opportunity for urban resilience enhancement with local government officials and community leaders as the targeted decision-making body. The implementation of the Scorecard in Addis Ababa required engagement with local stakeholders for the design of the indicators (questions) and targets (answer schemes) of the Scorecard. It was anticipated that the Scorecard approach would provide a “broad brush” assessment to enable local policy makers and communities to establish priorities for more in-depth analysis, to allocate funds, and to develop emergency and disaster management programs more effectively.

The RPS was adjusted to the context of a Sub-Saharan African city and administered for the Addis Ababa Metropolitan area in a workshop that spanned two days (June 28 – 29, 2016). The workshop was held with two different groups of participants: 1) sub-city representatives from Addis Ababa and 2) municipal, federal and NGO representatives from different departments concerned with Disaster Risk Reduction and Management within the city. Each group was surveyed with the help of a local facilitator. The facilitator ensured that all questions were adequately understood, misinterpretation was minimized, and discussions were steered and targeted.

The use of the RPS was intended to help stakeholders (city official and community representatives) to identify the degree to which they would be able to build their resilience by identifying gaps and opportunities for resilience enhancement (UNISDR, 2012a). Thereby giving them a means to:

- foresee and/or acknowledge threats and risks;
- better understand and identify key gaps in earthquake resilience at the community and institutional level within their city;
- facilitate discussion between community leaders, stakeholders, and officials regarding their seismic risk and resilience;
- work with emergency services and other agencies on earthquake risk reduction;
- create an agenda to foster the development of detailed risk and resilience assessments based on the identified gaps that could lead to the construction or update of resilience management strategies;
- create benchmarks for monitoring and evaluating resilience and earthquake risk reduction;
- have a sense-of-community and social capital and
- Take collective responsibility to reduce the impacts of damaging earthquake events.

The remainder of this report is organized as follows. Sub-section 1.2 presents the study area and its exposure to earthquake events. Section 2 provides the methodology used for the analysis of resilience. Section 3 delineates the results obtained for each question using the scorecard approach, Section 4 presents an analysis of the results by the dimensional driver of resilience, and Section 5 presents activities and projects that could be of interest to reduce risk and improve the earthquake resilience of Addis Ababa.

1.2 The Metropolitan City of Addis Ababa

Addis Ababa is the capital city of Ethiopia. The city is in the region of Oromia highlands bordering the Great Rift Valley and is the country’s commercial and cultural hub. In 2016, the population of Addis Ababa was approximated as being 3.6 million. Addis Ababa has the status of both a city and a state, and the city is divided into ten boroughs called sub-cities. The city has recently been in a construction boom

with many high-rise structures being built all over the city. The location of the city could be appreciated in Figure 1.

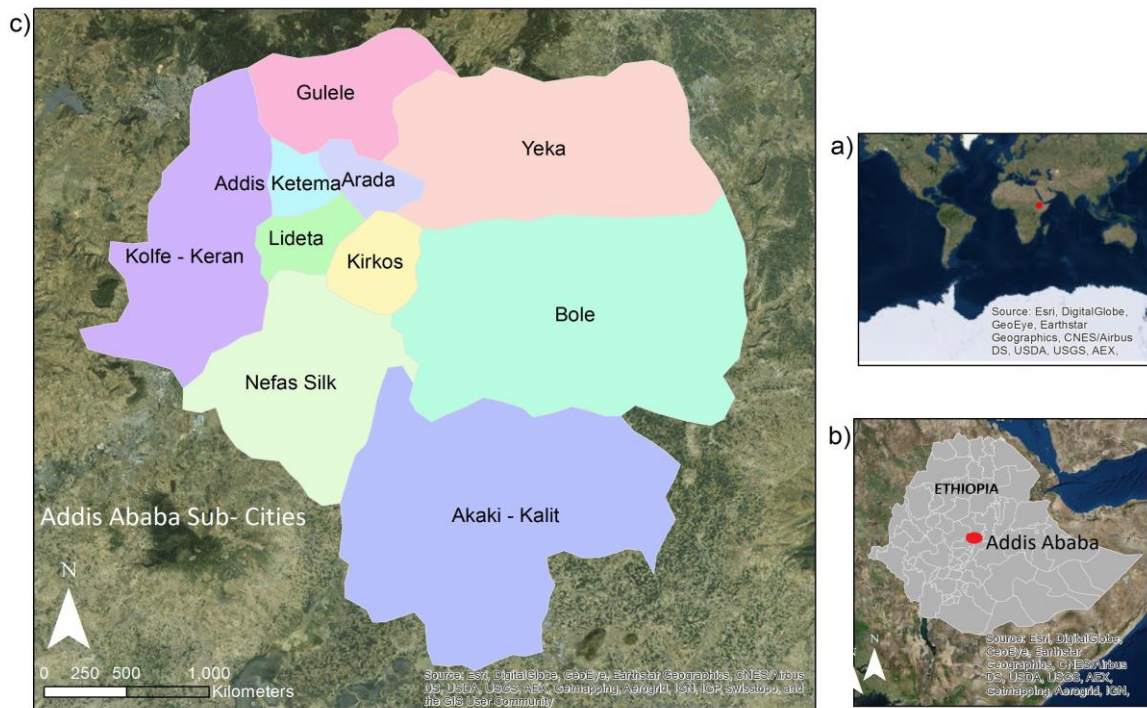


Figure 1 Location of Addis Ababa (Ethiopia).

- a) Location of Ethiopia in the world, b) Location of Addis Ababa in Ethiopia and c) Sub-cities in Addis Ababa.

1.2.1 Seismic risk of Addis Ababa

Damaging earthquakes with magnitudes greater than 6 occur almost annually in the East African Rift. To date, five earthquakes measuring 7M and above have occurred in eastern Africa since 1900 (Kebede & Kulhanek, 1991). The level of seismic activity in Ethiopia is considered moderate. The most recent earthquake event in Ethiopia occurred on 16 January 2016, which had a magnitude of 4.5 at a depth of 10 km. This earthquake struck the city of Hawassa, located in the Southern Nations, Nationalities, and People's Region. It is reported to have resulted in about 150 people being injured. Seismic events of moderate magnitudes have occurred near to Addis Ababa. The distribution of events from the homogenised earthquake catalogue of the Sub-Saharan Africa Seismic Hazard Project carried out by GEM in partnership with Africa Array, and USAID is depicted in Figure 2. Individual countries have their own models but are yet to be homogenised together to cover the African continent. The use of this regional model in this instance helps to view more holistically, which events near or outside of Addis Ababa and Ethiopia may have a potential threat to the capital city.

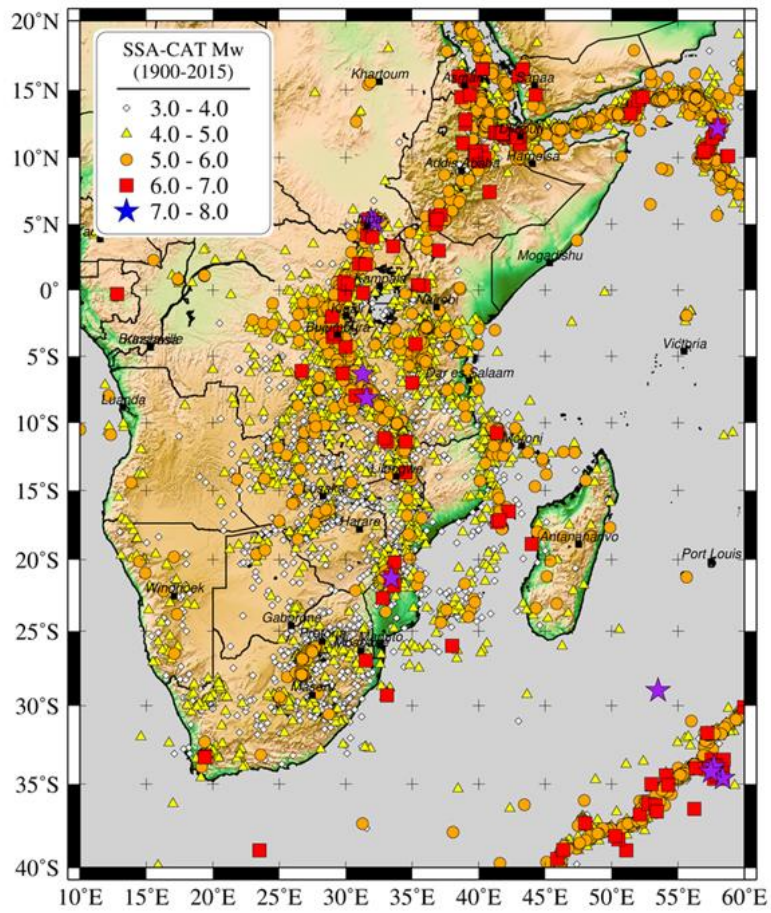


Figure 2 Distribution of events from the homogenised SSA earthquake catalogue.

Source: Poggi, V., Durrheim, R., Mavonga, T. G., Weatherill, G., Pagani, M., Nyblade, A., & Delvaux, D. (2016).

2 METHODOLOGY

2.1 The Resilience Performance Scorecard (RPS)

In line with the "building resilience in nations and communities" goal of the Hyogo Framework for Action HFA (now the Sendai Framework for Disaster Risk Reduction), the RPS was developed in collaboration with local stakeholders and experts on disaster risk reduction. The main aim was to address resiliency of key dimensions within a city's communities and its government's functional and operational activities. Six dimensions that mainstream risk reduction into planning and decision-making processes at the local level were identified:

1. Awareness and Advocacy. It represents the level of awareness and knowledge of earthquake risk within communities and among communities leaders and public institutions.

2. Social Capacity. It is related to the capacities of the population to prepare, respond and recover from a damaging earthquake.

3. Legal and institutional arrangements. It corresponds to the mechanisms available to advocate earthquake risk reduction in the city.

4. Planning, regulation and mainstreaming risk mitigation. It is related to the commitment and mainstreaming of disaster risk reduction through regulatory planning tools in the city.

5. Emergency preparedness, response, and recovery. It reflects the effectiveness and performance of the risk management system of the city of response and recovery in case of emergencies.

6. Critical services and public infrastructure resilience: that correspond to the capacity of lifelines and critical facilities to react and respond during and after earthquake events.

These six key areas of the RPS are closely aligned with the UNISDR's 10 Essentials of a Resilient City (UNISDR, 2012b). The Scorecard's main aim is to track progress on the mainstreaming of risk reduction approaches in a city's organizational, functional, operational and development systems and processes. It also seeks to address issues to do with urban resilience and does so at multiple levels of geography or administration divisions. The urban resilience goals are divided into three strategic goals as shown in the chart Figure 3. Each of the strategic goals corresponds to one or more likely key dimensions analysed in the Scorecard where these goals are to be implemented. The connection between the six key dimensions to one or more of the ten Essentials is depicted in Figure 3. Furthermore, several questions that were developed for the Scorecard correspond to each of the six key areas of urban resilience.

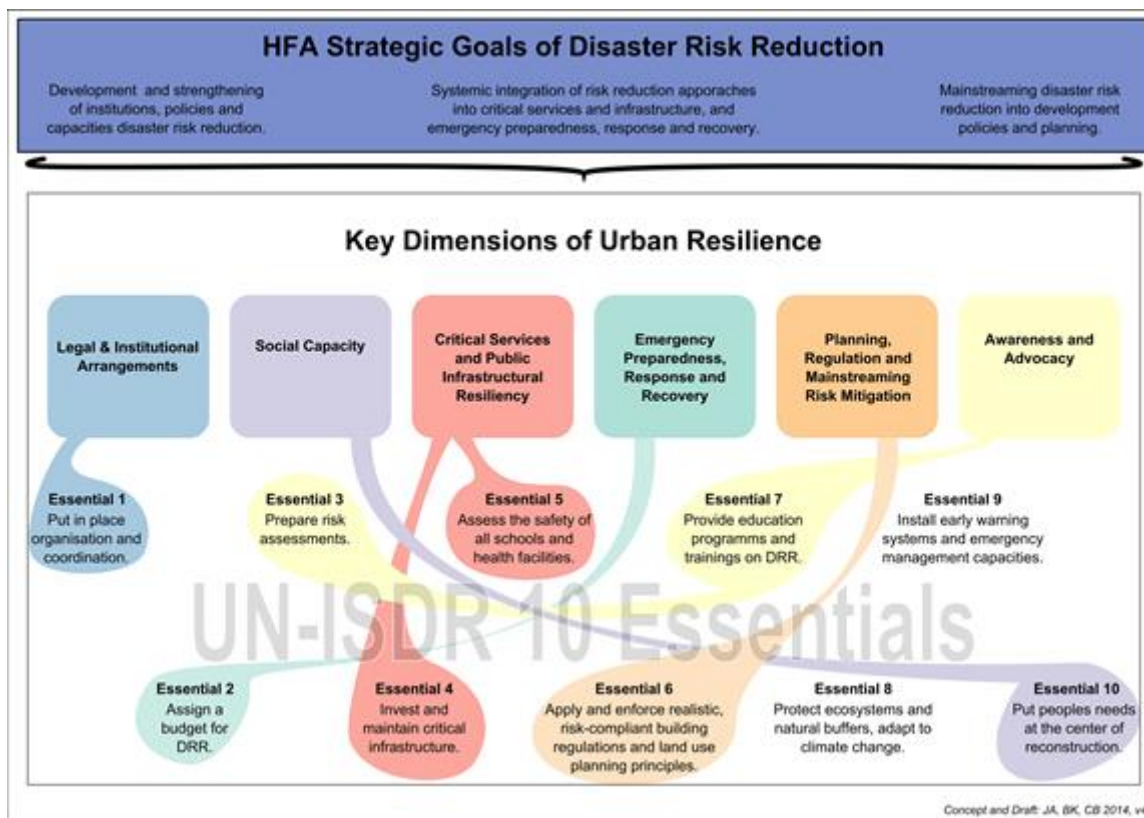


Figure 3 Key dimensions and essentials of urban resilience.

Adapted from Anhorn, J., Burton, C., & B. Khazai (2014)

While the key dimensions of the scorecard are consistent across different scales, some indicators (questions) and targets (answer schemes) along each of the themes within the six dimensions were adjusted to represent the appropriate scale. For example, to ensure relevance to the local context, targets (answer scheme) and indicators (scorecard questions) for measuring urban resilience for each of the six key areas were adjusted to represent the proper scale of analysis. These adjustments were based on in-depth interviews with various stakeholders such as academia, urban planners and urban planning associations, community development associations, city and local officials, national and international NGOs and relief and response organizations.

It was within this context that the initial scorecard for Addis Ababa City was done collaboratively with the Addis Ababa City officials, community leaders, and other stakeholders to understand potential gaps in resilience, in which measures could be put in place to fill those gaps, and identify critical areas where further analysis would be needed.

2.2 Structure of the Scorecard

The purpose of the development and application of the RPS is to provide a tool that can capture the key functional and organizational areas for urban resilience with communities and local government officials as the targeted decision-making body (UNISDR, 2014). In this regard, the structure of the Scorecard was developed considering the dimensions listed in the sections above. Moreover, each dimension was divided into a set of indicators (questions). Specific questions of the scorecard can be adjusted for the local context of the area being analysed. It is within this context that the dimensions, indicators and

brief explanations of them are detailed in Table 1 to provide a guideline for the development of a scorecard to represent the needs of the city being analysed.

The indicators considered for each dimension and their rationale are listed in Table 1.

Table 1 Rationale of the indices adopted for resilience assessment Valcarcel et al. 2016.

Indicators	Rationale
Dimension: awareness and advocacy	
Level of awareness and knowledge of earthquake risk	Inform population may demand the development of risk mitigation projects and may participate in emergency response activities.
Information about earthquake safety, preparedness, and risk reduction.	Adequate channels and mechanisms of communication facilitate the dissemination of relevant information for risk identification, mitigation, and emergency response.
Public outreach activities informing about disaster safety, preparedness and risk reduction	Meetings, presentations, and events regarding earthquake risk allow stakeholders to disseminate relevant information for vulnerability reduction and emergency response. Also, such meetings are useful to raise awareness and create community groups working for their seismic safety.
Training and capacity building programs to increase technical and professional resources for earthquake risk reduction	Trained persons will demand and lead the development of risk mitigation activities within their communities.
Dimension: social capacity*	
Healthcare and social assistance programs available for vulnerable groups	Healthcare providers, including physicians, nursing homes, and hospitals, are important post-event sources of relief.
Ties and connections between people	A community with strong ties is more likely to create organisations and working-groups for risk reduction and emergency response, or to depend on each other for earthquake response activities and recovery.
Social integration considering different economic levels	The socioeconomic status of communities determines the ability to absorb losses and enhance resilience from hazard impacts. Wealth enables communities to absorb and recover from losses more quickly due to insurance and social safety nets. Those people who are dependent on social services for survival are already economically and socially marginalised and require additional support in the post-disaster period.
Social integration of minority populations	Race and ethnicity impose language and cultural barriers that affect access to post-disaster funding and residential locations in high hazard areas.
Access to electricity gas and clean water	The lack of access to sewers, water, gas, infrastructure represents a condition of vulnerability and marginalization.
Primary education	Education is linked to socioeconomic status, with higher educational attainment resulting in greater lifetime earnings. Lower education constrains the ability to understand warning information and access to recovery information lower education constrains the ability to understand warning information and access to recovery information.
Interaction between formal and informal institutions	Strong interactions between formal (governmental) and informal institutions could facilitate the development of risk mitigation projects and emergency response plans that include citizen participation.
Participation in decision making	Formal mechanisms of participation of community leaders in decision making allow the incorporation of community needs in programs for disaster risk management.
Protection of historic buildings and cultural heritage	The protection of cultural values and heritage is a key aspect to preserve the identity of communities.
Dimension: legal and institutional arrangements	

Indicators	Rationale
Regulations, ordinances, or incentives for earthquake safety and risk reduction	Legal instruments such as regulations and ordinances usually establish responsibilities, duties, plans, concepts, strategies and priorities. Therefore, such instruments facilitate the coordination between public institutions, communities and the private sector regarding the development of risk mitigation projects and emergency response activities.
Community leaders with roles and responsibilities for Disaster Risk Reduction	Formal mechanisms of participation of community leaders in decision making allow the incorporation of community needs in programs for disaster risk management.
Mechanisms of coordination and cooperation for disaster preparedness, safety and risk reduction	
Confidence in the central and local government and non-governmental institutions to prepare for, respond and recover from a damaging earthquake	Confidence in the government facilitates the use of public resources and the participation of communities in the development of risk management programs.
Dimension: planning, regulation and mainstreaming risk reduction	
Earthquake resistant building construction codes	Building codes and their implementation reduces the construction of structures highly vulnerable to earthquake events.
Reinforcement and retrofitting of private infrastructure	The retrofitting of private infrastructure mitigates the physical vulnerability of (residential, commercial) buildings, reducing potential damages and losses in case of events.
Availability and use of earthquake insurance	The use of insurance regarding earthquake risk favours the availability of economic resources for recovery and reconstruction activities.
Availability of funding for disaster risk management plans or earthquake mitigation programs	The availability of financial resources facilitates the development of risk identification and mitigation programs.
Dimension: emergency preparedness, response, and recovery	
Population storing goods to be used in case of disasters	Population storing goods will have access to resources required to guarantee minimal conditions of living in emergency situations. Such population will not depend entirely on the aid and support from the community, the government and public institutions.
Local centres for implementing and coordinating emergency response and management	Centres with adequate resources for emergency coordination facilitates the decision-making process during crises, providing a common space for the communication and the interaction between different actors (public, private institutions, and communities) as well as the access to essential services for people participating in the management of emergencies.
Standard operational procedures for coordinating emergency rescue and response activities	In the case of emergency, protocols and procedures for emergency response are used to define the required participants and resources as well as their roles and responsibilities.
Funds for emergency preparedness, response and recovery operations	The availability of funds for emergency response facilitates a prompt assistance to the affected population, as well as the repair and reconstruction of infrastructure damaged.
Human resources for emergency preparedness, response and recovery operations	The availability of human resources and equipment favours a prompt and effective response in case of emergency.
Equipment for emergency rescue, response, and clean-up operations	
Response plan for post-earthquake emergency operations	Plans for post-earthquake emergency operations are useful to define responsibilities and resources required for a prompt and effective response.
Dimension: critical services and public infrastructure resilience	
Assessment, reinforcement, and retrofitting of critical public infrastructure	Facilities such as schools, hospitals, and critical infrastructure such as lifelines provide important services to communities in normal

Indicators	Rationale
Structural improvements to reduce seismic risk in lifelines	conditions as well as in the case of emergencies. Therefore, the reduction of the structural and non-structural vulnerabilities of such buildings and infrastructure could be promoted to guarantee their operation and functionality during and after earthquake events.
Business continuity plan of local government offices for the aftermath of a damaging earthquake	Business continuity plans are used to guarantee the operation and functionality of governmental offices after emergencies and earthquake events.
Plans for the repair or replacement of critical lifelines in the aftermath of a damaging earthquake event	The implementation of plans for recovery and reconstruction of lifelines facilities a prompt restoration of the services affected, by defining responsibilities, functionality targets and financial resources required.

Adapted from Cutter et al. (2003).

2.3 Scoring system

For each indicator (questions), a set of targets (answer schemes) were established in to understand gaps in earthquake resilience in a city's communities and its organizational, functional and operational systems and processes. In this sense, the implementation of the Scorecard requires engagement into a preparatory process where the local context is identified for the design of the indicators (questions) and targets (answer schemes) of the Scorecard. The targets were initially defined by using four main categories (Khazai et al., 2015)(Anhorn et al. 2014):

1-Almost none. "Little or no awareness" This level represents little or no awareness, understanding, and mainstreaming of disaster risk within a community or a city. There is no institutional policy or process for incorporating risk reduction within the functions and operations of the city or its communities. Additionally, in some cases, there is an adverse attitude and adverse institutional culture towards adopting measures to reduce risk. Thus, significant resistance is expected from any risk reduction initiative potentially resulting in greater vulnerability and higher losses in the future.

2-Low. "Awareness of needs" This level refers to an early stage of awareness. The city or community has a growing level of awareness, and there is support for disaster reduction among the policy makers. The city and its communities may have activities, and dedicated efforts for preparedness but these are simply limited to response. Support is limited and does not necessarily carry through at all levels of the local government; resistance to change is expected at various levels where "business as usual" is judged sufficient. In general, the city/communities have no established policy, guidelines or system for mainstreaming, and action will be needed at the highest level to establish such policies and systems. This level is expected not to result in risk reduction in the long term. Vulnerability to earthquakes under these circumstances may increase.

3-Moderate. "Engagement and Commitment". This third category refers to a high level of engagement and commitment to Disaster Risk Reduction (DDR) by the institutions involved. However, the policies and systems have not been fully established yet. The city/community may not have a deep understanding of the mainstreaming process and requirements, and there may still be limited capacity to increase resilience, but overall there is a willingness to take some action; commitment for change, and to shift from response only to mainstreaming DRR. There may be "pockets of resistance," to mitigation and DRR planning but these are expected to be overcome with time.

4-High. "Full integration" This level refers to a situation where risk reduction and resilience is fully absorbed into planning and development processes as well as core services. The city/community places high importance on reducing disaster risks in a sustainable program of action at multiple levels and

within multiple sectors, and there is a comprehensive demonstration of practice. This level describes a situation where disaster risk reduction is “institutionalized”. However, this is not to suggest that an optimum level of attainment has occurred: there is still a need for further progress. The process of mainstreaming should be viewed as open-ended: while organizations should aim to achieve this level, they should also aim to make continuous improvements to their approach.

Within these levels, graduated variations of the following topics were also considered:

- The level of implementation of risk reduction, emergency response and recovery plans.
- People are participating in disaster risk management programs.
- Availability of mechanisms of information, coordination, and communication.
- The frequency of and participation in risk management activities.
- Coverage of risk management programs, lifelines, and critical services.
- Availability of resources for risk mitigation, emergency response, and recovery.

For the sake of simplicity, numerical values (1 to 4) were assigned to each category. A score for each question (Sub City/ local authority) was calculated by using linear max-min normalization and the average results obtained by the correspondent participants as described in Equation. 1

$$SI_{i,j} = \frac{max - avg}{(max - min)} \quad \text{Eq.1}$$

Where $SI_{i,j}$ is the score of the index i and dimension j ; max corresponds to the maximum score (4), min corresponds to the minimum score (1) and avg corresponds to the average of the participants’ results. A score for each dimension was obtained as the average of the scores obtained for the corresponding indicators. By using such a normalized scale, results close to 0 represent a very low resilience (almost none), and values close to 1 represent a high resilience.

In this way, the aim was to collaboratively develop and implement an initial scorecard that can guide the city of Addis Ababa and other stakeholders in understanding potential gaps in resilience, in which strategies can be put in place to fill those gaps, and research can be applied to critical areas where further analysis is needed.

2.4 Workshop setting and participants

The workshop spanned two days from June 28th - 29th 2016. The workshop was held with two different groups of participants concerned with Disaster Risk Reduction and Management within the city: 28 community representatives from each of Addis Ababa’s 10 Sub-Cities and 21 Municipal and Federal representatives from different departments. The questions were translated into the local language of the people. Specifically, Amharic and examples from Addis Ababa were used. Each group were surveyed with the help of a local facilitator. The facilitator ensured that all questions were adequately understood, misinterpretation was minimized and discussions were steered and targeted. Answers were transferred from each participant using remote controllers to a base station. Thus, all participants transmitted their answers in time and completeness was ensured. The images of the RPS workshop in Addis Ababa are presented in Figure 4.



Figure 4 Resilience Performance Scorecard Workshop Participants.

Two sessions were utilized to capture the scores of each group independently, and a final session of discussion and comparison of results was conducted. It was anticipated that the scorecard approach would enable local policy makers and communities to establish priorities for more in-depth analysis, to allocate funds, and to develop emergency and disaster management programs more effectively. The use of the scorecard helped to identify the degree to which communities build their resilience because they can identify gaps and opportunities for resilience enhancement. The latter allowed communities to: 1) foresee and/or acknowledge threats and risks; 2) work with emergency services and other agencies on earthquake risk reduction; 3) have a sense of community and social capital; and 4) take collective responsibility to reduce the impacts of disruptive events and disasters.

3 EVALUATION OF EARTHQUAKE RESILIENCE IN ADDIS ABABA

3.1 Awareness and Advocacy

The objective of this theme is to identify the level of awareness and knowledge of earthquake risk in community leaders and public officials. This theme encompasses the perception of the population regarding earthquake risk, the information available regarding earthquake safety and the development of training to increase abilities to identify and respond in case of earthquakes. Perception towards disasters depends on being a victim or not, gender, ethnicity, spatial location, magnitude, the degree of the hazard (extent, level, and duration) and the capacity of the community (Aboagye, Dari, & Koomson, 2016). In Jimma, the largest city in south-western Ethiopia, 22.5% (n=309) of the sampling population of the study carried out by Hajito et al.(2015) reported to have experienced an earthquake.

3.1.1 Level of awareness and knowledge of earthquake risk

The scoring for both community leaders and governmental officials regarding the level of awareness and knowledge of earthquake risk in Addis Ababa is presented in Figure 5. It is interesting to see the significant difference in the results. While government officials consider that more than one-third of the population have high or moderate levels of risk awareness, community leaders express that almost 90% of the population have very low or non-existent level of risk awareness. Overall, the results show clearly the need to increase risk education among the city’s population.

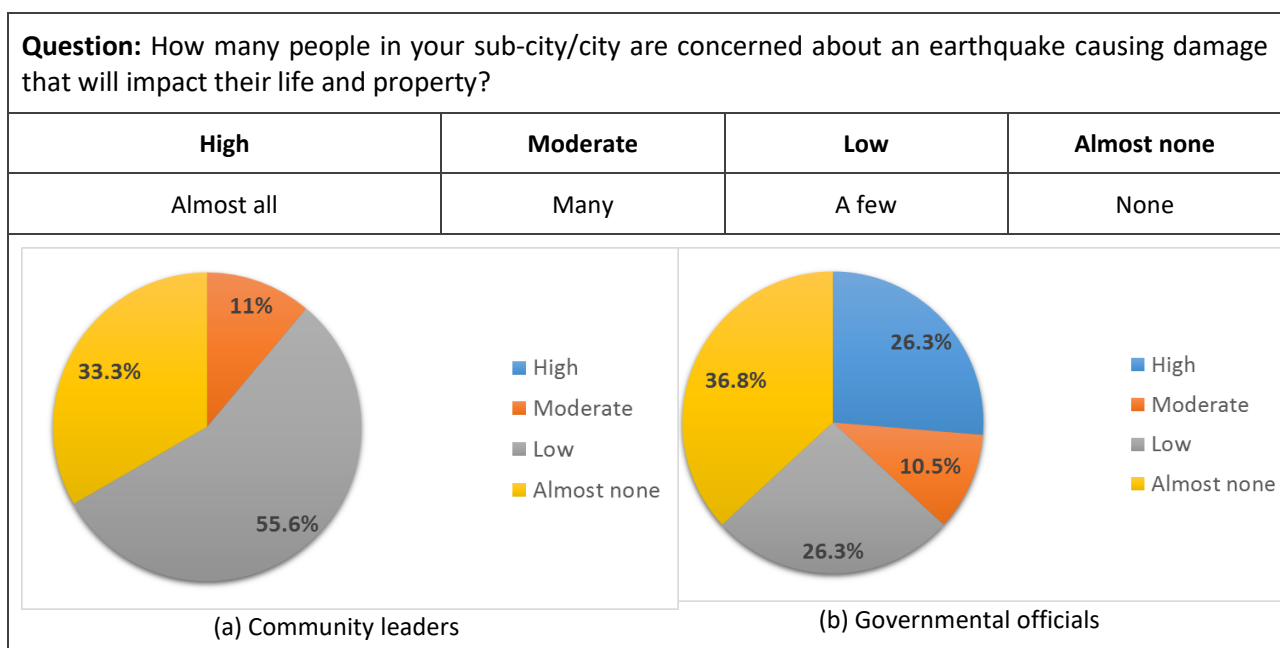


Figure 5 Level of awareness and knowledge of earthquake risk.

These results for Addis Ababa are in sharp contrast with levels of awareness regarding other hazards (floods, droughts, disease outbreaks and car accidents) measured in Jimma, which according to Hajito et al. (2015) are about 85%. Even the relatively high levels of awareness observed in Jimma may not be enough to result in tangible actions. According to the Red Cross, some of their respondents in Jimma still consider disasters as “God’s punishment.” Although awareness does not always lead to action; it is a precursor for desired actions, such as high level of disaster preparedness and better coping ability (UN, 2008).

Although several studies have demonstrated that older people, due to their long experience, are more aware of the consequences of the disasters than younger people, Hajito et al. (2015) observed in Jimma, that young respondents (ages 18-24) have higher awareness levels than older adults (>50 years).

3.1.2 Information about earthquake safety, preparedness, and risk reduction

An evaluation of the availability and reach of information on earthquake safety, preparedness, and risk reduction is depicted in Figure 6. 80% the community leaders believe that information is not available. In the case of the governmental officials, more than half of them considered the availability of such information to be low (57.9%). The scarce availability of information suggests that there might not be any information, or else it exists, but it is disseminated neither among the public nor within the governmental officials. Only those working directly in earthquake risk management might be more familiar with the existence of such material. The results show that more needs to be done to develop, promote, and improve communication mechanisms to the public.

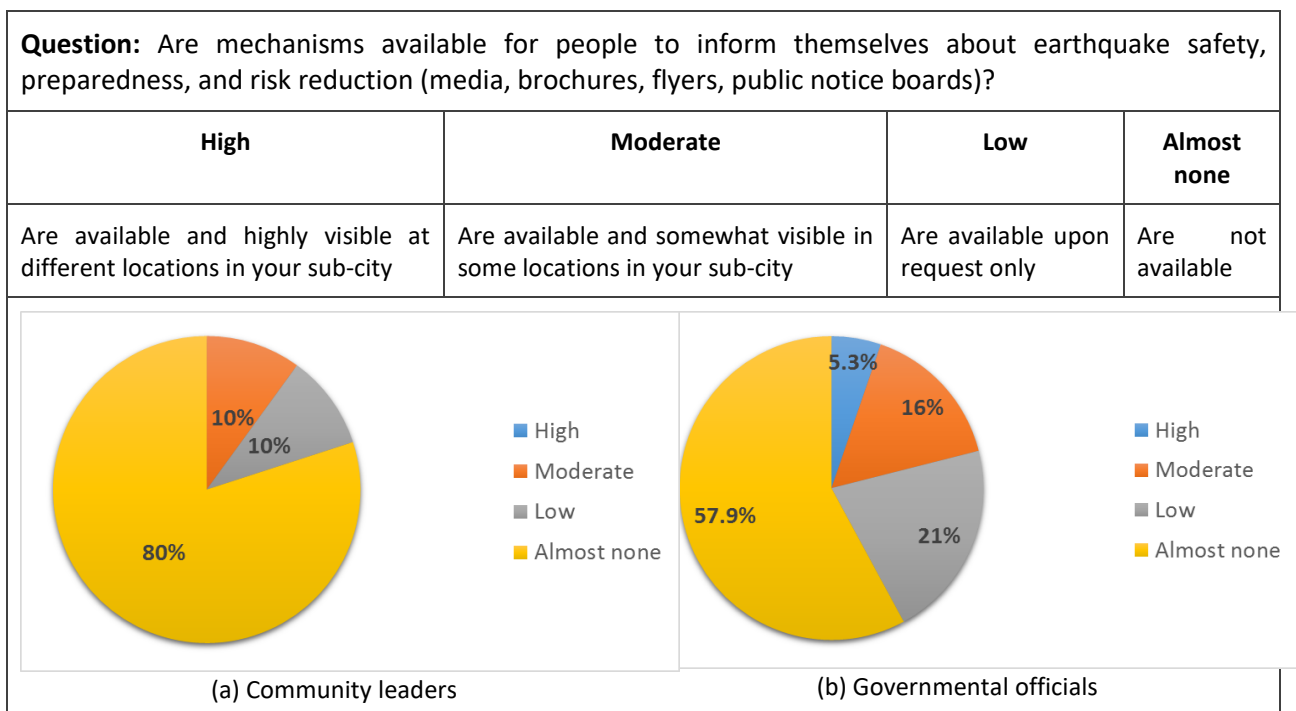


Figure 6 Information about earthquake safety, preparedness, and risk reduction.

In the case of Jimma, it was found that the major sources of information about hazards are relatives or acquaintances, followed by radio broadcasting and health practitioner (Hajito et al., 2015).

3.1.3 User-oriented convenience of information provided on earthquake safety

Figure 7 is directly linked to the previous question on availability of information on earthquake safety but captures how the information is presented (different languages which exist within the country). Again, the results show that more needs to be done to develop, promote, and improve communication mechanisms to the public.

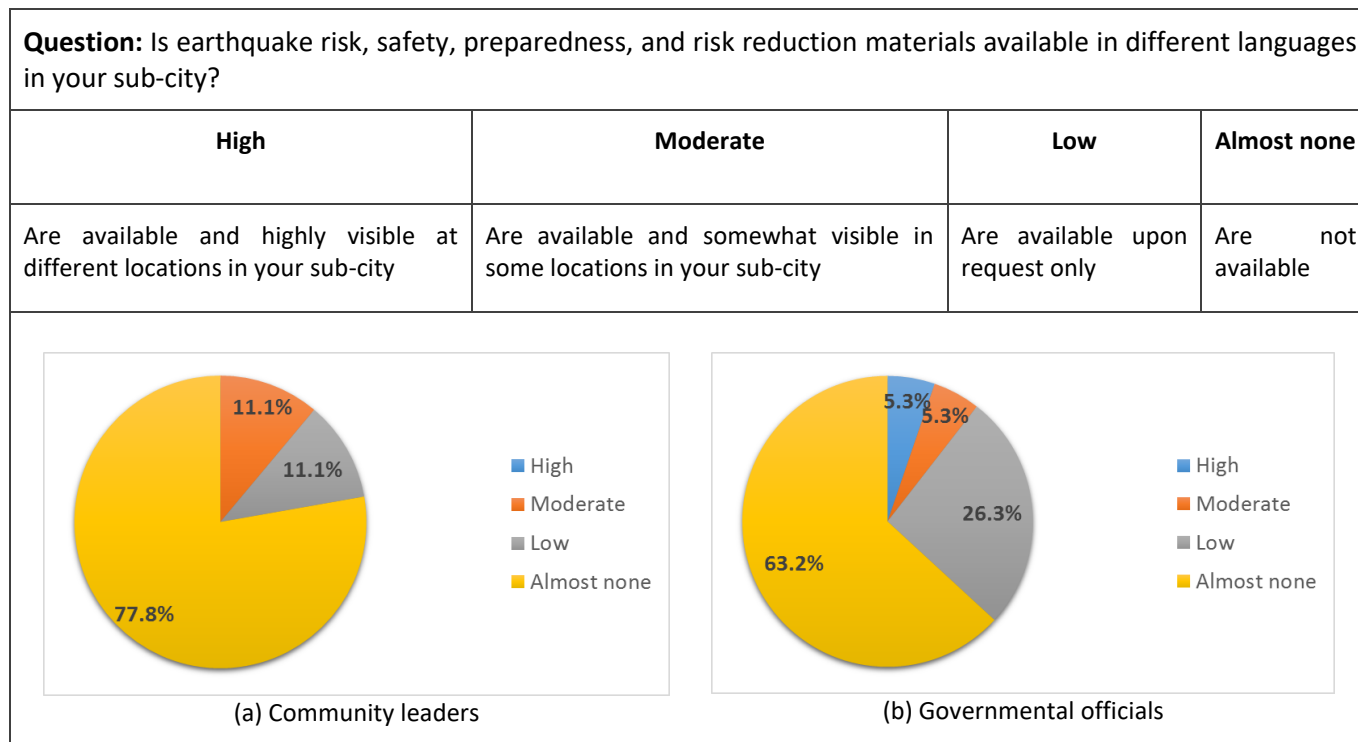
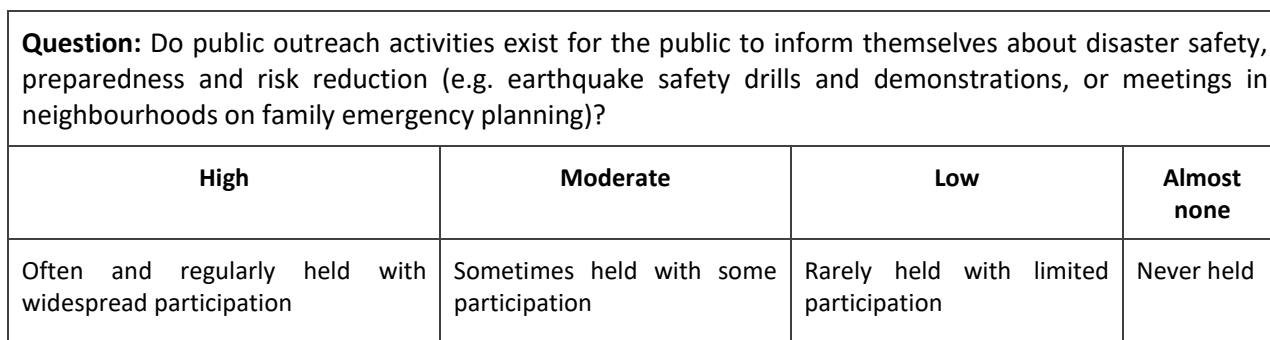


Figure 7 User friendliness of information provided on earthquake safety.

3.1.4. Public outreach activities

The distribution of scores that pertain to public outreach activities to inform disaster safety, preparedness and risk reduction is depicted in Figure 8. Both government officials and community participants characterized such activities as low and almost non-existent (>80% in both cases). Efforts are still necessary to inform a wider audience about what is being done to increase disaster safety, preparedness, and risk reduction and about the role of the community in supporting those efforts.



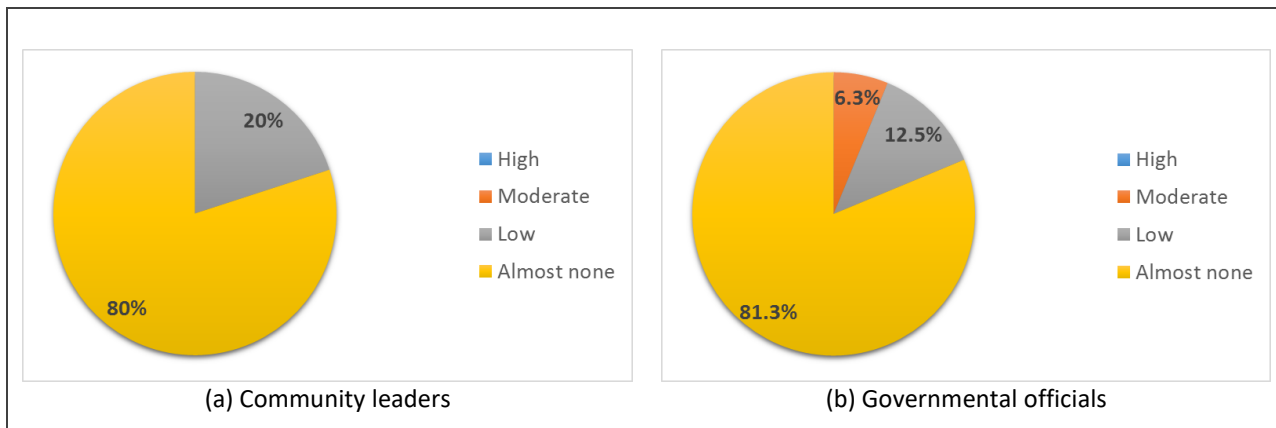


Figure 8 Public outreach activities.

3.1.5. Participation in public outreach services

The scoring of community leaders and local government representatives regarding their participation in public outreach services about disaster safety, preparedness, and risk reduction is presented in Figure 9. The community leaders and the governmental officials seemed to agree (60% vs 78.9% respectively) on acknowledging their almost-null level of participation in outreach activities on disaster safety, preparedness, and risk reduction.

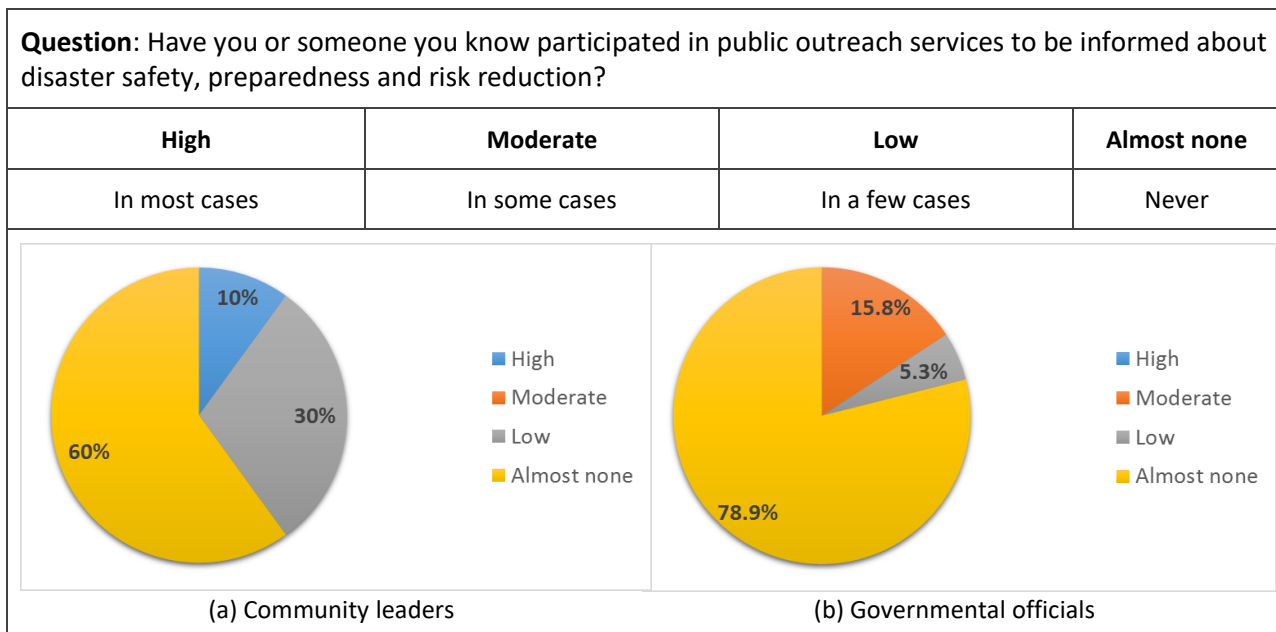


Figure 9 Participation in public outreach services.

It is necessary to implement the framework developed by the government for engaging communities. These can be achieved by leveraging informal initiatives and support formal ones. There are informal initiatives at the sub-city and community level for service delivery. It includes building capacity among city officials and community members and improving coordination, rather than maintaining fragmented initiatives (WB & GFDRR, 2015).

3.1.6. Training and capacity building programs

The scoring distribution for the prevalence of training and capacity building programs to increase technical and professional resources for earthquake risk reduction is presented in Figure 10. 100% of the community representatives and about 85% of the government officials concurred that no good programs existed for capacity building and that a few limited ones are offered only sporadically.

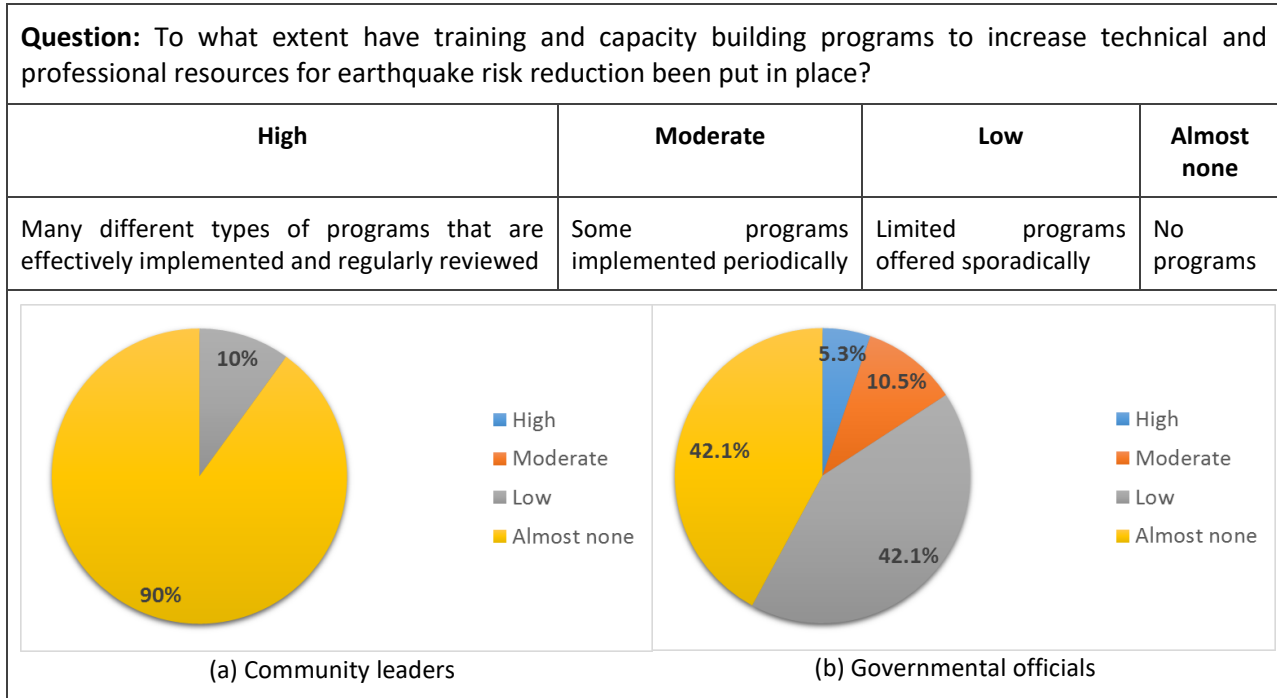


Figure 10 Training and capacity building programs.

To increase the number of training and capacity building programs, it is necessary to implement the policy directions and strategies regarding implementation capacity described in the National Policy and Strategy on Disaster Risk Management formulated by the Government. These strategies include undertaking regular capacity building activities, establishing a training centre on disaster risk management (Contreras, 2001), identifying and scaling up disaster risk management best practices and developing a roster of trained personnel that can be deployed in times of disasters (Ethiopia, 2014).

3.2 Social capacity

The objective of the social capacity dimension is to identify the capacity of populations to prepare efficiently, respond and recover from damaging earthquakes. This theme encompasses resources for social assistance to the community, integration of the population, the interaction between private and governmental officials with the community, the participation of community leaders in decision-making and the protection of historic buildings and cultural heritage. Social capacity also covers community health and well-being. Results and ancillary information are presented in the following sections.

3.2.1 Healthcare and social assistance programs available for vulnerable groups

The scores of community leaders and representatives of government officials regarding the prevalence of healthcare and social assistance programs for vulnerable groups are presented in Figure 11. It is also

a measure of differential access to resources, in this case, access to healthcare and social assistance. The burden of unequal access to resources is often borne by the more socially vulnerable populations. Socially vulnerable populations will likely experience the consequences of an earthquake differentially, even though they are subjected to similar levels of ground shaking. Understanding the differential impacts of an earthquake as a product of characteristics that give rise to vulnerability is a critical element for fostering mitigation plans and the development of policy to reduce earthquake risk. About 70% of both community leaders and government officials consider that healthcare and social assistance programs for vulnerable groups are either very limited or non-existent highlighting the need to do more in this important area.

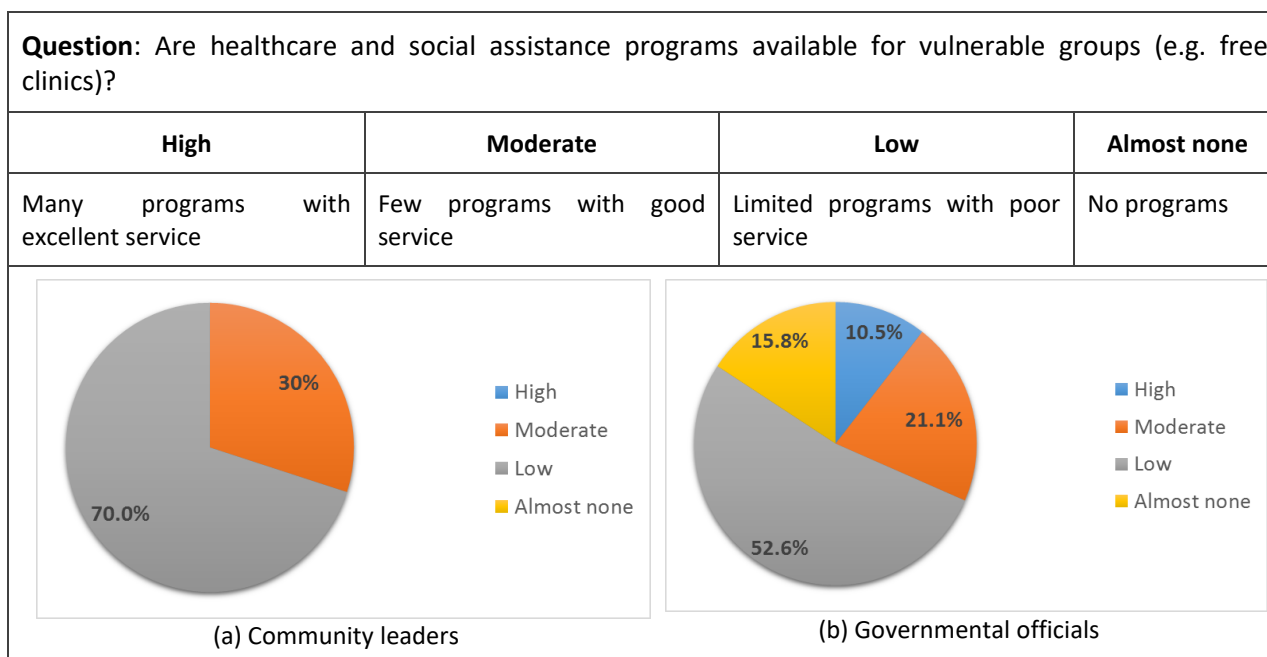


Figure 11 Healthcare and social assistance programs available for vulnerable groups.

According to the World Bank (WB) and the Global Facility for Disaster Risk Reduction and Recovery (GFDRR) (2015), the most vulnerable groups in Addis Ababa do not have access to the social services. The Bureau of Labour and Social Affairs (BOLSA) identified five categories of the vulnerable population: the elderly; the disabled; street people/beggars; the poor; and sex workers. Many people, however, fall into more than one category making the social protection system inefficient. A better understanding of the needs of the vulnerable population in Addis Ababa is needed to improve the delivery of social programs.

3.2.2 Ties and connections between people in the Sub-cities

The results of perceived ties and connections between people in the Sub cities is depicted in Figure 12. Many of the participants both community and governmental consider some people know each other, but strong ties do not exist. 26.3% of the governmental officials scored the high category. These results show that it may be necessary to create systems within the communities in sub-cities for building capacities that can support community resilience and health.

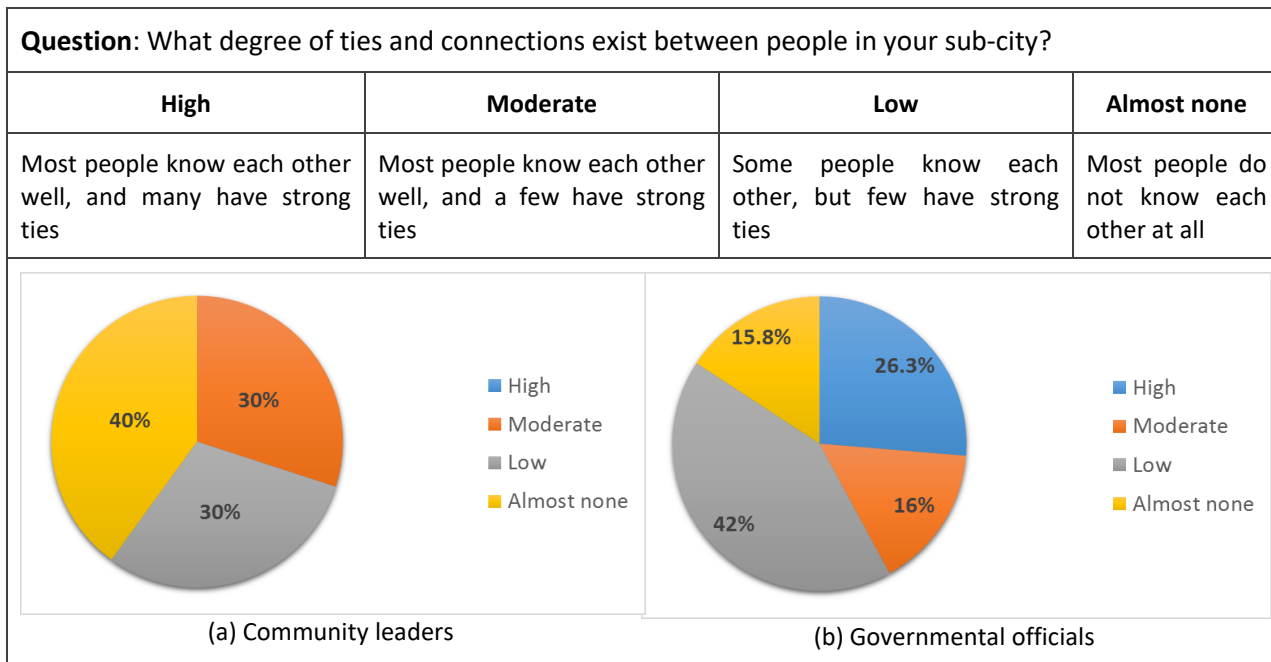


Figure 12 Ties and connections between people in the sub-cities.

3.2.3 Social integration considering different economic levels

Scoring regarding social integration considering different socioeconomic levels is presented in Figure 13. Community leaders, as well as the governmental officials, scored mostly in the low-moderate range. According to them, not much segregation exists. Within such programs, specific activities could be developed to promote a better connection between community members.

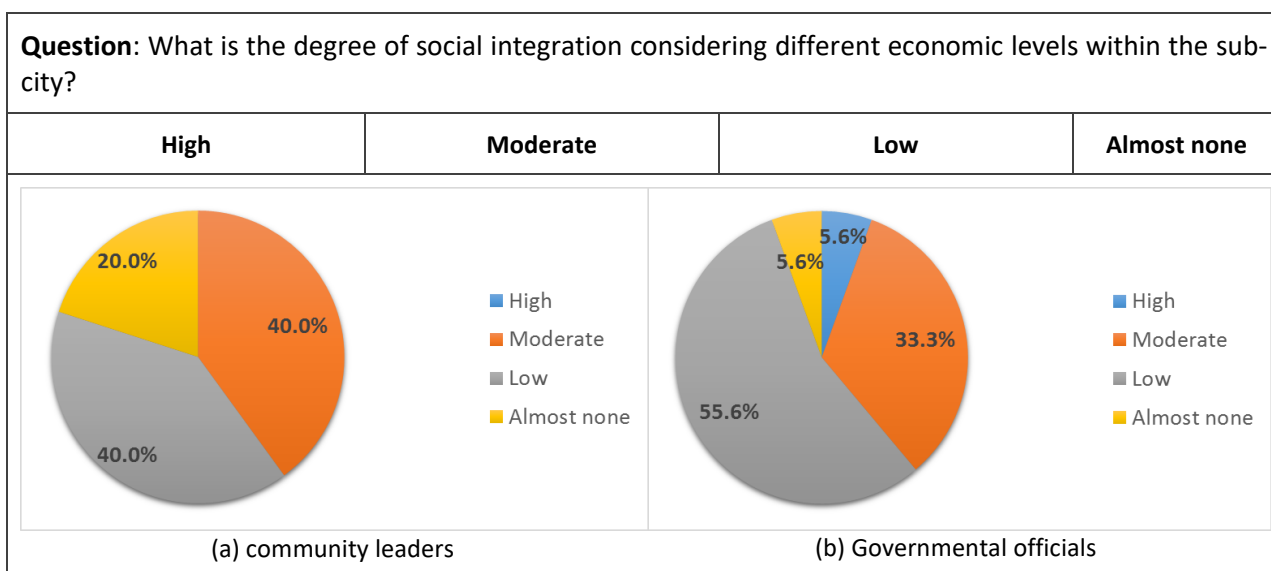


Figure 13 Social integration considering different economic levels.

3.2.4 Access to electricity, gas, and drinking water

The scores from community leaders and representatives from governmental officials regarding the access to electricity, gas, and drinking water are depicted in Figure 14. 60% of the community leaders over 70% of the government officials consider that there is a Moderate-High access.

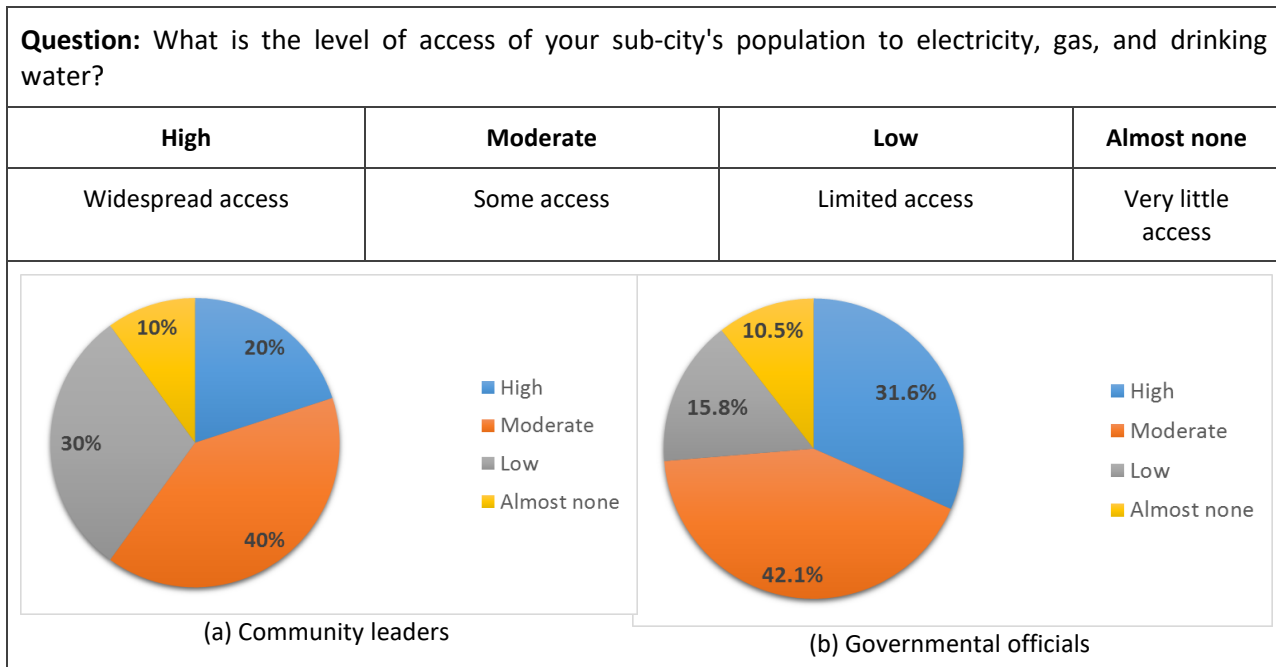


Figure 14 Access to electricity, gas, and drinking water.

The key resilience features in a critical infrastructure such as water supply, power system, and gas provision are robustness/resistance, resourcefulness, response and recovery and adaptability (Panteli & Mancarella, 2015). Addis Ababa depends on surface and groundwater to provide drinking water to the population. In this sense, it is necessary to identify other potential sources of water, such as rain and storm water catchments for gray-water uses such as industry, landscaping, and cleaning. Additionally, it is mandatory to tackle the 36.5 percent of estimated leakage of water supply to improve this service. To achieve this objective, it is essential to make more efficient the maintenance and the response to reported breakages. The operational efficiency and monitoring need to be improved, as well to increase the potential and avoid over extraction. Regarding wastewater collection is necessary to invest in piped sewerage and decentralised treatment facilities (WB & GFDRR, 2015). The rapid growth of the city demands to increase in power and gas generation capacity and efficient transmission and distribution system. The Addis Ababa City Government (AACG) and the companies should collaborate to ensure proper and timely planning of needed infrastructure for basic services according to the city development (WB & GFDRR, 2015).

3.2.5 Primary education

The scoring of community leaders and government representatives regarding the access to primary education is described in Figure 15. 90% and 94.7% of the community leaders and governmental representatives respectively, consider that almost all people have reached this level. This score shows a good perception and more so where both parties agree.

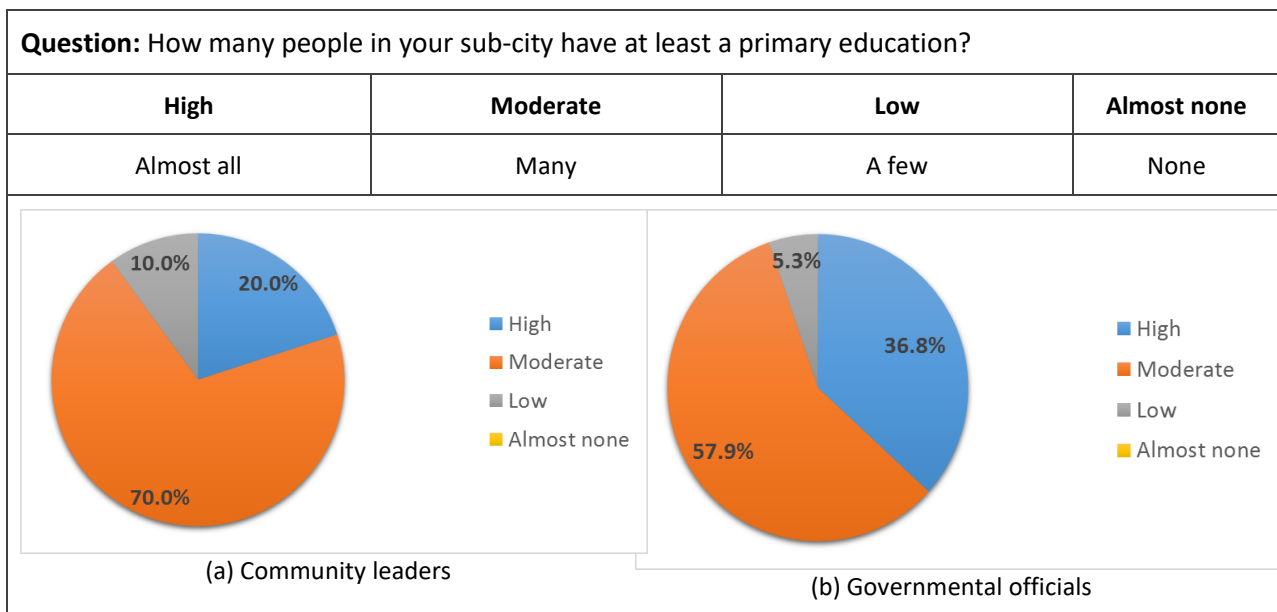
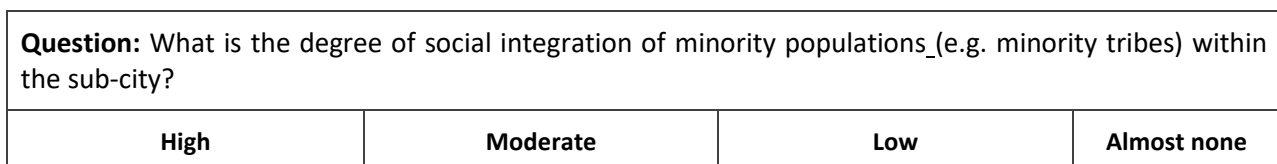


Figure 15 Primary education.

Addis Ababa has a policy for universal provision of basic services such as education but is struggling to provide equal access to poor, who are not formally registered (WB & GFDRR, 2015). Therefore, it is necessary to include all the population in the national census that their needs such as access to education can be identified and covered.

3.2.6 Social integration of minority populations

The scoring of community leaders and representatives of government officials regarding the social integration of minority populations is presented in Figure 16. Membership in a minority group often contributes to susceptibility to loss or harm from hazard events (Cutter, Boruff, & Shirley, 2003). This susceptibility is partially due to marginalization and poverty that may result from being a member of a minority group. There was a 20% score within the almost none category for the community leaders however there was a 39% and 40% score in the moderate category for governmental officials and community leaders, respectively.



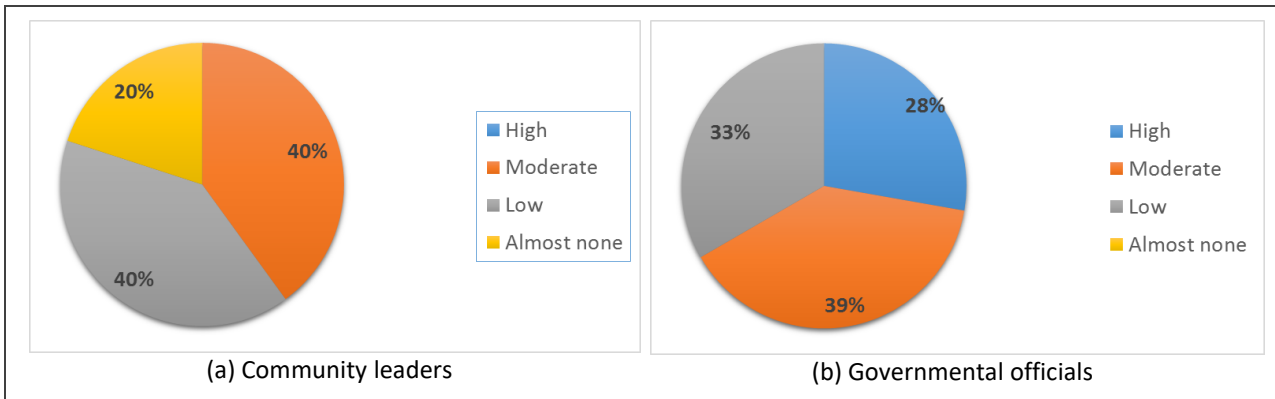


Figure 16 Social integration of minority populations.

It would be necessary to carry out consultation and engagement of minorities to ensure that the system covers the needs of the entire population (WB & GFDRR, 2015). Activities, such as the RPS contributes to considering a wider range of vulnerabilities, risk management capacities, and localized information.

3.2.7 Interaction between formal (governmental) and informal officials

The perceived level of interaction between formal and informal officials is described in Figure 17. All categories were represented in the scores. 50% of the community leaders believe there were moderate interactions, which is quite impressive. However, it is interesting to note that 47% of the governmental representatives felt there was a low level of interaction. Such discordance maybe due to some government members not being directly involved with/within the community. Such relationships are important for the reduction of earthquake risk and to increase resilience communication from the grassroots, through all levels of government (Anhorn, Burton, & Khazai, 2014).

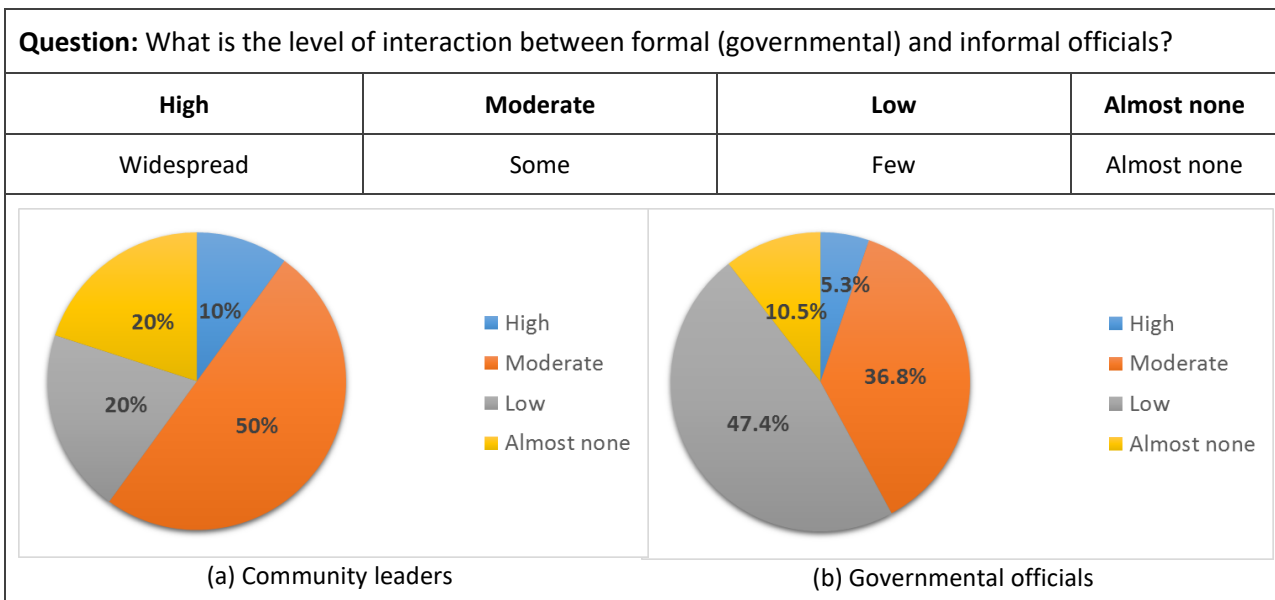


Figure 17 Interaction between formal (governmental) and informal officials.

3.2.8 Participation in decision making

Following the previous question, Figure 18 presents the scores regarding the participation of members of the sub-cities in decision-making processes. In this case, nearly 60% of the community participants & 73% of the governmental representatives consider an almost none - low participation, while the other 40% of the community is split equally between moderate – high engagement. These results suggest the need to promote a wider participation of community leaders in projects for earthquake risk management.

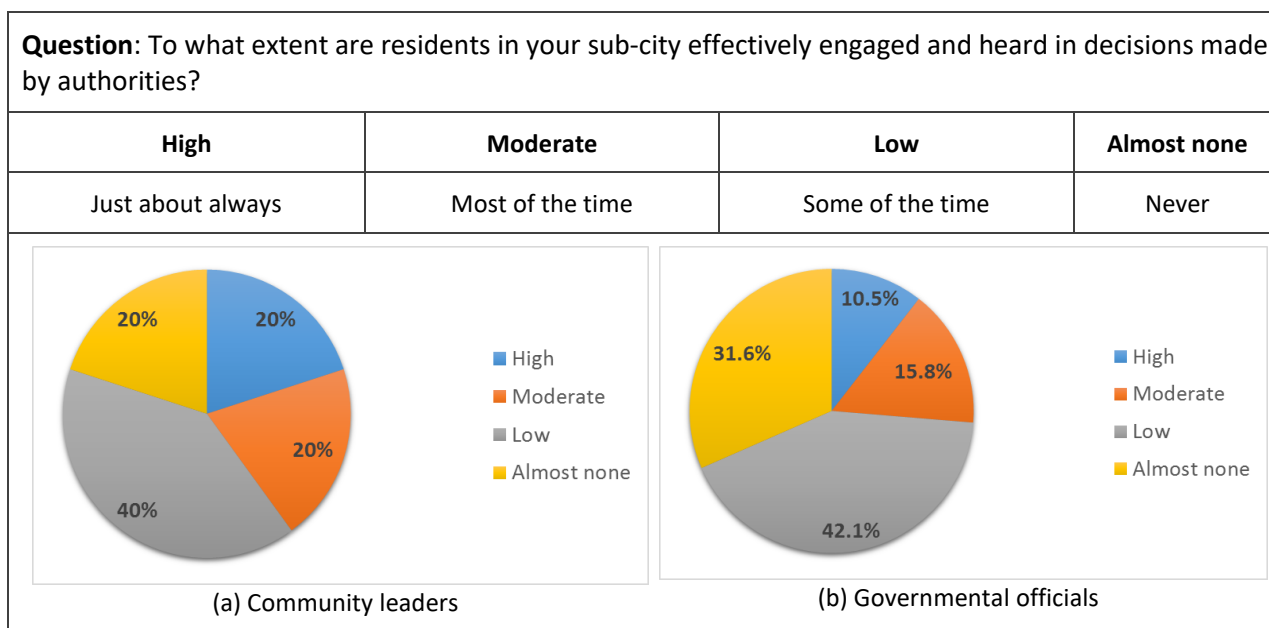


Figure 18 Participation in decision-making.

3.2.9 Programs for the protection of historic buildings and cultural heritage

The scoring for programs for the protection of historic buildings and cultural heritage is depicted in Figure 19. Results show that 80% of the community leaders and 84% of the representatives of governmental officials consider no preservation programs exist for the protection of cultural heritage. Given the status of programs, a starting point may be improved communication of the results and benefits of such efforts. Also, given the city’s historical and cultural heritage value, technical and financial resources could be promoted for the retrofitting of public and private buildings.

Question: Are special programs in place to protect historic buildings and cultural heritages if a damaging earthquake were to occur?			
High	Moderate	Low	Almost none
Programs are in place to protect both private and public historic buildings and cultural heritage	Programs are in place to protect only historic public buildings and cultural heritage	Only on individual bases historic buildings and cultural heritage are preserved	No preservation programs exist

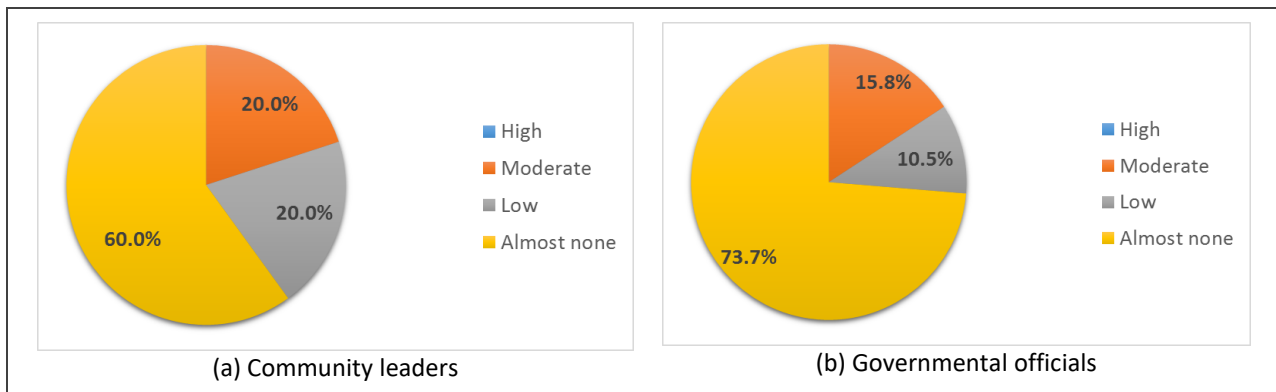


Figure 19 Programs for the protection of historic buildings and cultural heritage.

3.3 Legal and Institutional Arrangements

The objective of the legal and institutional arrangements dimension is to identify how effective mechanisms are at advocating earthquake risk reduction in the city. This dimension encompasses regulations for earthquake risk reduction, the participation of community leaders, mechanisms of coordination between sub-cities, private and public organizations, and the confidence of public and private officials in risk management. The status and current achievements in such topics, as well as the scores obtained in the workshop, are presented in the following sections. Ethiopia has a national policy legal framework for disaster risk reduction (DRMFSS, 2013; Ethiopia, 2014), but few studies tackle community awareness and perception about common disasters (Hajito et al., 2015).

3.3.1 Regulations, ordinances, or incentives for earthquake safety and risk reduction

The scoring to better understand the effectiveness of regulations, ordinances, or incentives for earthquake safety and risk reduction in the city is presented in Figure 20. 40% of the community representatives consider that regulations do not exist, and the other 60% felt that they do exist but they have not been implemented. 53% of governmental officials believe that such regulations do not exist.

Question: Have regulations, ordinances, or incentives for earthquake safety and risk reduction been effective for your sub-city?			
High	Moderate	Low	Almost none
Most regulations have been fully implemented	Some regulations have been implemented	Regulations exist, but they have not been implemented	Regulations do not exist

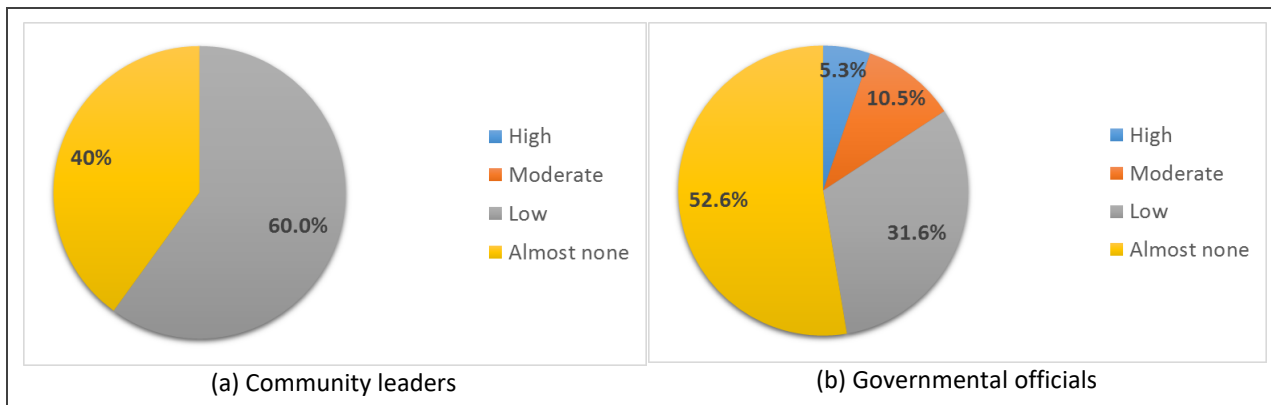


Figure 20 Regulations, ordinances, or incentives for earthquake safety and risk reduction.

This answer is paradoxical, having a National Policy and Strategy on Disaster Risk Management formulated by the National Government and issued in July 2013 (Ethiopia, 2014). One of the points in this document is enforcing laws and directives. Nevertheless, it would be necessary to start with the dissemination among governmental officials and community of this document. Afterward, it is necessary to research about the progress about meeting regulations, ordinance and incentives for earthquake safety and risk reduction achieved up to now since 2013.

3.3.2 Community leaders with roles and responsibilities for Disaster Risk Reduction

The scoring for community leaders and representatives of government officials that pertain to roles and responsibilities of community leaders for disaster risk reduction is presented in Figure 21. 30% of the community leaders consider that there are no persons with such functions and 20% said there are people but with no experience. On the contrary, 52% of the participants from governmental officials voted for the high category. Such differences are likely to be related to the low community engagement in the decision-making of community-related DRR activities. Having community members with clear roles and responsibilities before, during, and after a hazard event may assure a timely response and recovery (UNISDR, 2012; Anhorn, J. et al., 2014).

Question: Are there people within the city with clear roles and responsibilities for Disaster Risk Reduction (DRR)?			
High	Moderate	Low	Almost none
There are designated and trained persons whose main function is DRR	There are designated and trained persons, but their main function is not DRR	There are persons without training or expertise, and their main function is not DRR	There are no persons with such functions

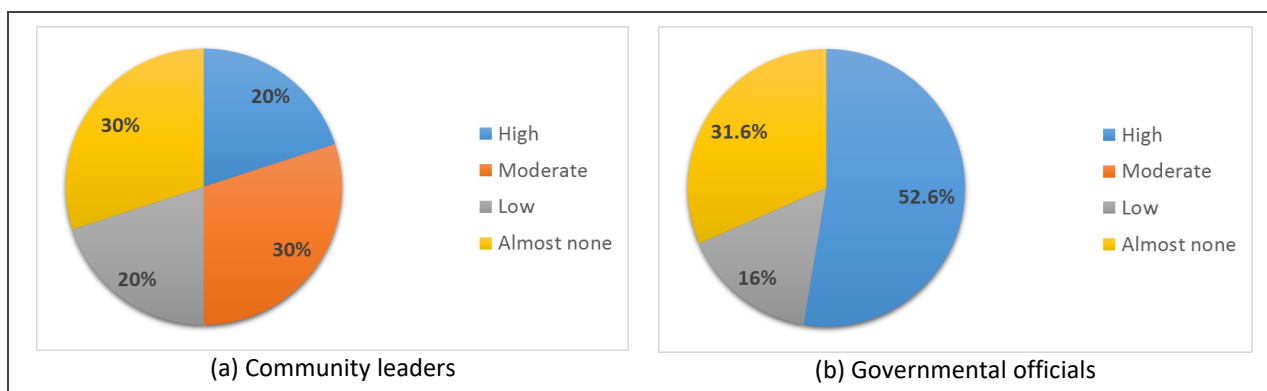


Figure 21 Community leaders with roles and responsibilities for Disaster Risk Reduction.

3.3.3 Mechanisms of coordination and cooperation

The scoring of the community leaders and government officials that pertain to mechanisms of coordination and cooperation for disaster preparedness, safety and risk reduction between 1) sub-cities with the national government; 2) sub-cities with other sub-cities; and 3) sub-cities and private enterprises are presented in Figures 22, 23 and 24.

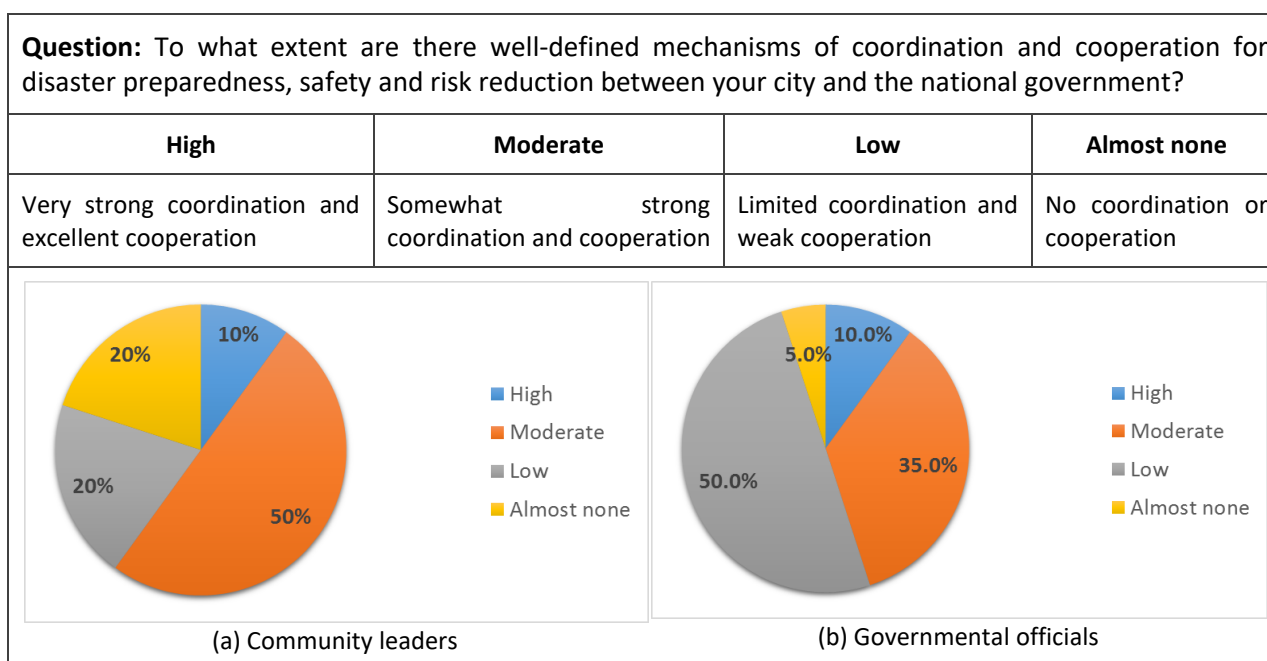
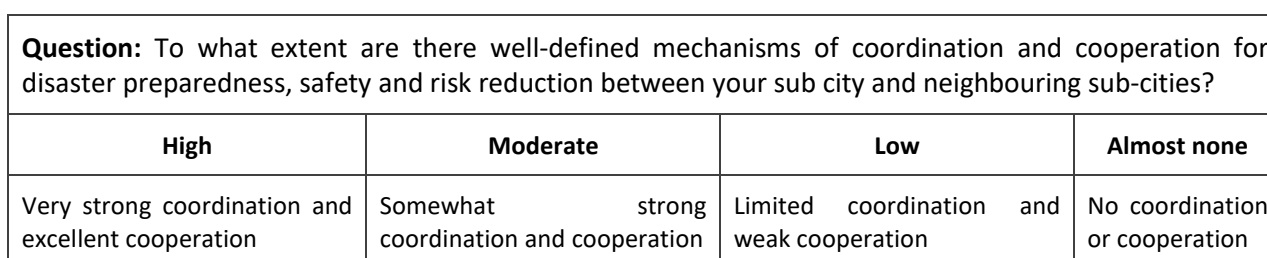


Figure 22 Mechanisms of coordination and cooperation between sub-cities.



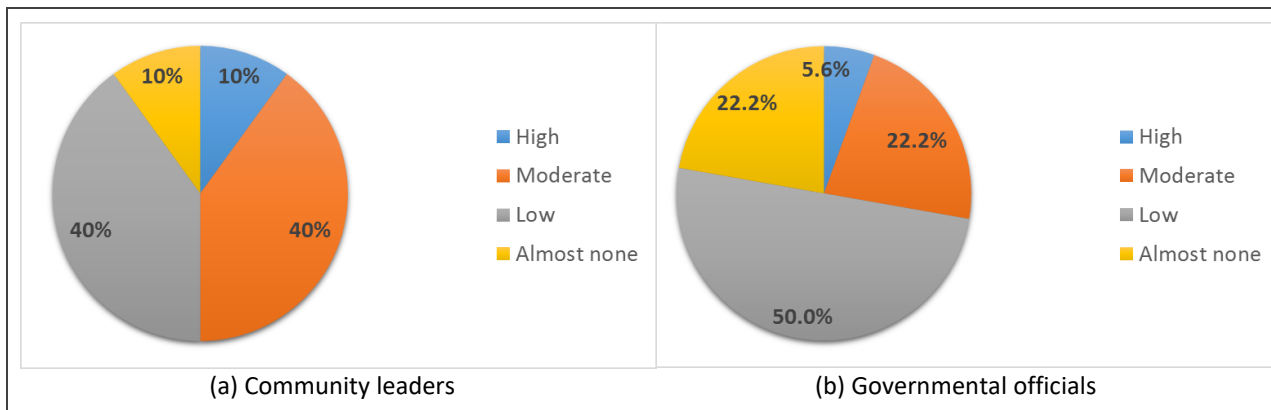


Figure 23 Mechanisms of coordination and cooperation: sub-cities and the municipality.

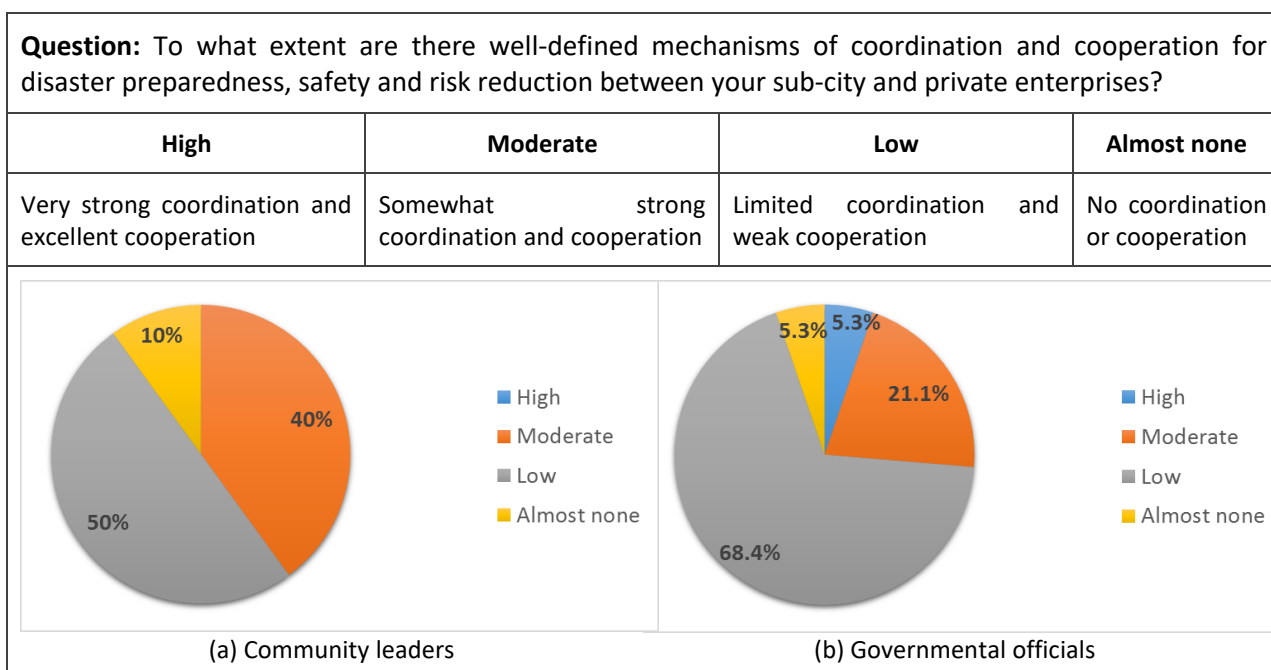


Figure 24 Mechanisms of coordination and cooperation: sub-cities and private enterprises.

It is worth noting that 50% of the community leaders group consider that mechanisms of coordination and cooperation for disaster preparedness between the city and the national government are somewhat strong coordination whereas 50% of the governmental representatives felt there were limited coordination and weak cooperation. Within sub-city to sub-city, 50 % of community leaders scored in the very strong – somewhat strong coordination and cooperation, while again 50% of the government representatives scored in the limited coordination and weak cooperation. However, with the interaction between sub-cities and private enterprises, both concurred that there was limited – no coordination and cooperation. These results suggest that communities and government are not aware of the alternatives for coordination for disaster risk management. An additional area of opportunity is coordination and cooperation with private enterprises for disaster preparedness, safety, and risk reduction.

3.3.4 Confidence in the central and local government and non-governmental officials

The level of confidence in the central and local governments, as well as non-governmental officials for response and recovery from damaging earthquake events, is showed in Figures 25, 26 and 27.

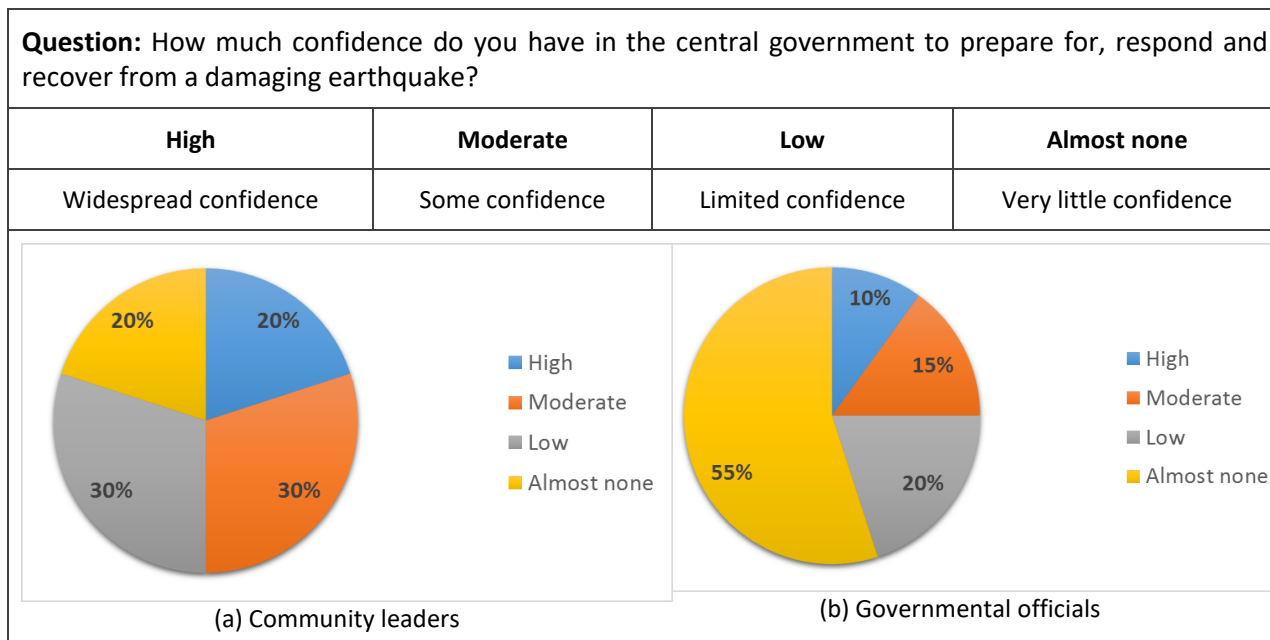


Figure 25 Confidence in the central government.

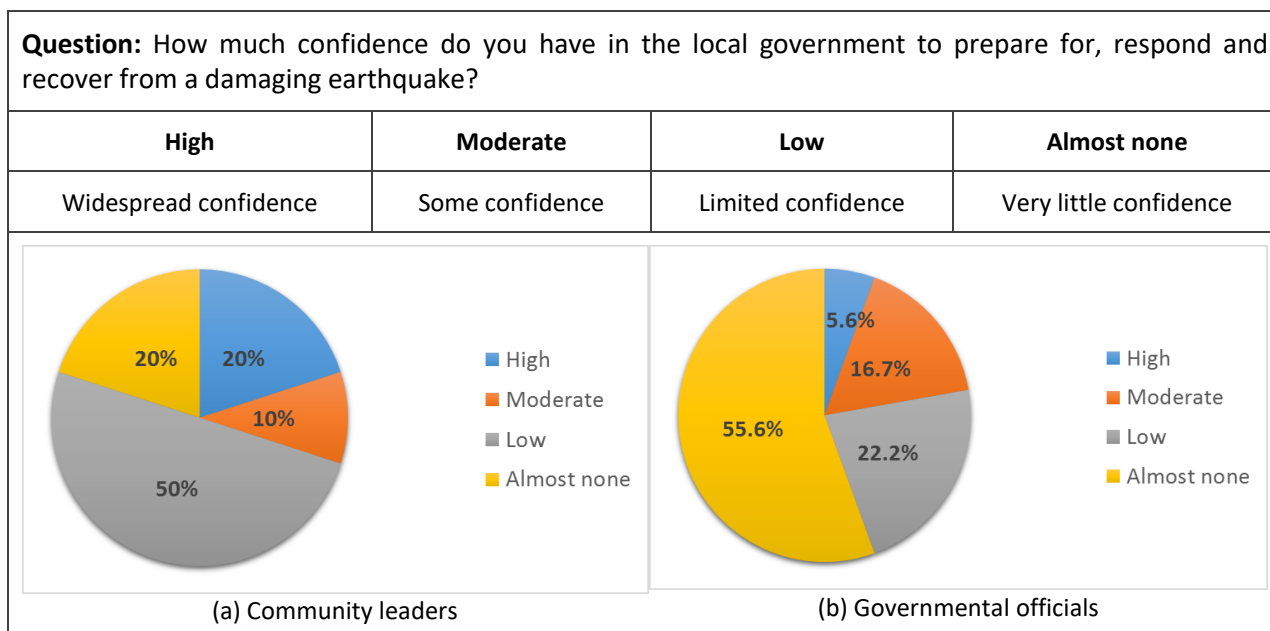


Figure 26 Confidence in the local government.

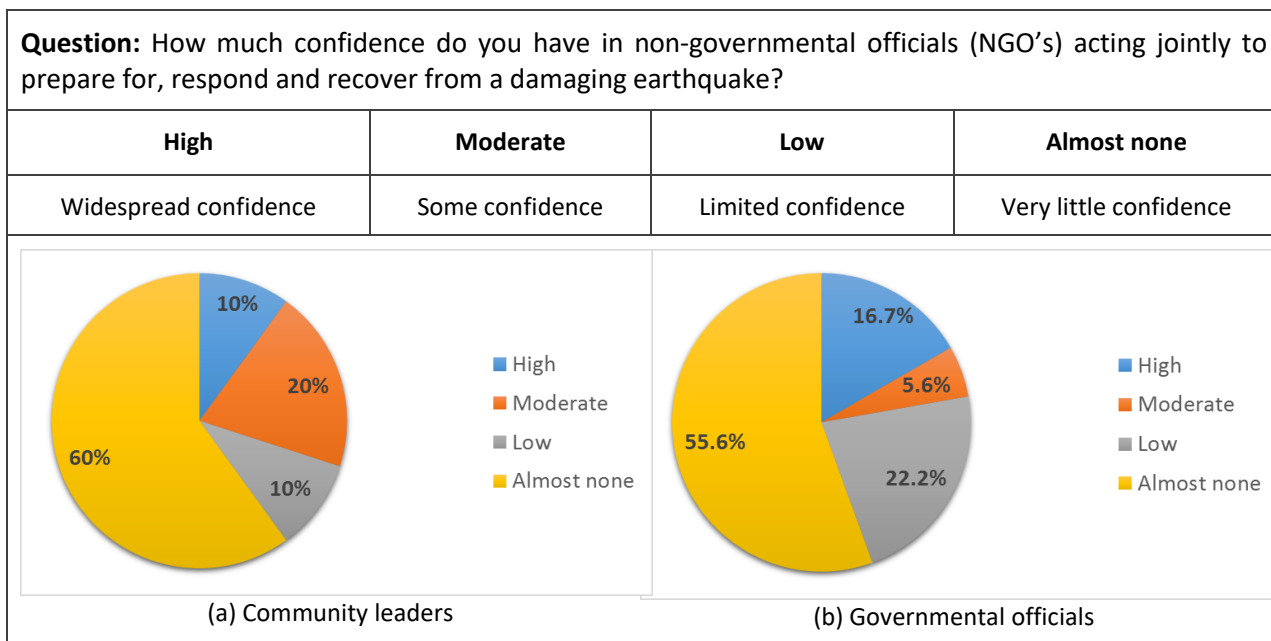


Figure 27 Confidence in non-governmental officials (NGO's).

The results demonstrate a general lack of trust in the government (both the local governments and the central governments) and a lack of trust in NGO's to prepare for, respond to, and recover from damaging earthquakes. What is interesting to note as well is how the government officials themselves seem not to trust in themselves and the NGOs. These results show the need for strengthening the confidence of the community in the government and vice versa.

3.4 Planning, Regulation, and Mainstreaming Risk Mitigation

The objective of the planning, regulation, and mainstreaming risk mitigation theme is to identify the perceived level of commitment and mainstreaming of disaster risk reduction through regulatory planning tools in the city. This theme encompasses earthquake-resistant building codes, the reinforcement of private infrastructure, the availability of insurance and funds for disaster risk management plans. The status and current achievements in planning and risk mitigation as well the scores obtained during the workshop are presented in the following sections.

3.4.1 Earthquake resistant building construction codes

The voting distribution for the enforcement of earthquake-resistant building construction codes is depicted in Figure 28. The community leaders had 50% saying codes do not exist while the other 50% believed that they were not enforced. Over 52% of the participants of governmental officials considered that they were not enforced. Only 10.5% of the governmental participants, overall, voted within the moderate category. There is a need to provide workshops to key government and municipal/local government officials on the existence of the risk reduction guidelines. For example, the country has the National Incident Management System (NIMS) program designed to strengthen Ethiopia's disaster preparedness coordination and response capacity, which is run by the Ministry of Agriculture Disaster Risk Management and Food Security Sector (DRMFSS). The city of Addis has the Fire Emergency Prevention and Rescue Authority (FEPPRA) which together with the Oromia Region Disaster Prevention and Preparedness Bureau can go a long way in holding sensitization, safety awareness and capacity building rallies, workshops, information workshops.

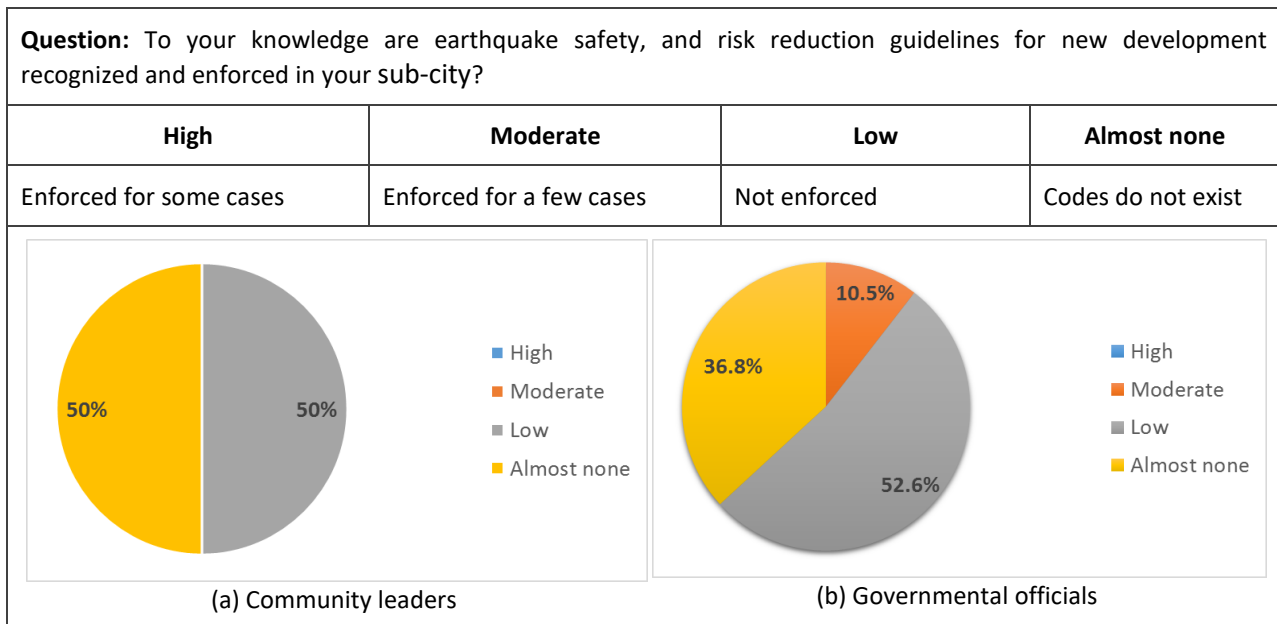


Figure 28 Earthquake resistant building construction codes.

3.4.2 Reinforcement and retrofitting of private infrastructure

The reinforcement and retrofitting of private infrastructure are presented in Figure 29. In the case of community leaders, only 30% scored in the low category showing that they believed that construction codes were being enforced in their area. However, there was less certainty within the governmental group, with most of them (over 50%) scoring in the almost none-Low category.

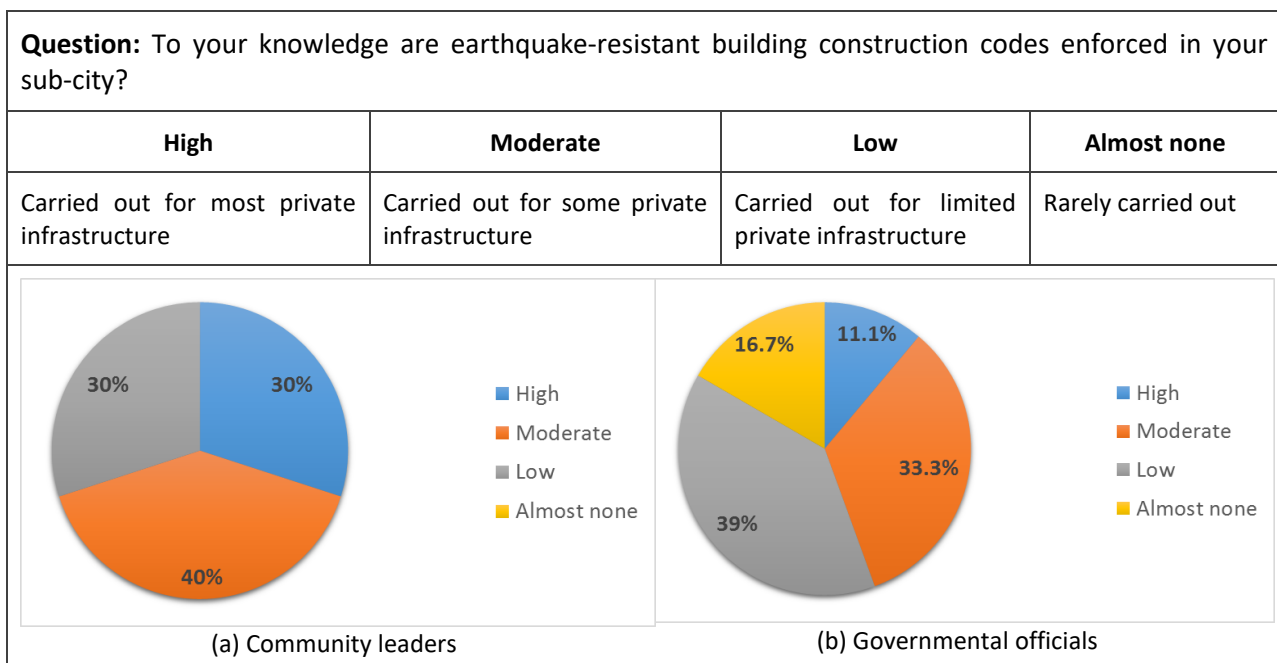


Figure 29 Reinforcement and retrofitting of private infrastructure.

In 1980 the first seismic code for building in Ethiopia was introduced (CPI-78)(Kassegne, Engeda, Kebede, & Tessema, 2012). This code was revised in 1984 as ESCP1-83 ("ESCP-1:1983, Code of Practice

for Loading ", 1983). These two codes were followed by a significant change introduced in 1995 called EBCS-1995 by the Ministry of Works and Urban Development ("EBCS-8: 1995, Code of Standards for Seismic Loads," 1995). Despite, the existence of three generations of seismic code in Ethiopia, its law enforcement was never codified by the country's legal systems until 2009. In this year, the Building Proclamation 624/2009 was introduced as a legal document that summarizes the building regulations and requirements, to be used by local authorities. The delay in the codification of the law enforcement could explain the lack of awareness of official about the existence of a building construction code ((FDRE), 2009). The necessary action is the socialization of the Building Construction Code of 1995 (EBCS-1995) especially among the officials in the Governmental Institutions.

3.4.3 Availability and use of earthquake insurance

The scores regarding the availability and use of earthquake insurance within the city are shown in Figure 30. Most of the community leaders (90%) and governmental officials (89.5%) consider that no insurance is available or utilized.

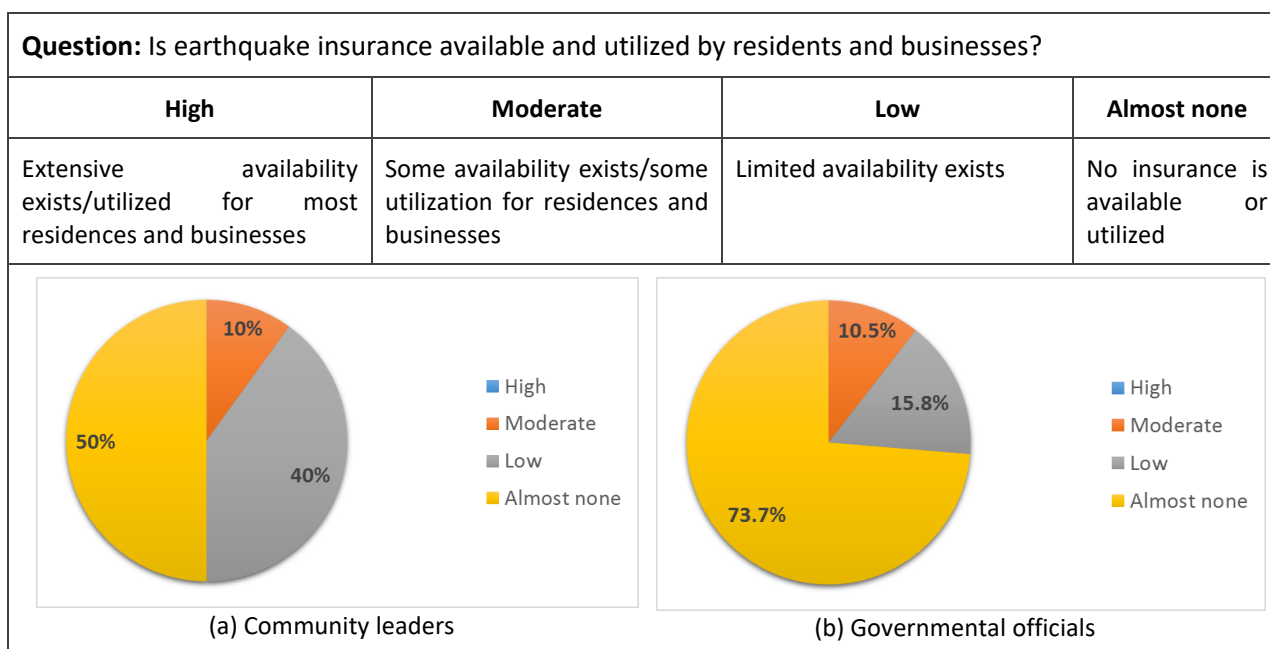


Figure 30 Availability and use of earthquake insurance.

The low insurance penetration in Addis Ababa stems from the low frequency of earthquake events, compared with floods, fires, droughts and disease outbreaks (Hajito et al., 2015). This fact accounts for the perception that earthquake risk is lower than it is (Bevere & Grollimund, 2012).

Activities such as the RPS facilitates the awareness of the community about the risk in which they are living. These kinds of activities must be encouraged and the results disseminated to foster actions such as increasing the penetration of the insurance among the community.

3.4.4 Availability of funding

The availability of funding for disaster risk management plans or earthquake mitigation programs is presented in Figure 31. 90% of the community leaders believe that some availability and utilization exist contrary to the governmental officials of whom 40% were of the same opinion. These results reflect a huge disparity between the community and government, and more information would need to be found to understand this difference.

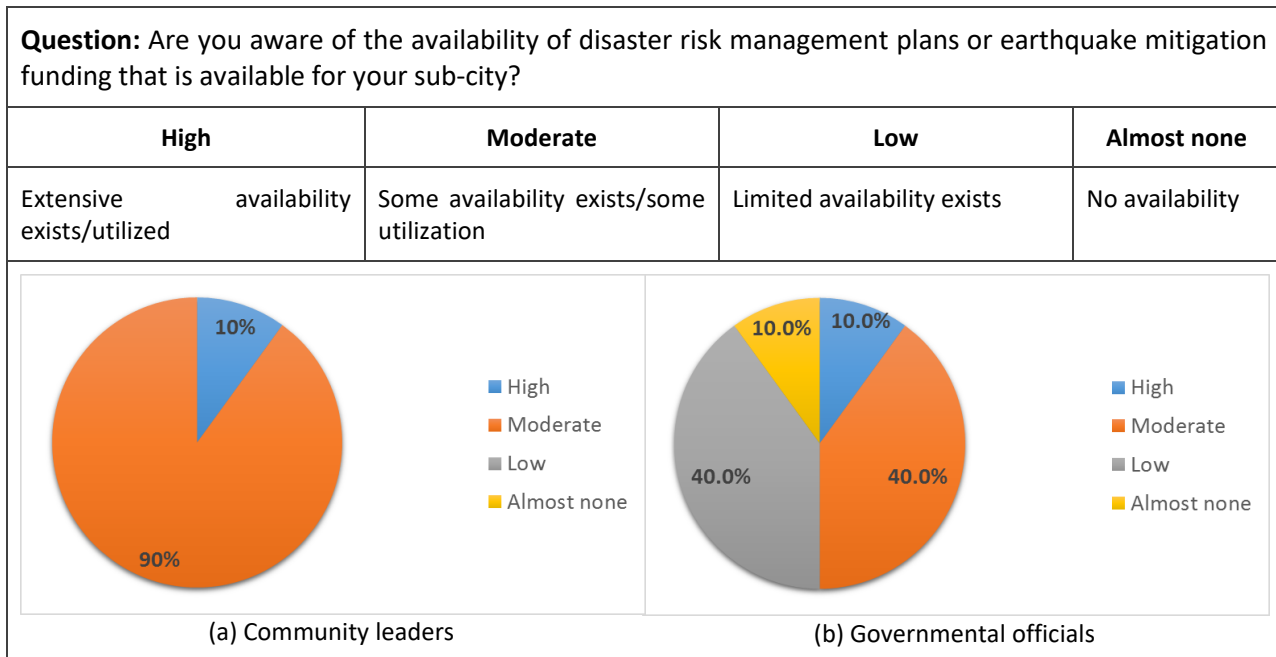


Figure 31 Availability of funding.

3.5 Emergency Preparedness, Response, and Recovery

The objective of emergency preparedness, response, and recovery theme is to identify the effectiveness and performance of the risk management system within the city for response and recovery in the aftermath of a damaging earthquake event. The theme encompasses the inaction of community response centres, the prevalence of standard operational procedures and funds for emergency planning and response. Also, this theme covers workforce and equipment available for emergency situations, and plans for post-earthquake emergency operations. The status and current achievements as well the scores obtained during the workshop and presented in the following sections.

3.5.1 Population storing goods to be used in case of disasters

The scores drafted from the responses of community leaders and representatives of the city's governmental officials that regard the storage of goods to be used in case of an earthquake disaster are described in Figure 32. Around 90% of the community leaders consider that few to almost none of the population stores goods to be used in case of an earthquake disaster. The same trend can be seen for the governmental officials. According to these results, very few people store goods.

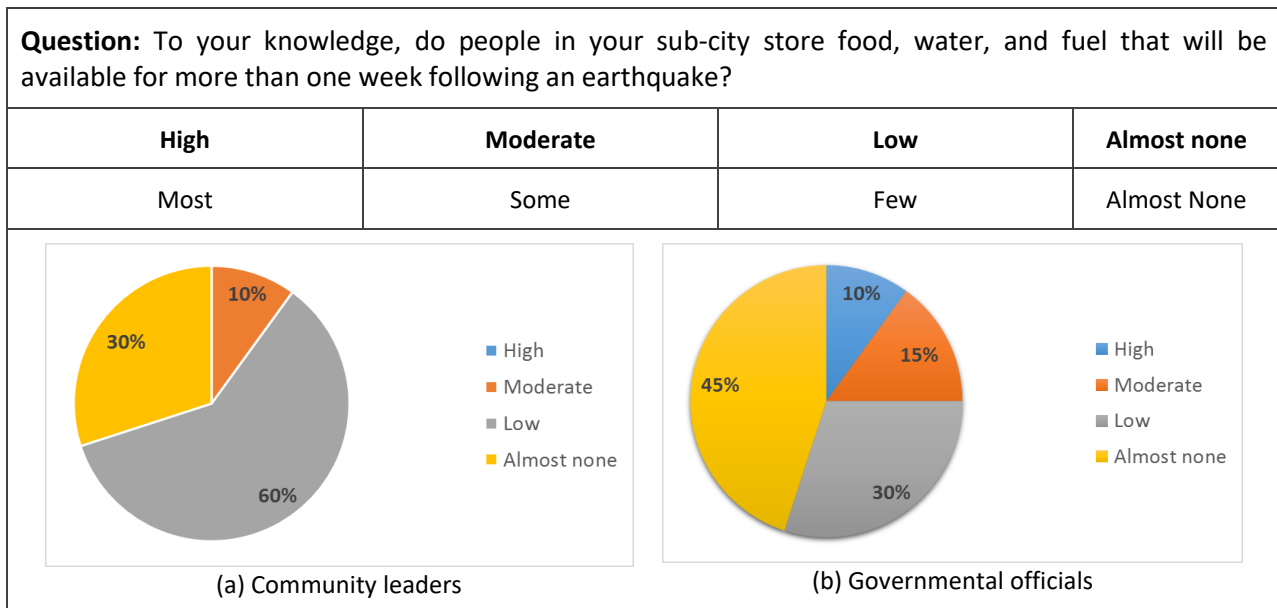
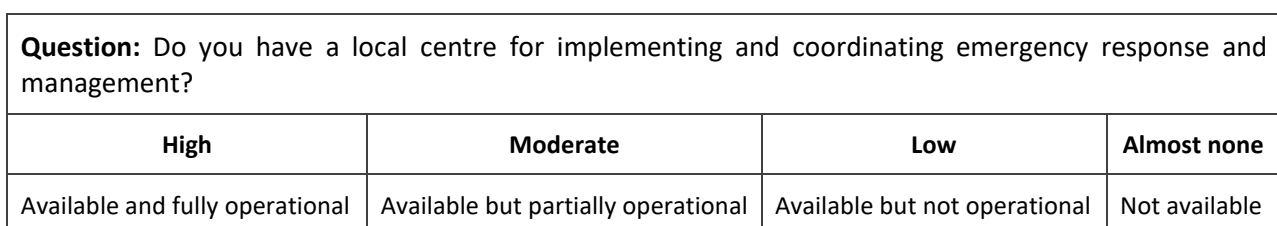


Figure 32 Population is storing goods to be used in case of disasters.

If they do not already exist, FEPR could create a new unit(s) with defined roles and responsibilities focusing on risk management and preparedness for major incidents. The low preparedness in these aspect makes the city highly vulnerable. The city seems to be in an emerging state regarding the key pillars of disaster risk reduction – prevention, mitigation, preparedness, response, and recovery. The combination between well-functioning and inclusive disaster preparedness and emergency response mechanism will make the city more resilient (WB & GFDRR, 2015). FEPR could also develop the emergency preparedness plan suggested by the World Bank (WB) and Global Forum for the Disaster Risk Reduction (GFDRR) (2015). This plan covers aspects such as recommendations for the community about storing goods to be used in case of disasters. It would also be necessary to say which kind of goods, the reason to keep them and how to keep them usable and how to use them. This information can be defined in manuals and socialized in workshops. The government would then provide some of the goods in case of disaster for highly vulnerable communities.

3.5.2 Local centres

The presence of centres within communities that are used for implementing and coordinating emergency response in the event of an earthquake is depicted in Figure 33. At least 60% of the community leaders scored high and where of the opinion that local centres were available. Nevertheless, the governmental representatives were split in their opinions. Community residents might identify a certain community centre as serving such a purpose while those in government do not view it in that way. There might be a need to educate both parties on the existence of such centres and identify them.



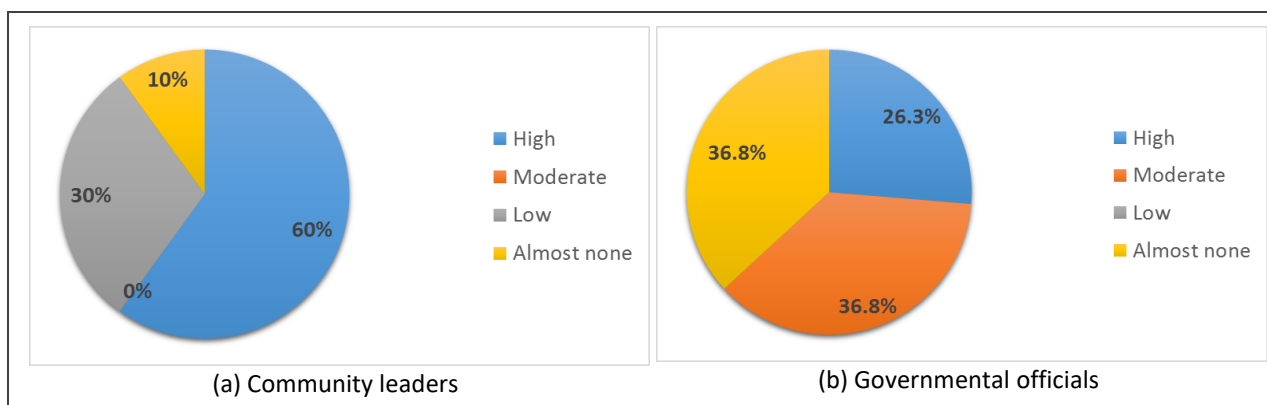


Figure 33 Local centres for emergency response and management.

In Ethiopia, there is an organisational structure created from the national to the district level, called disaster prevention and preparedness committee (Hajito et al., 2015). However, these committees need a physical headquarter (Contreras, 2001). The community must easily identify them, and all of them must be equally distributed around the city, either with similar service areas (response areas) or with smaller service areas, where the zones will be highly vulnerable.

3.5.3 Standard operational procedures

The scoring regarding the presence and use of standard operating procedures for coordinating emergency, rescue and response activities are presented in Figure 34. As found in the previous topic, there are differences in the scores of community leaders and governmental officials. 50% of the community leaders and 50% of government representatives consider that there are limited operational procedures. On the other hand, 50% of the community leaders scored in the moderate category while 5% of the representatives from public officials consider that there are well-defined procedures, 20% said none existed and 25% considered that they were moderate.

Question: Are there standard operational procedures (SOP) that include communication plans for coordinating emergency rescue and response activities of relevant units in your sub-city (e.g. Incident Command System)?

High	Moderate	Low	Almost none
Well defined procedures, and fully functional for all relevant units	Basic procedures, with limited functionality for all relevant units	Limited procedures for some units	No operational procedures

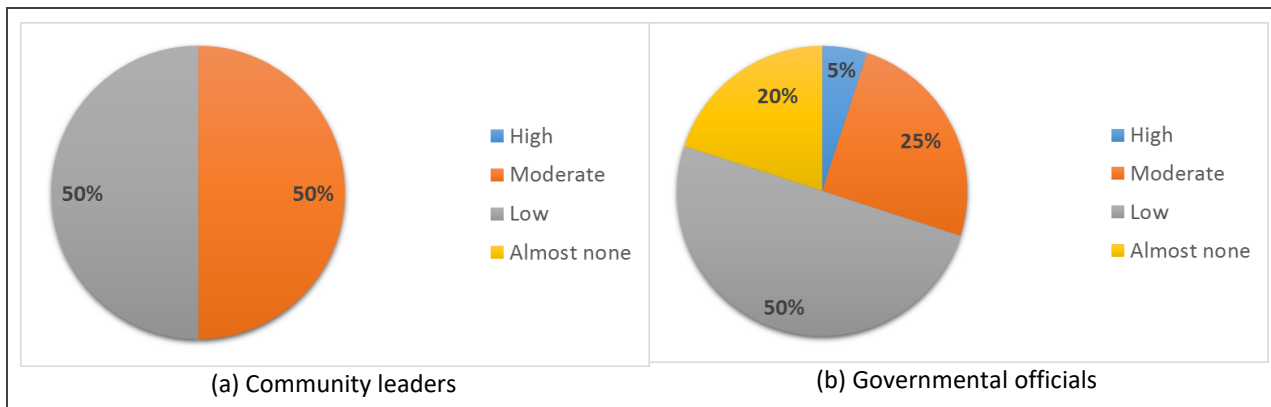


Figure 34 Standard operational procedures for emergency rescue and response activities.

Protocols for emergency response must be written under the agreement of all the operative officials, e.g. FEPPRA, Civil Protection, Red Cross and Police. This process must be led by FEPPRA. The topics of the protocols must be first response, search, and rescue (SAR), emergency response to floods, landslides, Hazmat, forest fires, etc. However, based on the answers from the community and the governmental officials, and based on previous answers, it is possible to assume that these protocols could already exist but they have been neither among the government officials nor the community or else simply people are not aware that they exist. It is necessary to organize workshops and drills to put them in practice and implement continuous improvement.

3.5.4 Funds for emergency preparedness, response and recovery operations

The availability of funds for emergency preparedness, response and recovery operations is depicted in Figure 35. Many of the community leaders 60%, consider that funds are available but with legal restrictions and special requirements while the governmental officials, less than 40% either consider that such funds are not enough or are available but with legal restrictions. These results may be the result of both availability types existing for a given area. Conversely, this may be due to a lack of knowledge of available funds in a given area.

Question: Are funds available for emergency preparedness, response, and recovery operations?			
High	Moderate	Low	Almost none
Funds are directly available and can be used at the Sub City's discretion	Funds are available but with legal restrictions and special requirements	Funds are planned for but are not available	Funds are not available

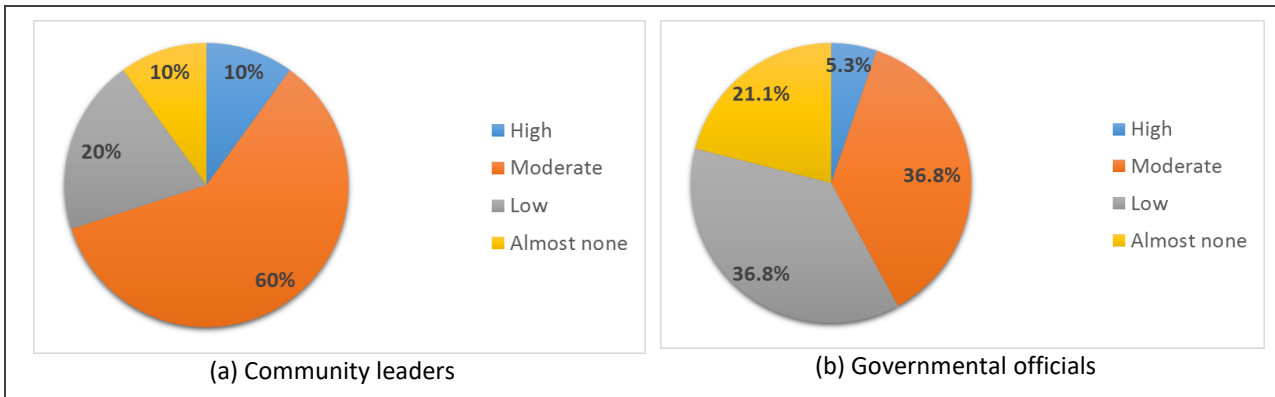


Figure 35 Funds for emergency preparedness, response and recovery operations.

3.5.5 Human resources for emergency preparedness, response and recovery operations

The scoring for human resources for emergency preparedness, response and recovery operations is rendered in Figure 36. Results show that many of the community leaders (90%), and governmental representatives, 85% consider that there are insufficient – limited human resources. This concordance shows that more does need to be done in training and making available skilled personnel for response and recovery.

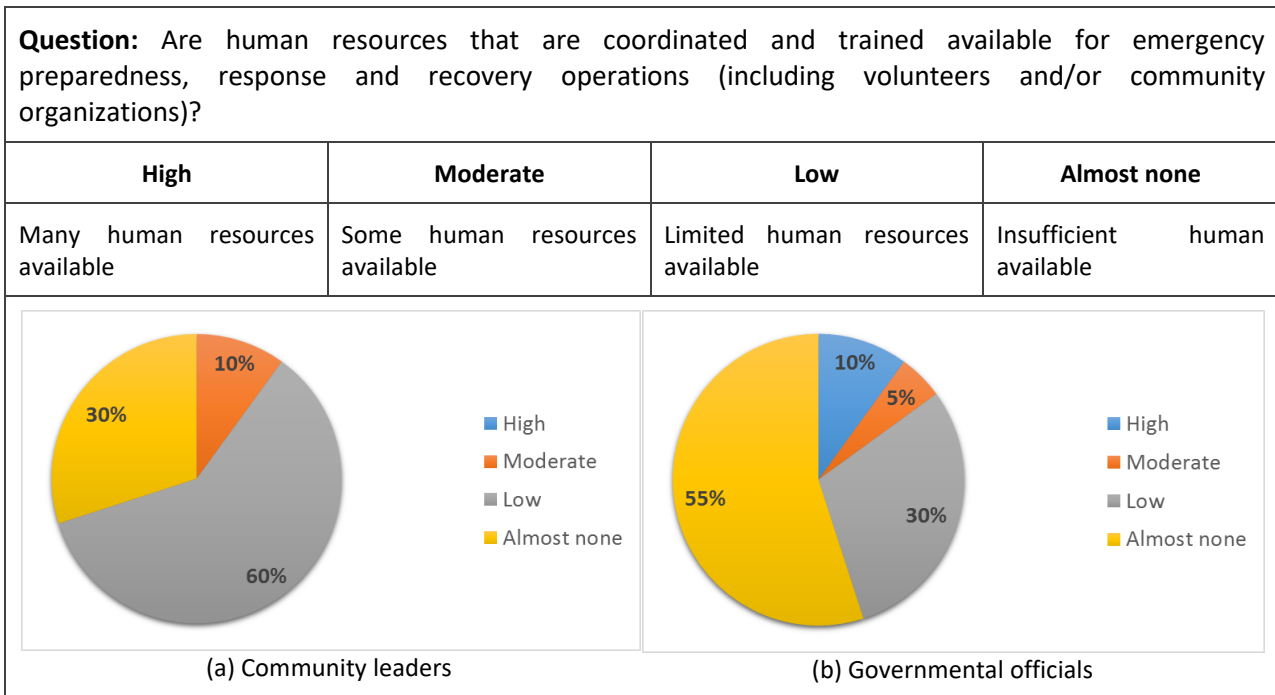


Figure 36 Human resources for emergency preparedness, response, and recovery operations.

3.5.6 Equipment for emergency rescue, response, and clean-up operations

The results for equipment for emergency rescue, response, and clean-up operations are presented in Figure 37. Around 35% of the participants from public officials consider that no equipment exists that is readily available; 30% consider it low, and around 30% consider it moderate. The same trend of results

can be seen for the community leaders making these results inconclusive. There is a clear lack of knowledge from both groups whether such equipment exists. Maybe examples of types of equipment could have been made for the question to be clearer.

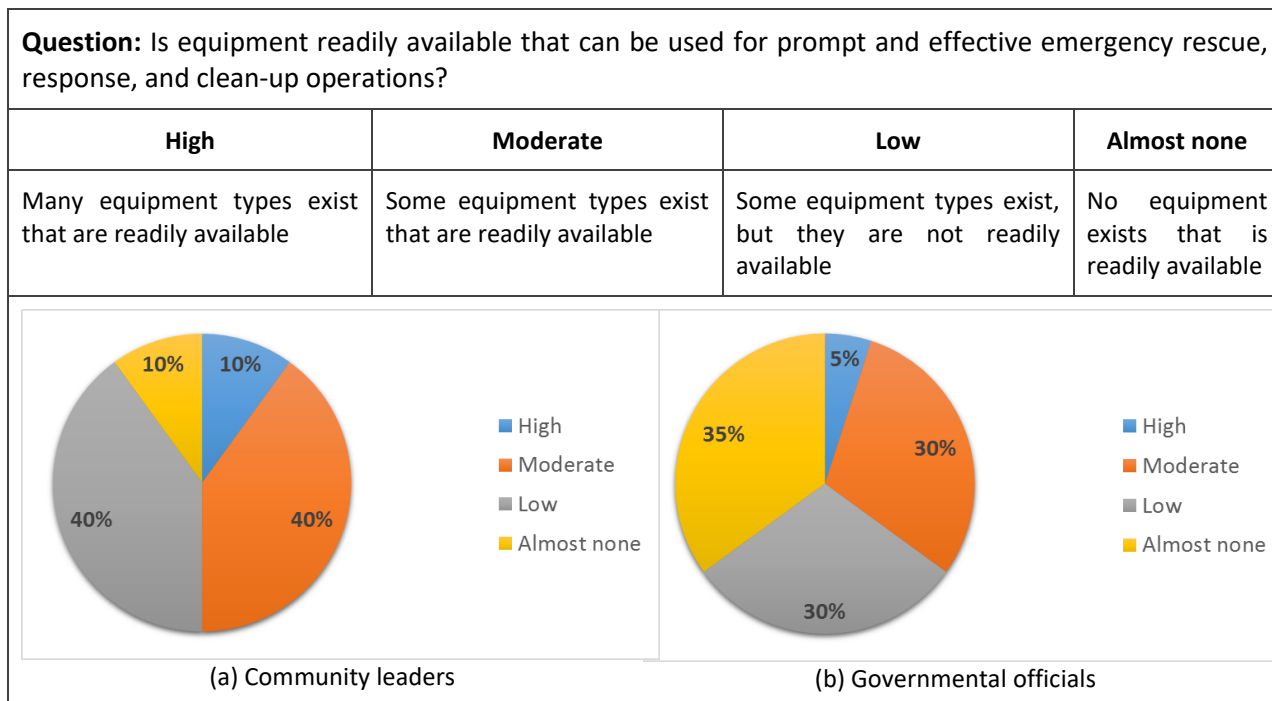


Figure 37 Equipment for emergency rescue, response, and clean-up operations.

3.5.7 Response plan for post-earthquake emergency operations

This sub-section presents results about response plans for post-earthquake recovery of the following eight sectors. The aforementioned sectors (i) access and distribution of drinking water and sanitation services; (ii) promotion of health and hygiene; (iii) infrastructure and rehabilitation; (iv) integral assistance to the population; (v) Integral safety of the population; (vi) productivity and livelihood stability; (vii) education, culture and environment and (viii) strategic infrastructure for development. Such sectors are considered by the Metropolitan System of Risk Management of Addis Ababa for the development of contingency plans.

- (i) Health and sanitation: From Figure 38, around 55% of the participants from governmental officials consider that no plans exist, and 22% consider that plans do exist but are not implemented. On the other hand, 60% of the community leaders thought that plans do exist but are not implemented while 40% said no plans exist. Given that all community leaders scored in the bottom half, it should be considered beneficial to promote programs for information about plans for health and sanitation.

Question: Is there a response plan for post-earthquake emergency operations; access to potable water and sanitation services?
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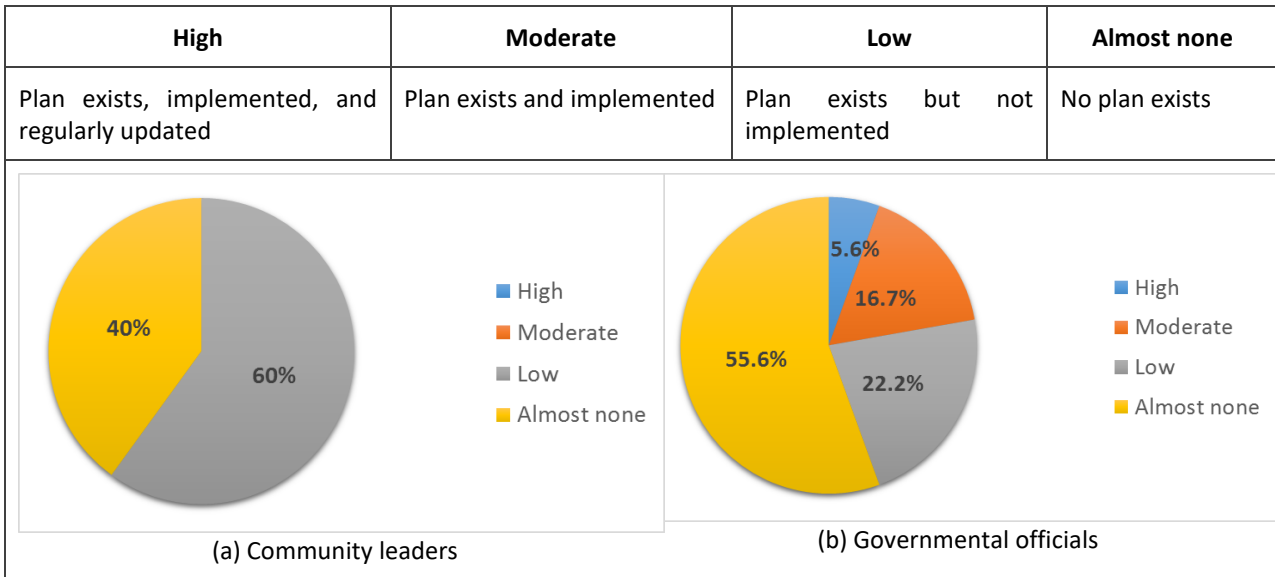


Figure 38 Response plan for post-earthquake emergency operations for health.

(ii) *Search and rescue*: Figure 39 presents the scores of community leaders and representatives from governmental officials regarding plans for post-earthquake search and rescue. The results were inconclusive due the varying responses received, all being representative of the four categories; however, it can be noted that most scored in the low and almost none categories for both community leaders and governmental representatives. It is important to note that the recovery time of a community often depends on the response time following a disaster.

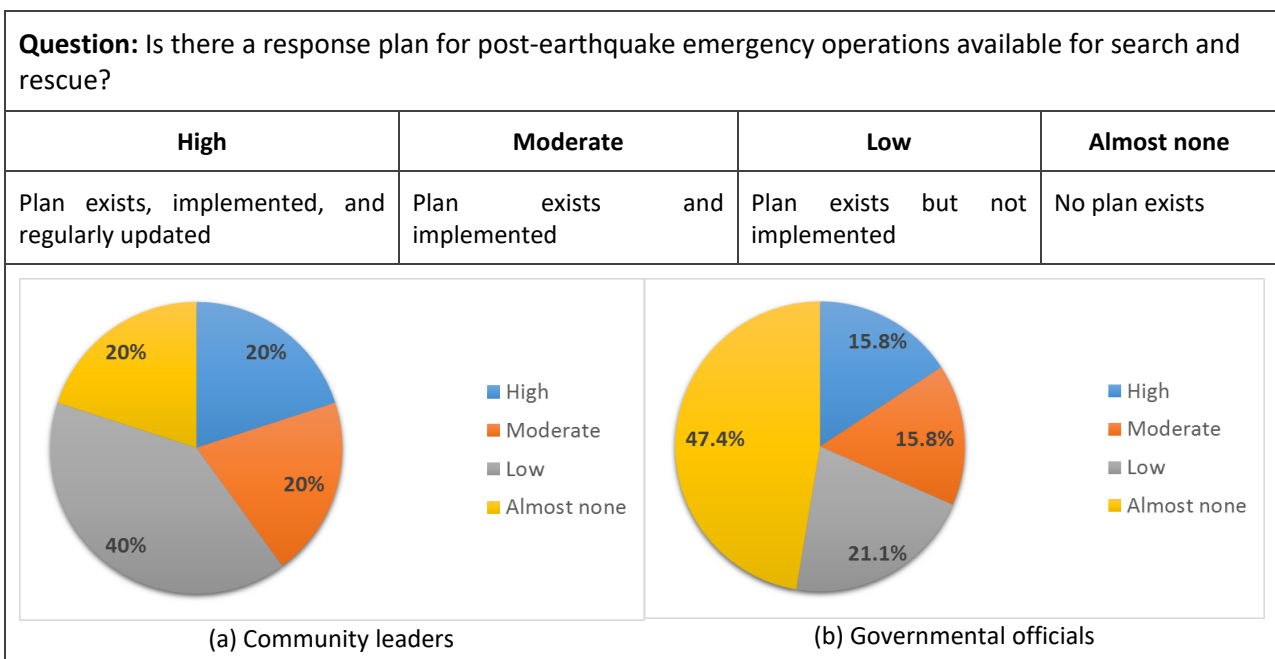


Figure 39 Response plan for post-earthquake emergency operations for search and rescue.

It is necessary to establish training programs in medium and heavy SAR for members of FEPPA, civil protection, Red Cross and Police, and light SAR for members of the community. The community must also be trained in first response and first aid. Besides the search and rescue plan, it is necessary to formulate a plan to organize the building survey in the city to estimate their degree of damage

(Contreras, 2009). An accurate estimation of the population that needs public shelter is critical for effective disaster response decision-making (Vecere, Monteiro, Ammann, Giovanazzi, & Melo Santos, 2017). This activity allows determining the number of people, who have to evacuate and probably will be in need of shelter.

(iii) *Mass care including shelter*: the voting for plans for integral assistance for the population is presented in Figure 40. Again, the results were more inclined towards the low scores showing that such plans may not exist.

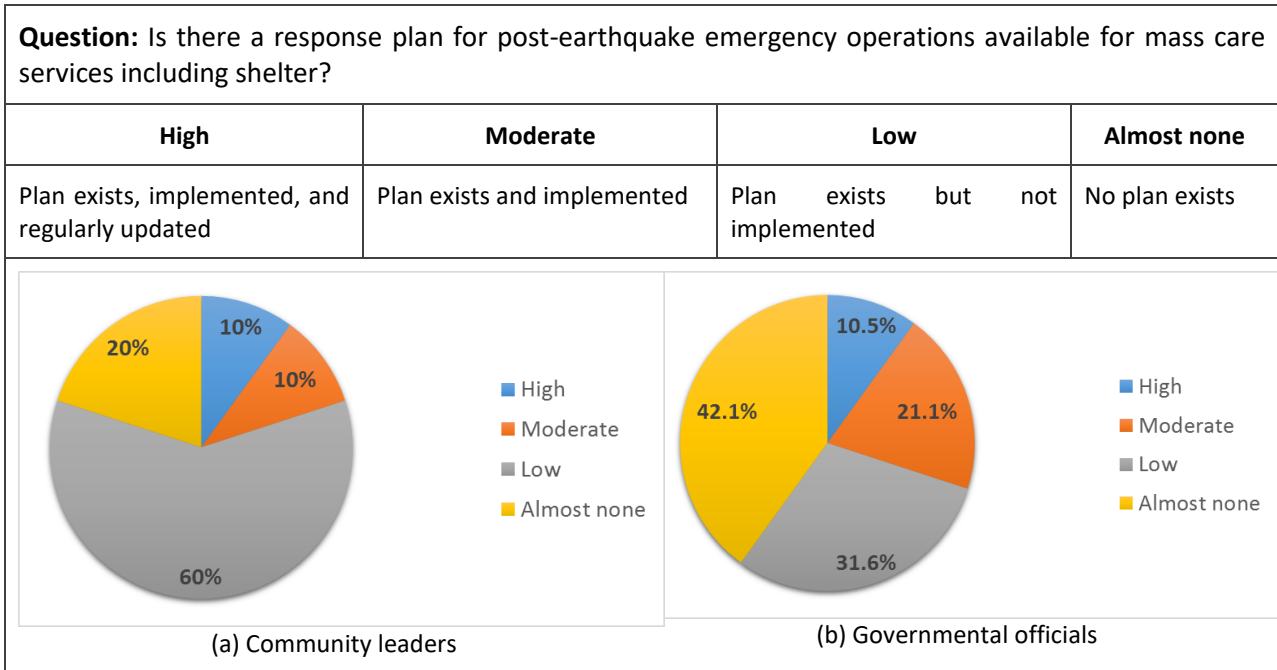


Figure 40 Response plan for post-earthquake emergency operations for integral assistance.

The shelter is an essential component of a pre-impact recovery plan. The short-term shelter demand can result in a temporary housing need for homeless population due to the earthquake, which will be a responsibility (Vecere et al., 2017). This plan should include a spatial component, where the places for shelter are already predefined (Contreras, 2001) according to certain service areas. Recently several models for short-term shelter needs have been developed: SYNER-G, HAZUS-MH, ERGO-EQ, MCEER shelter model, InaSAFE and RiskScape (Vecere et al., 2017). Another option would be to consider the possibility of allocating financial support for families that host people in need of shelters to avoid the occupation of public facilities such as parks, community or sports centres. It is important to remember that schools should not be used as shelters because their occupation could delay the return to normality.

(iv) *Population Security*: Figure 41 shows that for community leaders, they believe that plans exist and are implemented with 50% scoring in the moderate category and 30% in the high. However, the government officials' results were inconclusive as they almost had an equal representation of scores in all the categories.

Question: Is there a response plan for post-earthquake emergency operations available for population security?

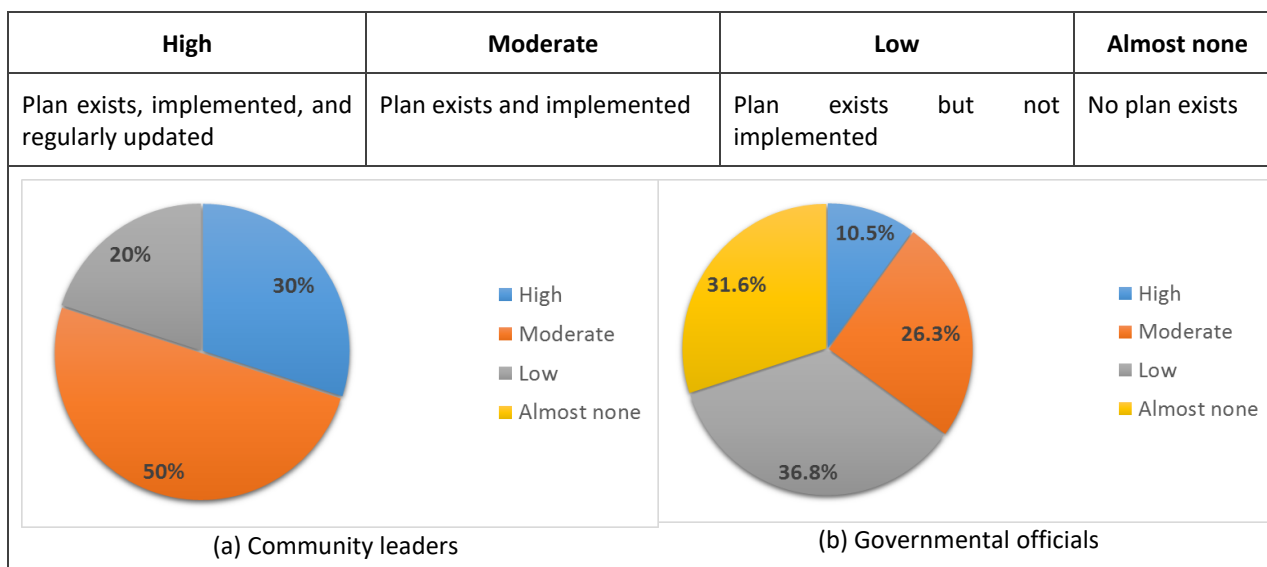


Figure 41 Response plan for post-earthquake operations for integral safety and security.

It is necessary to check if effectively the plan exists. If it does, then it should be socialized into the population, and if does not exist, then a plan should be formulated by the members of the operative officials lead by the Police Department of Addis Ababa with the support of the National Army. Private security companies could also be invited. The plan should be discussed amongst all these officials and then implemented. It is important to have a plan in this aspect to avoid lootings or any other kind of unrest.

(v) *Continuation of economic and livelihood activities*: All participants both from government officials and community leaders did not fully agree on whether or not plans existed for the continuation of economic and livelihood activities. This conclusion is depicted in Figure 42.

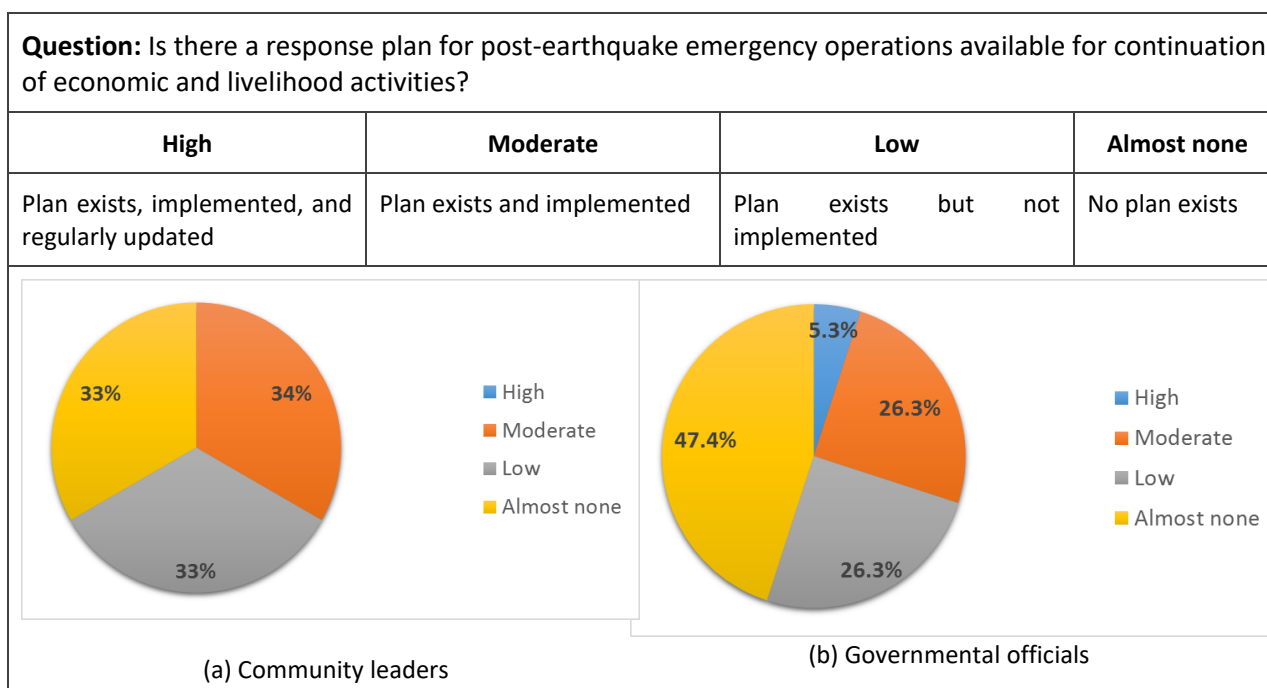


Figure 42 Response plan for post-earthquake operations for productivity and livelihoods.

Unfortunately, the existence of Business Continuity Plan (BCP) is very uncommon in the public sector and more common in the private sector. BCPs attempt to formulate a plan at pre-disaster to restart key business operations to a minimum acceptable predefined level (i.e., Minimum Business Continuity Objective (MBCO)). The restoration process must start immediately after a disruptive event within the so-called Maximum Tolerable Period of Disruption (MTPD) through referring appropriate BC plan(s) (Sahebjamnia, Torabi, & Mansouri, 2015). Disaster Recovery Planning (DRP) endeavors to ensure the full recovery (restoration) of all disrupted operations to their normal business state at post-disaster (ISO:22310, 2012; Sahebjamnia et al., 2015).

The lack of proactive BC and DR planning could lead to loss of reputation and market share. It can also bring customer service and business process failure, regulatory liability and increased resuming and restoring times (Herbane, Elliott, & Swartz, 2004; Hiles, 2010; Losada, Scaparra, & O'Hanley, 2012; Sahebjamnia et al., 2015). The BCP must be formulated in combination with contingency plans to ensure that managers know when to switch from continuity to the recovery phase and allocate resources after the occurrence of disruptive incidents (Sahebjamnia et al., 2015).

(vi) *Critical infrastructure and rehabilitation*: Figure 43 shows that around the 50% of the community leaders consider that plans existed and were implemented. However, from the results of the government officials, it seemed that 42.1% were not convinced such plans even exist.

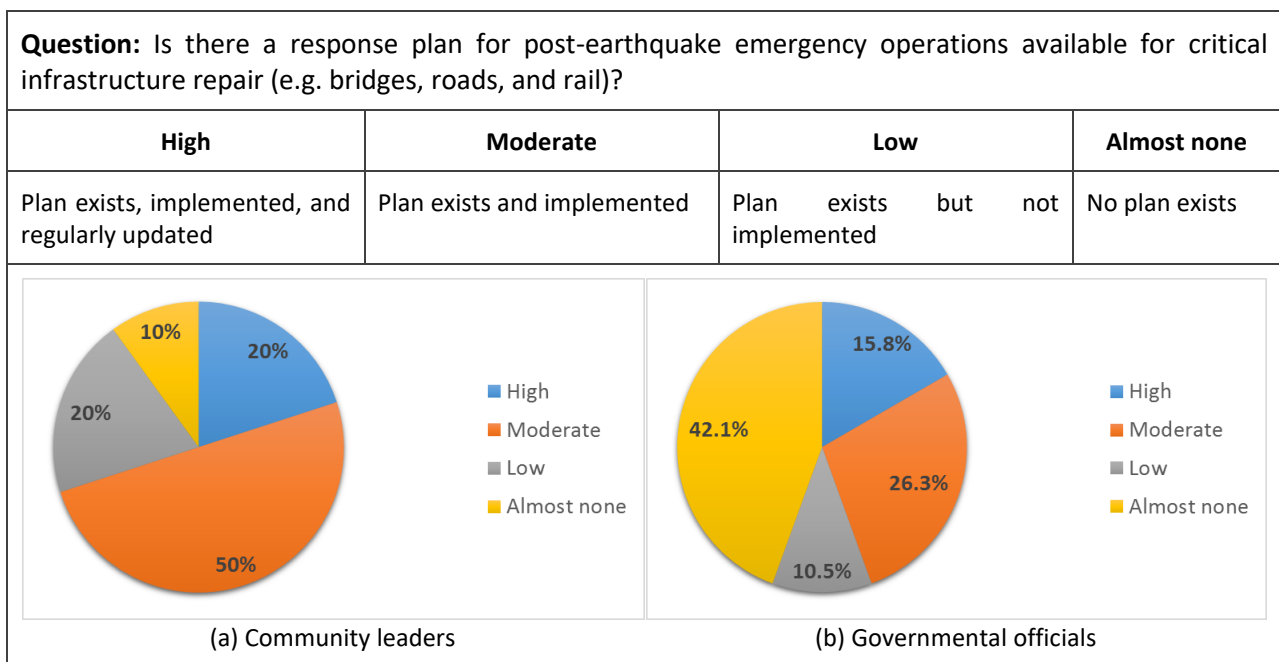


Figure 43 Response plan for post-earthquake operations for infrastructure and rehabilitation.

The lack of existence of a contingency or emergency response plans in critical infrastructure increases the vulnerability and reduce the resilience of the society. The key resilience features in a critical infrastructure are robustness/resistance, resourcefulness, response and recovery and adaptability (Panteli & Mancarella, 2015). The formulation of the response plans makes it possible to visualize the potential damages and failures in the systems to determine the procedures to face them and the alternative solutions. Another item to include in the plan would be to allocate responsibility for the repair and restoration of each component of the infrastructure. The existence of this plan reduces the occurrence of secondary or cascading effects. These plans should be formulated jointly by private companies, the government, and the city officials of Addis Ababa.

(vii) *Residential building and recovery*: most of the community leaders were not in agreement as to whether or not plans existed for residential rebuilding while 47.4% of the government officials considered that no plan exists. This situation is described in Figure 44.

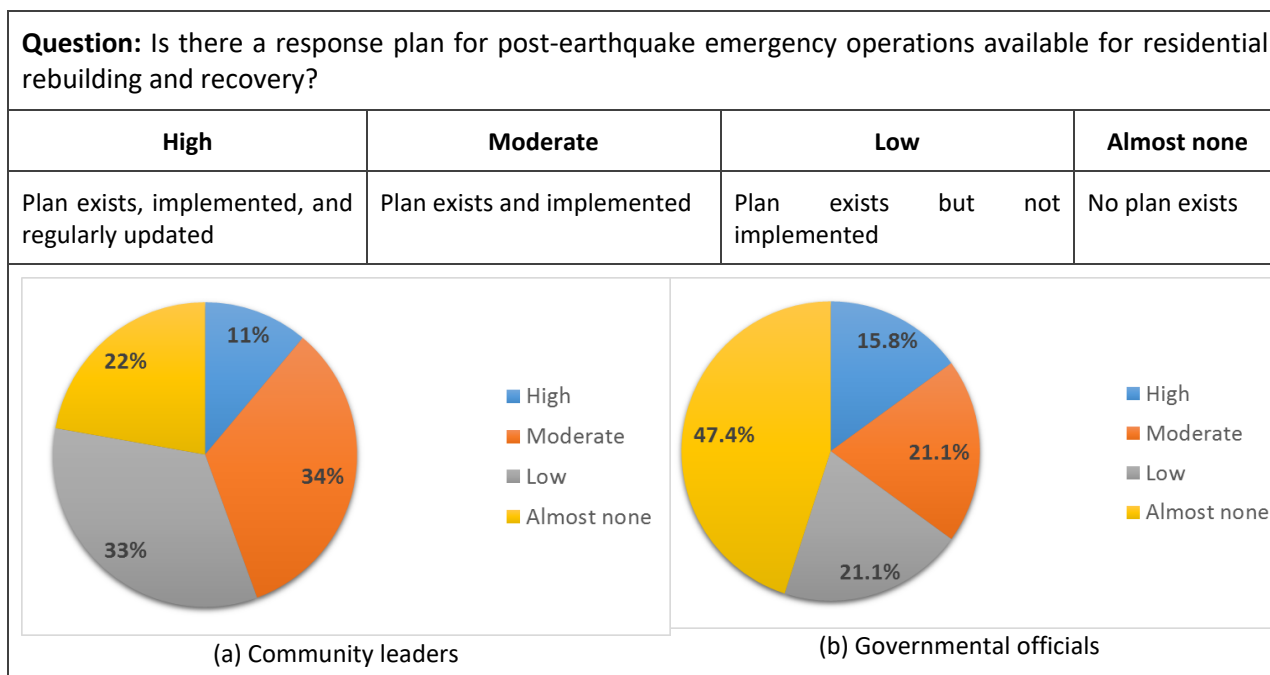
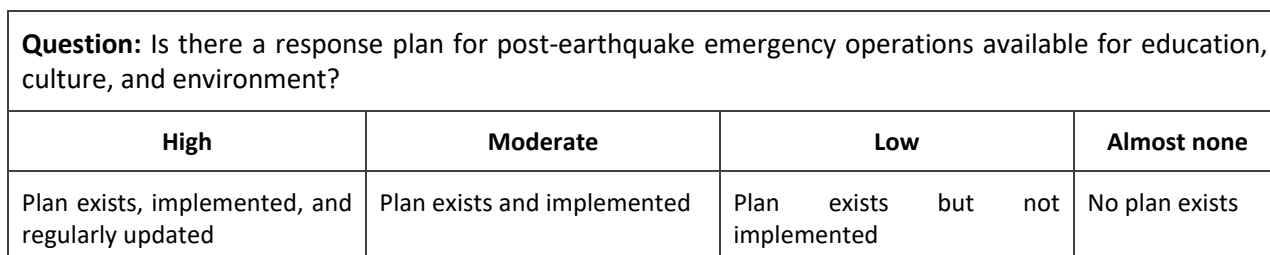


Figure 44 Response plan for post-earthquake operations.

The implementation of this plan should start with the formalization of property rights, which are usually an issue when grants are allocated for reconstruction. The plan could also include the promotion of insurance. The quick reconstruction of houses in Christchurch after the earthquakes in 2010 and 2011 in New Zealand was the result of the high level of insurance. The Addis Ababa City Government (AACG) would take the lead in the development of this plan.

(viii) *Educational, cultural, and environmental restoration*: Figure 45 shows that 31.6% of the participants from public officials consider that no plan exists, 31.6% scored low. As for the community leaders, 40% scored in the moderate and 30% in the high.



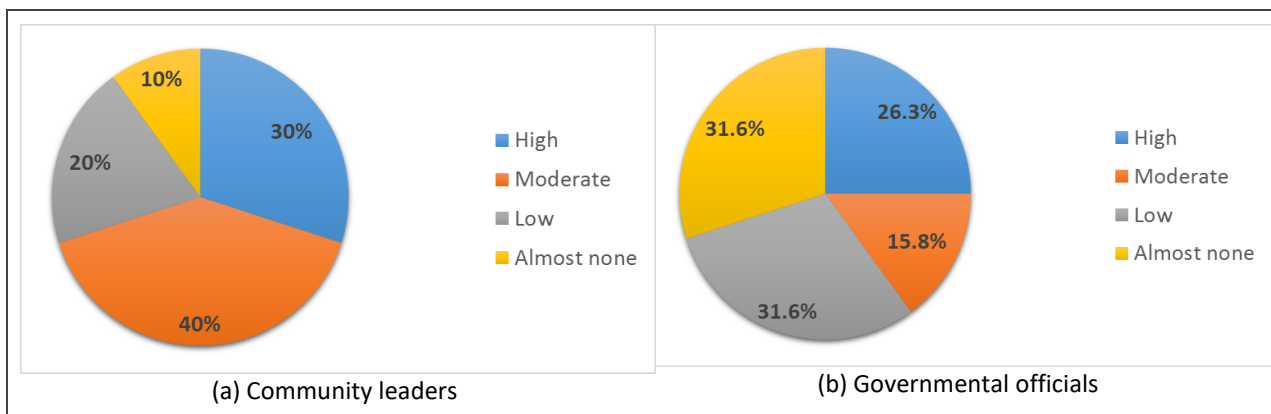


Figure 45 Response plan for post-earthquake emergency operations for education.

In this case, the answers from both, community leaders and Governmental officials point in the same direction, and it is necessary that schools, entities in charge of cultural assets and natural reserves elaborate on contingency and BCP plans.

3.6 Critical Services and Public Infrastructure Resilience

The objective of this theme is to identify the resilience of critical services in case of an emergency. This theme encompasses the assessment, reinforcement, and reduction of structural and non-structural vulnerabilities of critical public infrastructure and lifelines, as well as the development business continuity plans and plans to repair damaged structures. Assessment, reinforcement, and retrofitting of critical public infrastructures such as schools and hospitals.

3.6.1 Assessment, reinforcement and retrofitting of critical public infrastructures

Figure 46 presents the scoring of community leaders and government representatives regarding the assessment, reinforcement, and retrofitting of critical public infrastructures such as schools and hospitals. 60% of the community leaders believe it is carried out for some critical public infrastructure while 57% of the government officials argued to the contrary that such mitigation was low.

Question: To what extent is the assessment, reinforcement, and retrofitting of critical public infrastructure such as schools and hospitals carried out?			
High	Moderate	Low	Almost none
Carried out for most critical public infrastructure	Carried out for some critical public infrastructure	Carried out for few critical public infrastructure	Not carried out

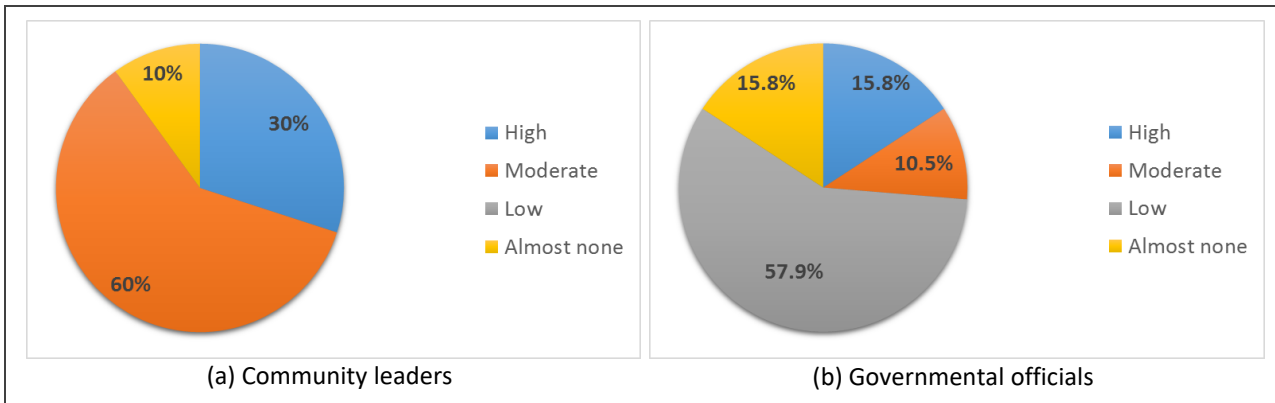


Figure 46 Assessment, reinforcement, and retrofitting of critical public infrastructure.

To protect the life of children and to guaranty the functionality of hospitals, it is compulsory to advance in the retrofitting of these facilities. Taking into account, the role of the hospitals in the emergency response, a priority in this action must be allocated to them.

3.6.2 Incorporation of non-structural improvements to reduce seismic risk

Health facilities

The votes about the incorporation of non-structural improvements to reduce seismic risk to make health facilities more resilient are presented in Figure 47. Many of the participants just under 60%, from governmental officials, consider that such mitigation has not occurred in any hospital.

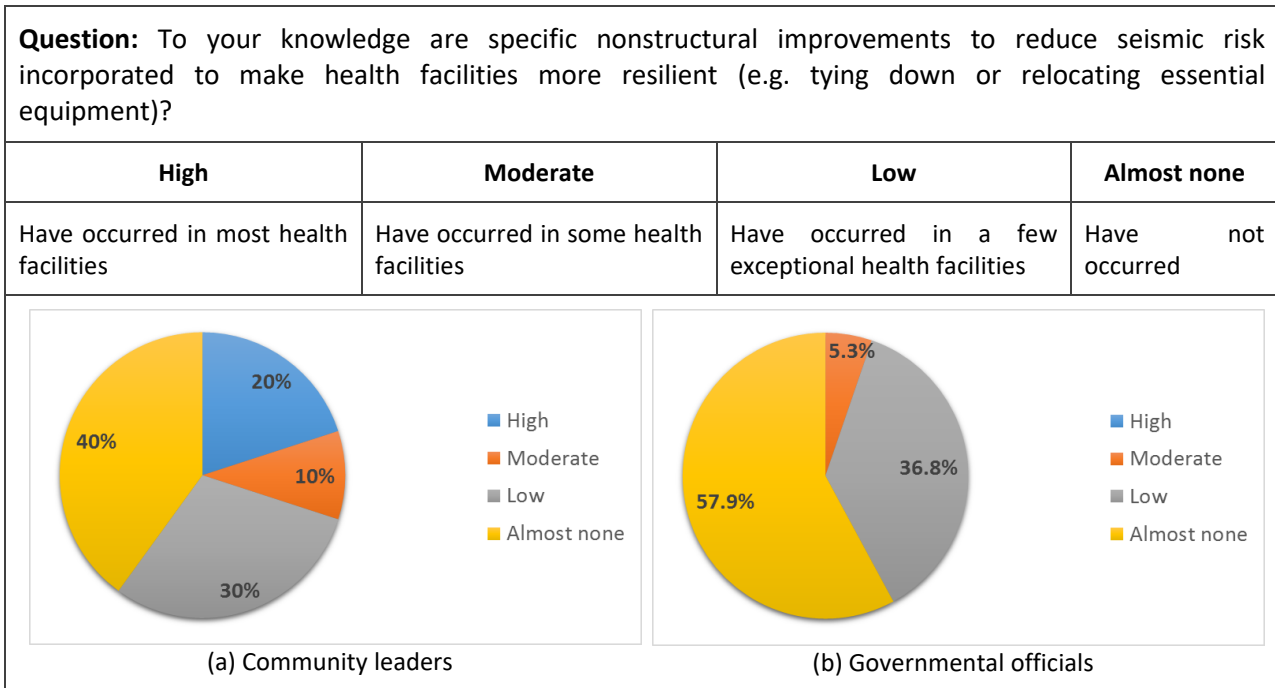


Figure 47 Incorporation of non-structural improvements for health facilities.

Taking into account the role of the health facilities in response to the emergency, actions to guarantee the functionality of them after an earthquake must be defined and accomplished. Each health facility must have an emergency response plan. It must be defined by the staff and implemented through drills with patients. Drills should frequently be repeated, e.g. every year to make the new staff and patients aware of its existence and changes.

Educational facilities

The scoring that pertains to the incorporation of non-structural improvements to reduce seismic risk to make educational facilities more resilient is presented in Figure 48. 65% of the government officials consider almost none of the implementation of such mitigation works has been done while 35% scored low. Within this context, it is relevant to promote the assessment of non-structural vulnerabilities of educational facilities and promote non-structural mitigation within national and local programs.

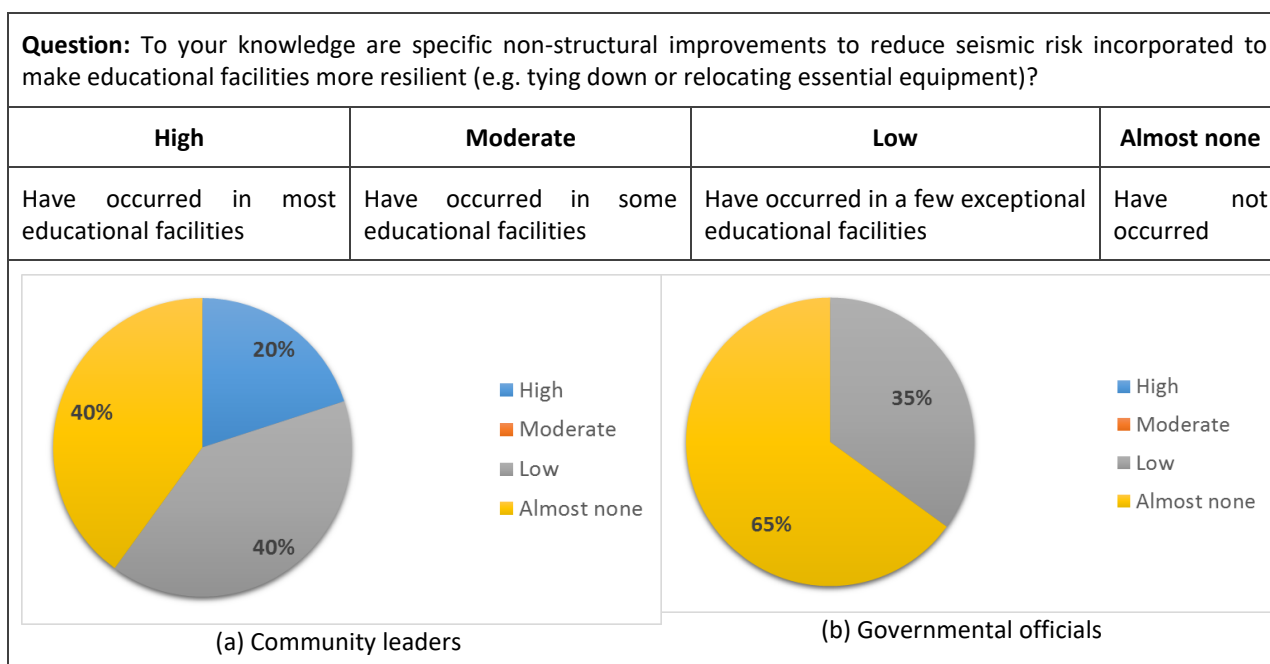


Figure 48 Incorporation of non-structural improvements for educational facilities.

Educational facilities constitute centres where people can share information and get support (Mutch, 2015). Taking into account that children are considered to be a highly vulnerable set of people, actions to reduce the risk in this kind of facilities must be taken. One of the actions is the formulation of the emergency response plans of the school, which must be defined by teachers and discussed with parents. The implementation of this plan must be undertaken by carrying out drills with the students. These exercises should be done at least once a year to ensure that new students and staff of the school are aware of them.

3.6.3 Structural improvements to reduce seismic risk in lifelines

The votes of community leaders and governmental institution representatives regarding the incorporation of structural improvements to reduce seismic risk in lifelines are shown in Figure 49. Most of the participants from governmental officials, 50% consider an almost none implementation of such mitigation and 40% voted in the low category. Based on these results, projects oriented to the assessment and reduction of earthquake risk of lifelines could be promoted.

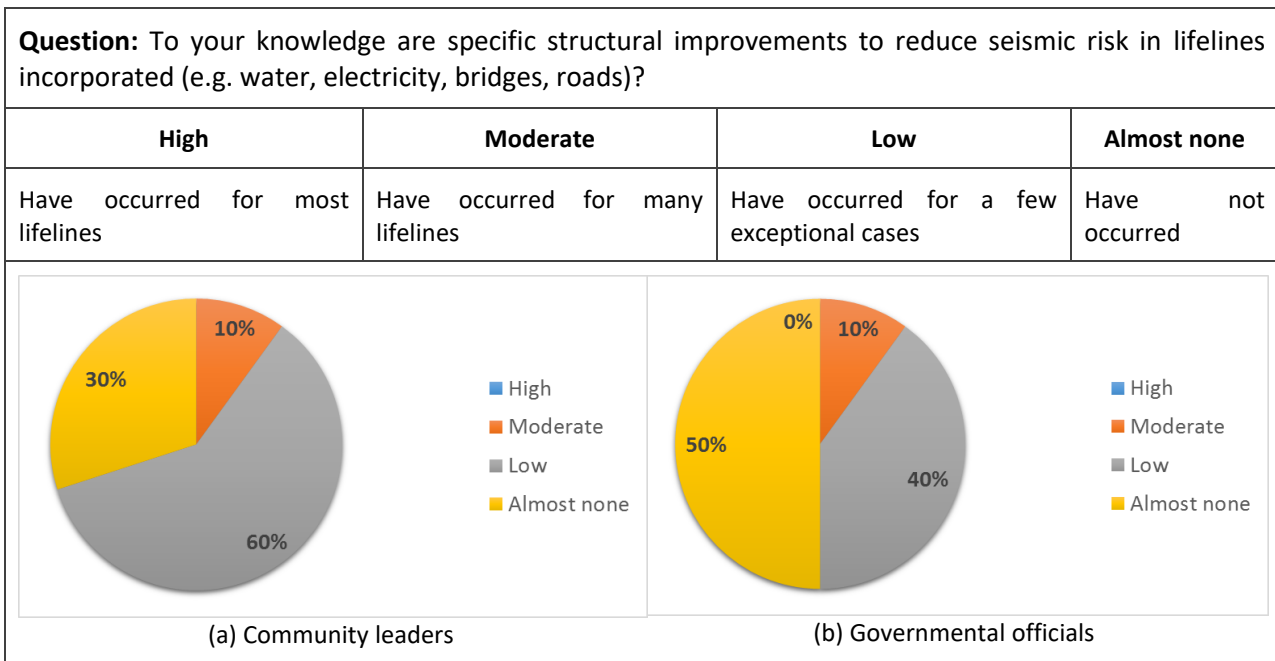


Figure 49 Structural improvements to reduce seismic risk in lifelines.

3.6.4 Business continuity plan of local government offices

The development and implementation of business continuity plans are delineated in Figure 50. 80% of the participants from the governmental officials consider that no plan exists. In this regard, more needs to be done to have such plans in place and make people aware of them.

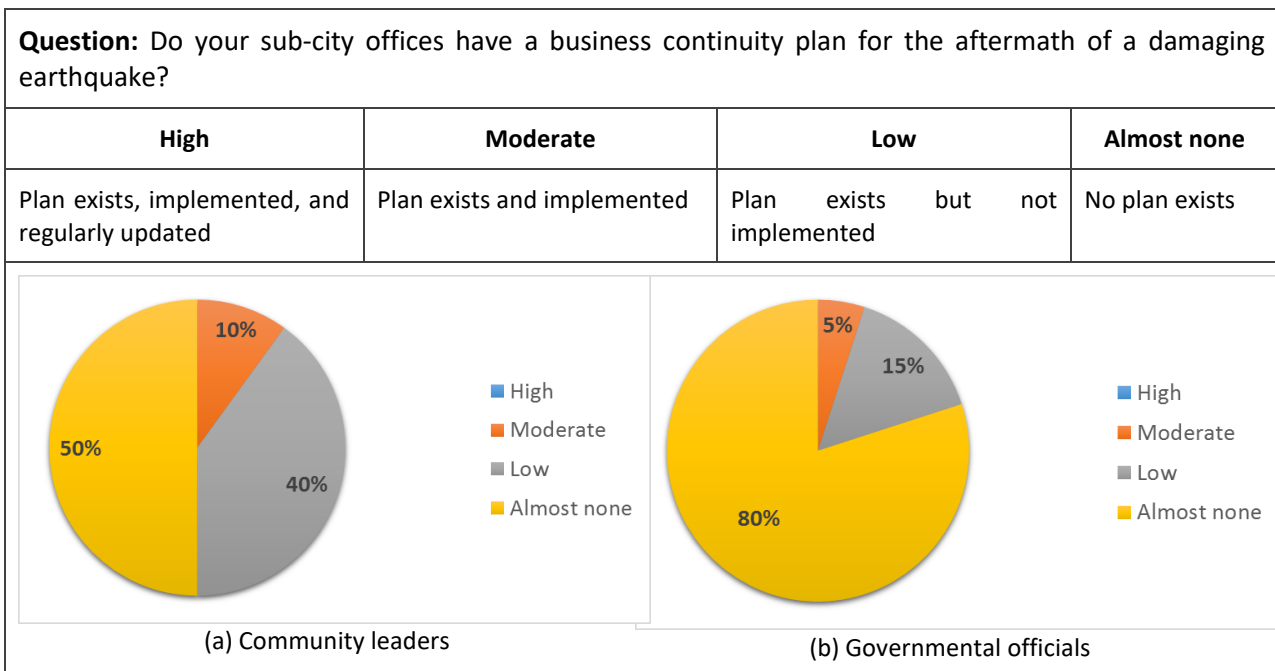


Figure 50 Business continuity plan of local government offices.

3.6.5 Plans for the repair or replacement of critical lifelines

The repair or replacement of critical lifelines in the aftermath of a damaging earthquake is depicted in Figure 51. 36.8% of the participants from the governmental officials consider that no plan exists; while another 36.8% considered that plans do exist but are not implemented. More needs to be done to address efforts in the definition and implementation of recovery activities of public systems and lifelines in contingency plans.

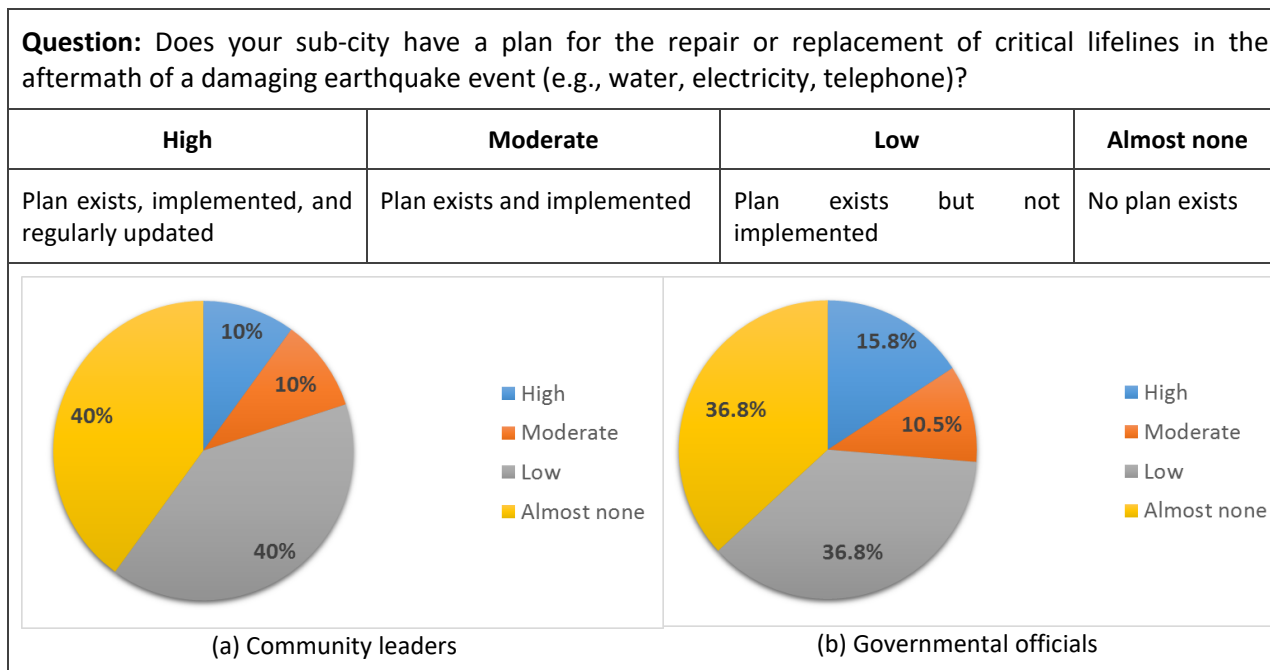


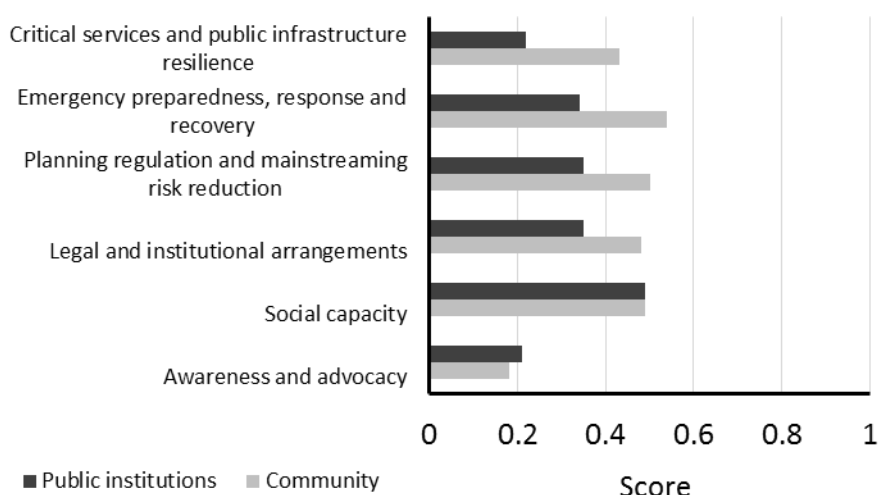
Figure 51 Plans for the repair or replacement of critical lifelines.

4 PERFORMANCE BY RESILIENCE DIMENSIONS

This part seeks to assess the resilience level of Addis Ababa by analyzing the six dimensions of resilience as a whole rather than treating them separately, as done in the previous chapter. As seen in Table 2 and Figure 52, the city is not doing well in any of the six dimensions of resilience with practically all the normalized scores being below 0.5. It must be remembered that results close to 0 represent a very low resilience (almost none) and values close to 1 represent a high resilience. Community leaders, in general, have a less negative view of the status of the city’s resilience when compared to the view of government officials. Community leaders, however, score very low when characterizing the levels of awareness and information regarding disaster resilience and this lack of information and understanding may significantly affect the accuracy of their views regarding all the other dimensions of resilience. On the other hand, the very low values (almost all of them below 0.35) given by the government officials, who are in charge of leading the implementation of resilience-enhancing initiatives, may be a better reflection of the actual status of resilience in Addis Ababa. In this case, it must be considered the fact because of people all over the world, and particularly government officials, tend to be rather generous when self-evaluating their performance.

Table 2 Resilience-dimensions indices.

Resilience dimension	Community Leaders	Government officials
Awareness and advocacy	0.18	0.21
Social capacity	0.49	0.49
Legal and institutional arrangements	0.48	0.35
Planning regulation and mainstreaming risk reduction	0.5	0.35
Emergency preparedness, response, and recovery	0.54	0.34
Critical services and public infrastructure resilience	0.43	0.22

**Figure 52 Summary of resilience-dimensions indices.**

The following graphs give a more comprehensive insight into how each sub-city scored in each of the six dimensions. They were then compared against the average scores of all sub cities and governmental officials in each of the dimensions to see how each sub-city performed in comparison to others.

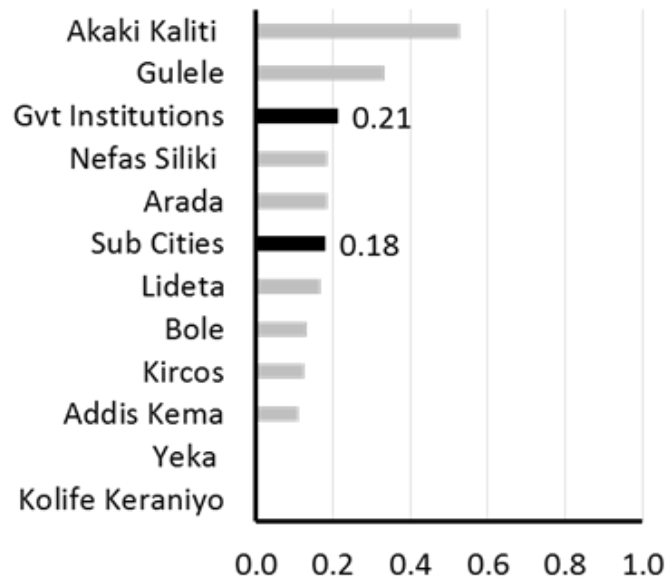


Figure 53 Awareness and advocacy results summary.

The average scores for awareness and advocacy of earthquake disaster information seen in Figure 53 were drastically low. The government officials were convinced they were doing more, but the figure of 0.21 is not satisfactory. Based on this graph, two sub-cities Akaki Kaliti and Gulele scored higher. This could be a result of more information being disseminated in these areas. Yeka and Kolife Keraniyo both scored 0 possibly showing a lack of attention in the distribution of information to these two areas. These low scores are of concern and information centres should be put up to close this wide gap.

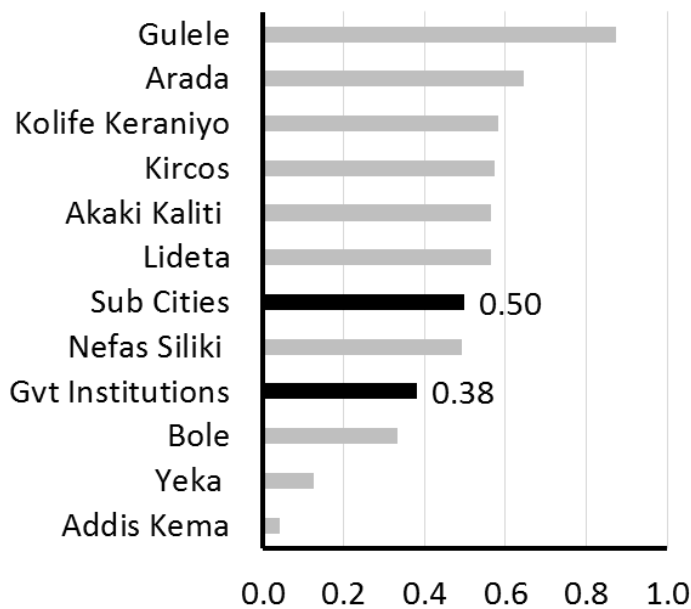


Figure 54 Legal and institutional arrangements result in summary.

The scores given by sub-cities as shown in Figure 54 are quite high especially Gulele and Arada with four other sub-cities having the same average score which is just under 0.6. Comparing this with how the government officials scored, it can be seen that the officials are not fully convinced that the situation is as optimistic as it is being depicted by community leaders. Bole, Yeka and Addis Kema sub-cities seem to

agree with this as they scored the lowest. This gap might be due to some groups of people not knowing what legal/social frameworks are available to them to help protect them from earthquake disasters.

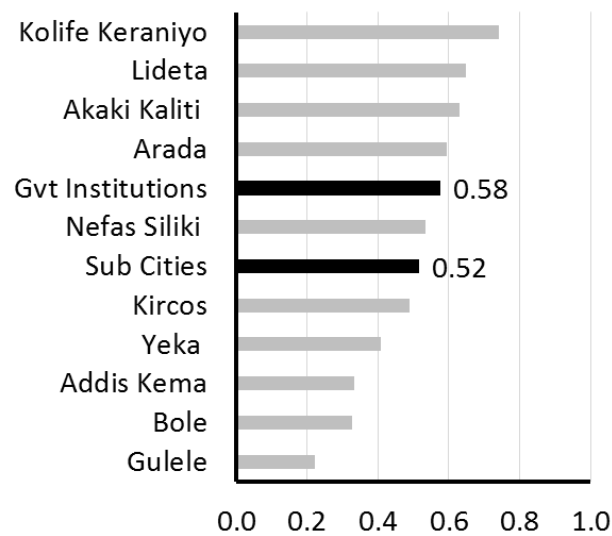


Figure 55 Social capacity results summary.

As can be noted from Figure 55, the response to this section was very positive, and it seemed most sub-cities had very healthy social ties within their respective communities. Comparing with average scores, most sub-cities fell above the average scores. However, Gulele, Bole, Addis Kema and Yeka scored quite low and this concerning as it shows a lack of capacities of the populations within these communities to prepare efficiently, respond and recover from a damaging earthquake. While the government officials may feel they are going a great job, more still needs to be done for these sub-cities.

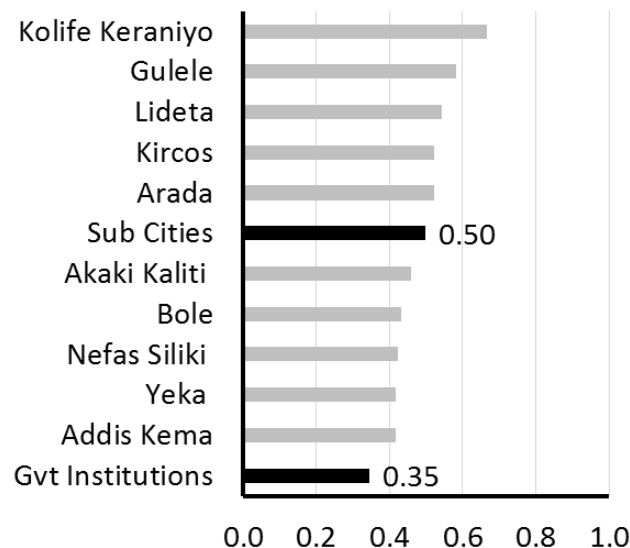


Figure 56 Planning, Regulation, and Mainstreaming Risk Mitigation result summary.

While all sub-cities thought that there were adequate plans for earthquake risk mitigation, Figure 56 also shows that the government officials were of the opinion that this was not the case. A pessimistic view like this from the government shows that they are aware of the shortcomings and gives them the opportunity to deal with the causes of this situation.

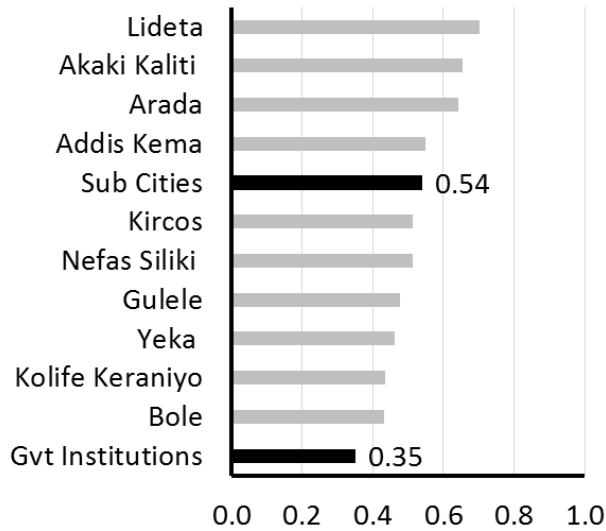


Figure 57 Emergency Preparedness, Response, and Recovery results summary.

It can be noticed from Figure 57 that Lideta, Akaki kaliti, Arada and Addis Kema sub-cities perceive that there are effective emergency preparedness measures in place. However, like the previous dimension, the government officials do not agree with this opinion and have scored the lowest. This result may reflect that the officials are aware of their weaknesses and acknowledge that the effectiveness and performance of the risk management system of the city may need to be re-examined regarding response and recovery in case of emergencies.

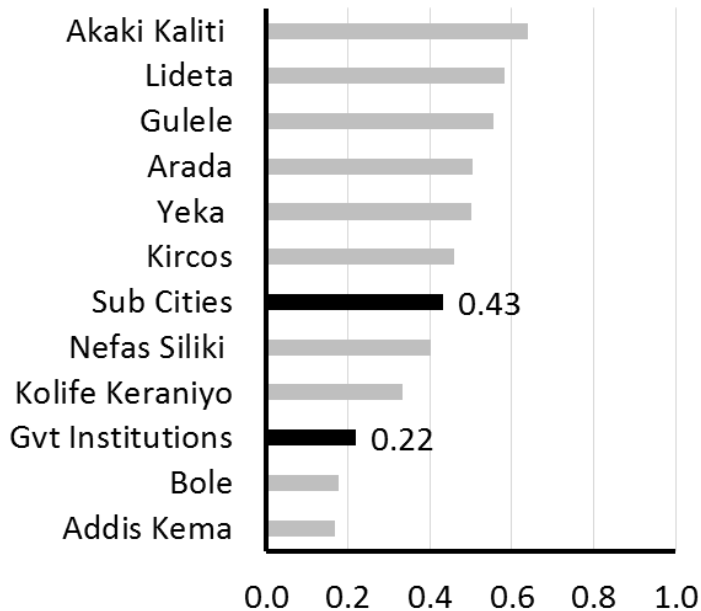


Figure 58 Critical Services and Public Infrastructure Resilience results summary.

Akaki Kaliti, Lideta and Gulele scored highest as seen in Figure 58. However, the average score for the sub-cities was low. Bole and Addis Kema scored the lowest even below the government officials average score. There is clear mistrust on the ability of the people in charge, the capacity of lifelines and critical facilities to react and respond during and after earthquake events.

Table 3 Ranking of sub-cities according to scores for each dimension

Dimension	Top 5	Bottom 5
Awareness and Advocacy	Akaki Kaliti	Bole
	Gulele	Kircos
	Nefas Sikili	Addis Kema
	Arada	Yeka
	Lideta	Kolife Keraniyo
Social Capacity	Kolife Keraniyo	Kircos
	Lideta	Yeka
	Akaki Kaliti	Addis Kema
	Arada	Bole
	Nefas Siliki	Gulele
Legal and Institutional Arrangements	Gulele	Lideta
	Arada	Nefas Siliki
	Kolife Keraniyo	Bole
	Kircos	Yeka
	Akaki Kaliti	Addis Kema
Planning Regulation and Mainstreaming Risk Mitigation	Kolife Keraniyo	Lideta
	Gulele	Nefas Siliki
	Lideta	Bole
	Kircos	Yeka
	Arada	Addis Kema
Emergency Preparedness Response and Recovery	Lideta	Nefas siliki
	Akaki Kaliti	Gulele
	Arada	Yeka
	Addis Kema	Kolife Keraniyo
	Kircos	Bole
Critical Services and Public Infrastructure Resilience	Akaki Kaliti	Kircos
	Lideta	Nefas sikili
	Gulele	Kolife Keraniyo
	Arada	Bole
	Yeka	Addis Kema

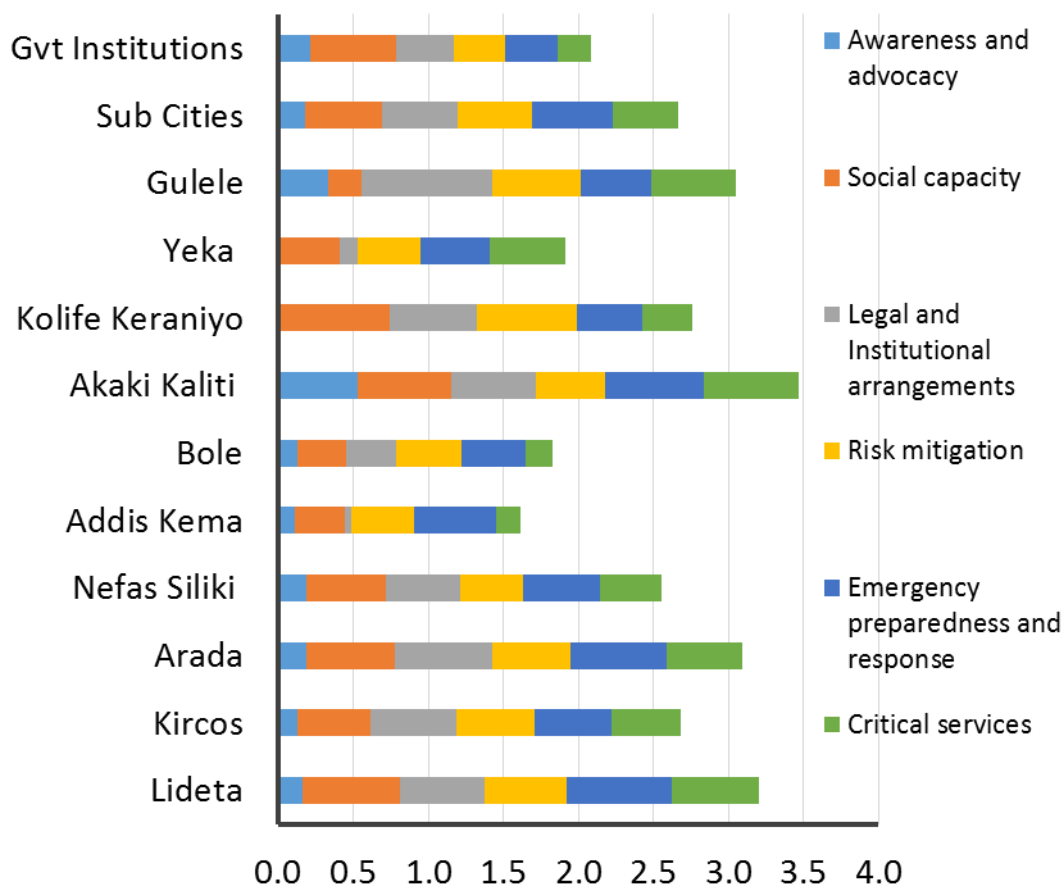


Figure 59 Total score by sub-city based on community leaders.

Table 3 and Figure 59 seek to analyse and show which sub-cities consistently scored higher or lower than the others. They show which areas within Addis Ababa have better overall resilience, and which ones have lower based on how they ranked on average. These results may be useful to identify sectors within the city requiring increased effort and investments for enhancing earthquake resilience.

Based on this information, it was seen that Arada sub-city was always in the top 5. Lideta and Akaki Kaliti appeared 5 out of 6 times in the top 5, and these two sub-cities always scored the highest. These three sub-cities give the impression that they are the most resilient amongst the others. Further investigation by the local authorities is recommended to be carried out to understand if this is the case on the ground and if it is, how these sub-cities can be used as examples to replicate their success to underperforming sub-cities.

Bole sub-city consistently scored the lowest and was always in the bottom 5. Yeka and Addis Kema appeared 5 out of 6 times in the bottom 5, and Nefas Sikili appeared 4 out of 6 times in the bottom 5. These four sub cities are considered to be the least resilient based on the information gathered. It is recommended as well to see the real situation within these communities and find out why this may be the case. A comparison with the better performing sub-cities could yield useful results that can be cross-replicated across the board.

The remaining sub-cities namely; Kircos, Kolife Keraniyo and Gulele appeared 3 out of 6 times on both the top and bottom five ranking. This result may be misunderstood as being in the average, but in fact, they may be less resilient and require further assistance to improve their overall resilience.

As seen from the results in Table 4, there is a low level of perceived resilience within the focus groups. Most of the participants scored in the low category, followed by the almost none category, then the moderate. None of the participants scored in the high resilience category. These results show a huge opportunity for the city of Addis Ababa to start pilot programs and bridge the gap in the areas that are lacking fundamental resilience activities.

Table 4 Percentage of resilience components by ranges of the index.

Range of indices		Percentage of components
Almost none	0.0 - 0.1	4%
	0.1- 0.2	13%
Low	0.2- 0.3	23%
	0.3-0.4	26%
	0.4-0.5	23%
Moderate	0.6-0.7	4%
	0.7-0.8	4%
	0.8-0.9	2%
High	0.9-1.0	0%
	1	0%

The actual data of the results of the resilience scorecard for Addis Ababa are shown in Table 5 and Figure 60. The actual values are colour coded from red (showing the lowest values recorded signifying lower resilience) to yellow as resilience scores improve and finally green for the highest values which correspond to higher resilience. These results are useful for evaluation and planning purposes as they show the response and the score for each question as a group average rather than per individual who participated. It can help shed light on the projects that could be prioritised for capacity enhancement for both the community and the city authorities.

Table 5 Resilience Scorecard results for Addis Ababa.

Theme	Name	Community Leaders	Government officials
Awareness and advocacy	T1-Earthquake risk perception & awareness	0.31	0.45
	T1-Availability of Information on earthquakes	0.14	0.22
	T1-Information in multiple languages	0.14	0.17
	T1-Awareness and Preparedness Exercises	0.13	0.08
	T1-Participation in awareness and preparedness exercises	0.25	0.12
	T1-Training and capacity building programs	0.11	0.25
Social capacity	T2-Health and social support programs	0.45	0.40
	T2-Participation in decision-making	0.33	0.50

Theme	Name	Community Leaders	Government officials
	T2-Social integration (economic)	0.44	0.46
	T2-Access to basic services	0.45	0.67
	T2-Basic primary education	0.67	0.65
	T2-Social integration (different ethnicities)	0.76	0.78
	T2-Interaction of government & other institutions	0.56	0.45
	T2-Community involvement in decision making	0.52	0.35
	T2-Programs to safeguard historic monuments	0.24	0.13
Legal and Institutional Arrangements	T3-Effectiveness of earthquake safety regulations	0.27	0.22
	T3-Individuals with clear DRR roles	0.52	0.55
	T3-Mechanisms for DRR (city vs. government)	0.58	0.49
	T3-Mechanisms for DRR (inter-sub city)	0.56	0.35
	T3-Mechanisms for DRR (city vs private enterprises)	0.52	0.42
	T3-Confidence in central government	0.54	0.25
	T3-Confidence in local government	0.52	0.23
Planning, Regulation and Mainstreaming of risk reduction	T3-Confidence in NGOs	0.34	0.26
	T4-Seismic building codes	0.23	0.25
	T4-Enforcement of seismic building codes	0.73	0.47
	T4-Availability of earthquake insurance	0.27	0.15
Emergency preparedness, response and recovery	T4-Funds for DRR & earthquake mitigation	0.76	0.51
	T5-Storage of food supplies	0.33	0.30
	T5-Centres for emergency response coordination	0.75	0.48
	T5-Emergency procedures	0.56	0.37
	T5-Funds for response and recovery	0.66	0.40
	T5-Trained personnel for response	0.37	0.22
	T5-Equipment for search, rescue and response	0.57	0.33
	T5-Plan for restoring health & sanitation services	0.31	0.26
	T5-Response plan for search and rescue	0.54	0.32
	T5-Plan for providing shelter	0.49	0.32
	T5-Security plan for victims	0.75	0.37
	T5-Business continuity plan	0.38	0.29
	T5-Plan to restore critical infrastructure	0.62	0.40
T5-Plan for residential rebuilding and recovery	0.51	0.33	
T5-Restoration of education, culture and environment	0.70	0.43	
Theme	Name	Community Leaders	Government officials
Critical services and public infrastructure resilience	T6-Assessment and reinforcement of critical facilities	0.78	0.42
	T6-Non-structural mitigation for health facilities	0.44	0.17
	T6-Non-structural mitigation for educational facilities	0.41	0.11
	T6-Structural improvements to life lines	0.35	0.21
	T6-Availability of a business continuity plan	0.23	0.08
	T6-Plans on the repair and replacement of critical lifelines	0.38	0.33



Figure 60 Government officials scores sorted from highest to lowest.

5 POTENTIAL ACTIVITIES FOR INCREASING RESILIENCE IN THE CITY

The application of the RPS was useful to evaluate the status, current gaps, and achievements concerning key dimensions of resilience in Addis Ababa. Using the results reported within, it is envisioned that it will be possible for relevant stakeholders to discover areas of opportunity. Further efforts are needed to evaluate the resilience of systems within Addis Ababa, to update resilience enhancement strategies with the participation of public officials and community leaders, to set benchmarks for resilience enhancement over time, to foster communications between various levels of government, and to develop earthquake risk reduction strategies. A set of potential activities for increasing resilience are suggested in this part of the report, to contribute to the development of a long-term earthquake plan reduction for the city.

The city of Addis Ababa is unique in that within its sub-cities, people seemed to know each other very well and showed a willingness to support each other during times of crises. There is the presence of welfare programs for contributing to the enhancement of the city's capacity to respond to emergencies but not specifically for earthquake events. From what could be seen from the responses, there was more awareness of other hazards such as droughts and floods mainly because they had experienced them before and had never experienced an earthquake event.

Considering the achievements of the city in risk management as well as the results of the resilience scorecard, this section presents, for each dimension and component, relevant topics that could be included in future agendas and programs of the Metropolitan System of Risk Management of Addis Ababa.

Awareness and advocacy. To make informed decisions, earthquake risk scenarios and loss estimate that consider residential, critical facilities and relevant economic sectors of the city could be promoted. Such results could be communicated in relevant languages to the public and could be available in a system of information for disaster risk management. Table 6 presents additional areas of opportunity to improve awareness and advocacy in Addis Ababa.

Table 6 Suggested topics to improve awareness and advocacy

Name	Suggested topics
Level of awareness	<ul style="list-style-type: none"> ▪ Promotion of risk identification projects. ▪ Implementation of a system of information for disaster risk of Addis Ababa.
Information about earthquake safety	<ul style="list-style-type: none"> ▪ The correspondent dissemination of the results, looking for a better understanding of risk within the communities.
Public outreach activities and Training and capacity building	<ul style="list-style-type: none"> ▪ To inform a wider audience in campaigns such as those promoted in the Urban Risk Reduction Program.

Social capacity. Social capacity within the city may be increased by considering these results coupled with indicators of social vulnerability and estimates of direct losses (physical risk) to plan and manage the city's earthquake risk from an integrated perspective. Areas of opportunity that may be considered to improve social capacity within the city are presented in Table 7.

Table 7 Suggested topics to improve social capacity

Name	Suggested topics
Ties and connections and integration between sub-cities	<ul style="list-style-type: none"> ▪ Promotion of drills and emergency plans at the community/sub-city level and even neighbourhoods.

Name	Suggested topics
Access to public services	<ul style="list-style-type: none"> Review of the coverage and access to public services to consider existing limitations in the design of emergency and contingency plans to supply the needs of vulnerable and affected populations after an earthquake.
Access to education	<ul style="list-style-type: none"> Review of the coverage and access to public education to consider such limitations in the design of post-earthquake emergency operations for productivity and livelihoods, as well as for education, culture, and environment.
Participation in decision making	<ul style="list-style-type: none"> Promotion of participatory mechanisms for community leaders in earthquake risk management projects.
Cultural heritage	<ul style="list-style-type: none"> Given the city's huge historical value, efforts could be promoted to retrofit historical buildings and cultural monuments.

Legal and institutional arrangement. Considering the organisation and functions of the city of Addis Ababa, roles and activities could be established in earthquake risk management plans for the city. Table 8 suggests topics that could improve legal and institutional arrangements within the city.

Table 8 Suggested topics to improve legal and institutional arrangements

Name	Suggested topics
Regulation, Ordinance or incentives for earthquake safety	<ul style="list-style-type: none"> Communication and explanation to the public of national and local regulations and ordinances for disaster risk reduction. Development of a long-term earthquake risk reduction strategy for the city.
Roles of community leaders in disaster risk management and cooperation between Sub cities, municipality, and NGOs	<ul style="list-style-type: none"> Promotion, with the collaboration of NGOs, of participatory mechanisms for community leaders and development of common agendas for disaster risk reduction between Sub cities and the Municipality. Evaluation of staffing needs and implementation of specialized training to improve staff capacity at the Metropolitan System of Risk Reduction.

Planning, Regulation and mainstreaming risk reduction. Areas of opportunity that may be utilized to improve aspects related to planning, regulation and risk reduction within the city are presented in Table 9.

Table 9 Suggested topics to improve planning, regulation and mainstreaming risk reduction.

Name	Suggested topics
Earthquake resistant building codes	<ul style="list-style-type: none"> Stronger control mechanisms for the implementation of the existing building code (EBCS-1995). Socialization of current building code (EBCS-1995), especially among governmental officials. Analysis of incentives for reinforcement or retrofitting of buildings to meet the requirements of the building code (EBCS-1995).
Budget for disaster risk reduction	<ul style="list-style-type: none"> Review of budget limitations and needs for promoting risk reduction projects. Design projects and proposals to be funded by international donors and organizations. Clear communication to the population of budget limitations as well as the criteria and procedures used for prioritizing interventions.
Availability and use of insurance	<ul style="list-style-type: none"> Review and analysis of insurance regulations, household capacities and insurance mechanisms for public infrastructure and residential buildings.

Emergency preparedness, response, and recovery. Suggested topics to improve aspects related to planning, regulation and risk reduction within the city are listed in Table 10.

Table 10 Suggested topics to improve emergency preparedness, response, and recovery.

Name	Suggested topics
Standard operational procedures for coordinating emergency rescue and response activities	<ul style="list-style-type: none"> ▪ Establishment of training programs for members of the community on first response, first aid and light search and rescue (SAR). ▪ Establishment of training programs for relevant institutions, such as FEPR, Civil Protection, Red Cross and Police, on medium and heavy search and rescue (SAR). ▪ Establishment of training programs for engineers, architects (both professionals and students) on building safety assessment after earthquakes. ▪ Formulation of a post-event building safety assessment plan to determine efficiently the occupancy feasibility of damaged buildings. ▪ Establishment of training programs on damage assessment and needs analysis (DANA). ▪ Dissemination and communication of existing operational procedures or protocols for emergency response. ▪ Implementation of existing operational procedures or protocols through simulation and drills with the participation of all relevant institutions, such as FEPR, Civil Protection, Red Cross and Police and the community.
Local centres for implementing and coordinating emergencies	<ul style="list-style-type: none"> ▪ The prevention and preparedness committee needs physical headquarters easily identified by the community and equally distributed around the city, either with similar service areas (response areas) or with smaller service areas in high-vulnerability zones of the city. ▪ Implementation of public outreach activities to inform about the local centres for emergency coordination.
Funds for emergency response and recovery	<ul style="list-style-type: none"> ▪ Estimation of the potential costs and financial needs for emergency response and identification of potential funding sources. ▪ Promotion of affordable, effective insurance mechanisms. ▪ Establishment of an emergency response and recovery fund to cover the needs of Addis Ababa in case of an earthquake
Resources for emergency response and recovery	<ul style="list-style-type: none"> ▪ Establishment of an information system of resources for emergency response. ▪ Evaluation of the city's response capacity by comparing current inventories with estimates of potential damages. ▪ Development of a pre-disaster shelter program to attend people left by an earthquake.
Contingency plans	<ul style="list-style-type: none"> ▪ Delineation of evidence-based contingency plans for earthquakes. ▪ Public outreach activities to inform about contingency plans and their implementation. ▪ Implementation of simulations and drills with communities to test, socialize and improve available contingency plans.

Critical services and public infrastructure resilience. Areas for the improvement of critical services and public infrastructure resilience within the city are described in Table 11.

Table 11 Suggested topics to improve emergency preparedness, response and recovery

Name	Suggested topics
Assessment and retrofitting of critical facilities and reduction of non-structural vulnerabilities	<ul style="list-style-type: none"> ▪ Assessment of physical vulnerability of health and educational facilities. ▪ Strengthening and retrofitting of health and educational facilities. ▪ Assessment of the vulnerability and potential losses of lifelines and implementation of mitigation actions.
Contingency/Emergency response plans and Business	<ul style="list-style-type: none"> ▪ Formulation and implementation of emergency response plans for schools and health facilities.

Name	Suggested topics
Assessment and retrofitting of critical facilities and reduction of non-structural vulnerabilities	<ul style="list-style-type: none"> ▪ Assessment of physical vulnerability of health and educational facilities. ▪ Strengthening and retrofitting of health and educational facilities. ▪ Assessment of the vulnerability and potential losses of lifelines and implementation of mitigation actions.
continuity plans for lifelines	<ul style="list-style-type: none"> ▪ Formulation of pre-disaster contingency and recovery plans. ▪ Formulation and implementation of Business Continuity Plans (BCP) plan for lifelines. ▪ Simulations and drills to review and adjust BCP.

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APPENDIX

Scores by resilience dimensions

Minimum, maximum and average values of the scores were obtained from each of the questions and are presented in this section. This analysis is useful to identify components requiring more efforts to improve the resilience to earthquakes in Addis Ababa. It also outlines the differences in the scores obtained from community leaders and representatives of the city's government/public officials.

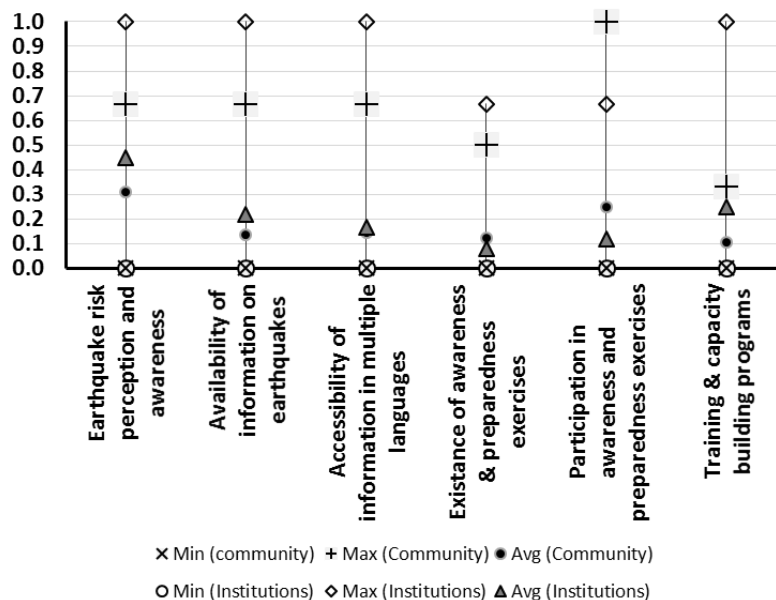
Awareness and advocacy

Scores obtained from each of the questions within this dimension are shown below in Figure A1. The government/public officials scored higher. It can be noted as well that the lowest score in this dimension was related to the question of the existence of awareness and preparedness exercises.

Lowest score Existence of awareness and preparedness exercises.

Highest score Earthquake risk perception and awareness.

Score differences between groups Scores given by public officials are higher than those given by the community representatives.



A 1 Awareness and advocacy.

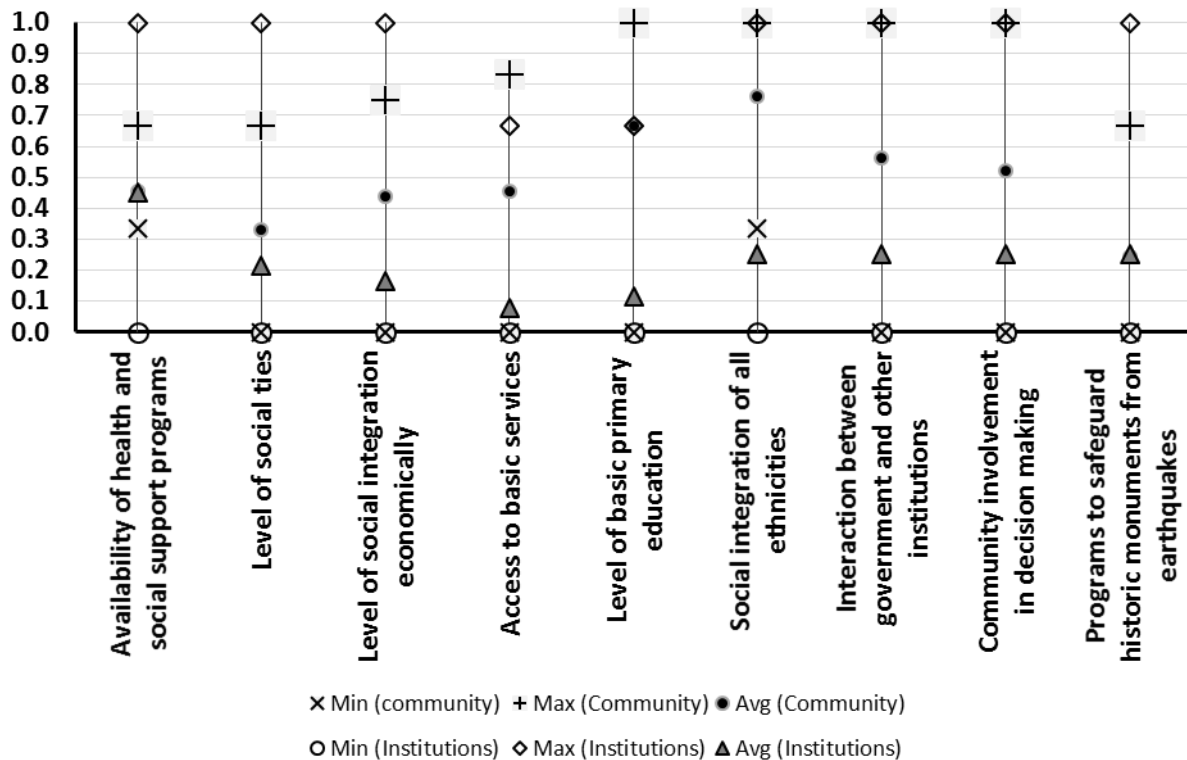
Social Capital

Overall, this dimension as can be seen from Figure A2 had the highest scores from both sets of groups. It is clear that the city officials have done a lot to support the community and the community recognizes the efforts that were put forward.

Lowest score Programs to safe guard historic monuments.

Highest score Social Integration of different ethnicities.

Score differences between groups Average scores given from the community were higher than those from the public officials. However, both groups scored in the high range.



A 2 Social Capital.

Legal and institutional arrangements

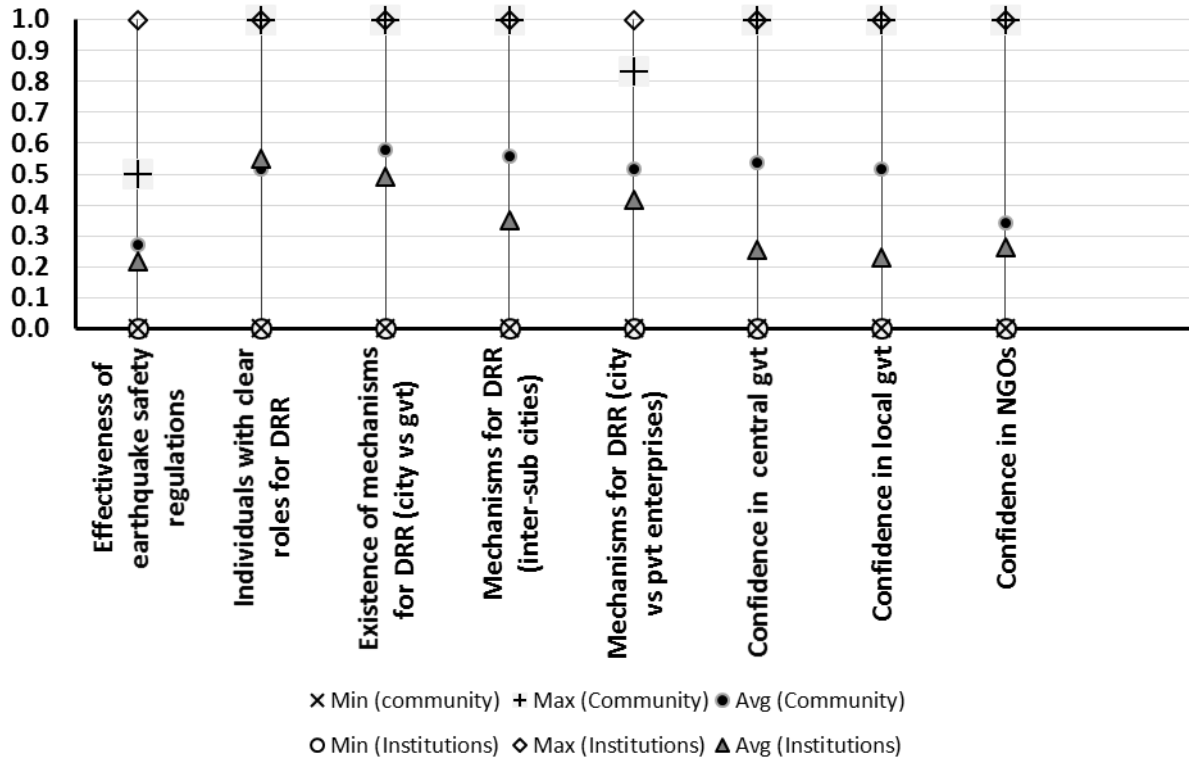
This dimension had high scores, more so from the community participants as seen in Figure A3. It could be construed that most of the participants were not aware if there were effective earthquake regulations. Nevertheless, there was high confidence in both the local and central governments, but so much for the NGOs.

Lowest score Effectiveness earthquake safety regulations.

Highest score Individuals with clear DRR roles.

Score differences between groups

Scores given by public officials are higher than those given by the community representatives.



A 3 Legal and institutional arrangements.

Planning regulation and mainstreaming risk reduction

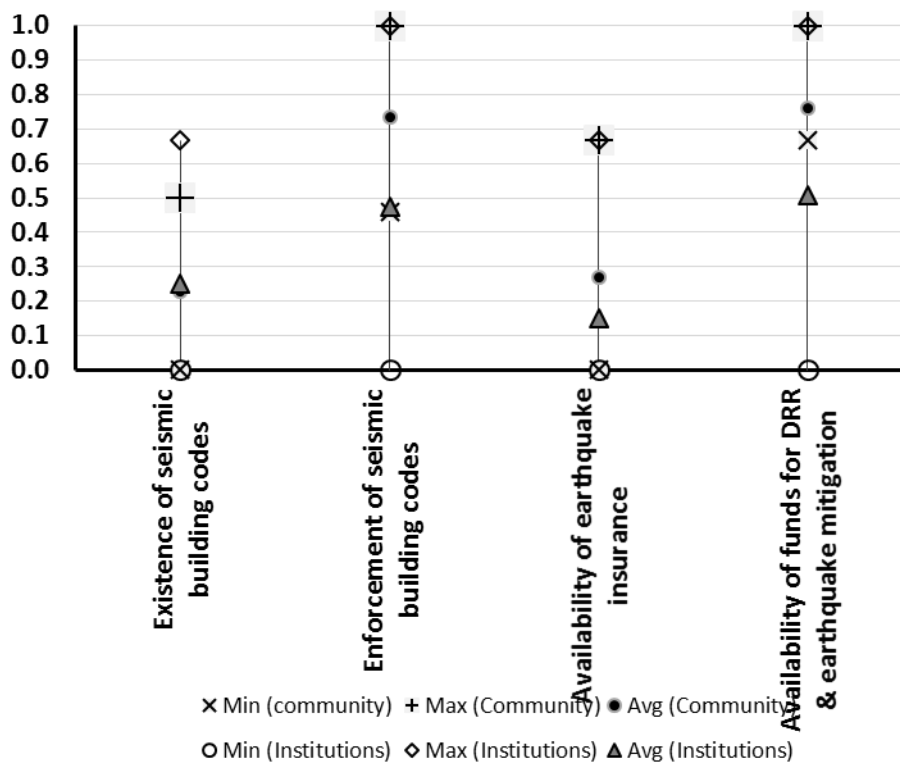
This dimension was well understood, and the results in Figure A4 show the community and the public officials scoring similarly although with varied values, with community always giving much higher scores. It is interesting to note that both groups view that there is a lack of building codes but consider that the enforcement is high. It may reflect that if codes existed, the city is willing to ensure their enforcement.

Lowest score Availability of earthquake insurance.

Highest score Funds for DRR and earthquake mitigation

Score differences between groups

Scores given by public officials are lower than those given by the community representatives, showing more conservativeness and might be due to them having more knowledge on the matter.



A 4 Planning regulation and mainstreaming risk reduction.

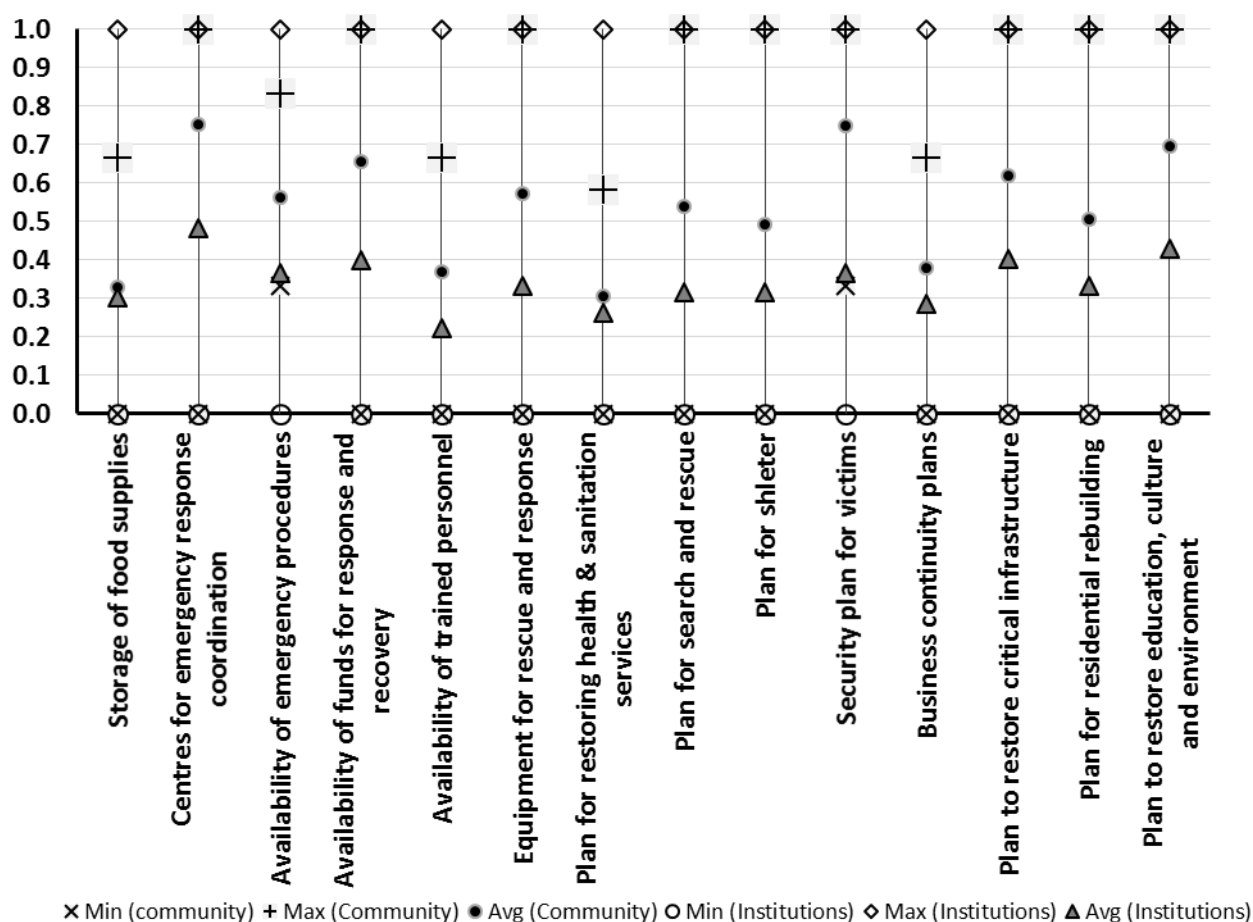
Emergency preparedness, response and recovery

This dimension had the most questions and sought to exhaust all possible topics within this vast area of disaster management as noted in Figure A5. Areas that might need more attention include training of personnel for disaster response, having/improving on plans for search and rescue and provision of temporary shelter immediately following a disaster event.

Lowest score Plan for restoring health and sanitation services.

Highest score Centres for emergency response coordination.

Score differences between groups Scores given by public officials are more reserved and lower than those given by the community representatives. They, however, follow the same general pattern of mimicking each other although with different score values.



A 5 Emergency preparedness, response, and recovery.

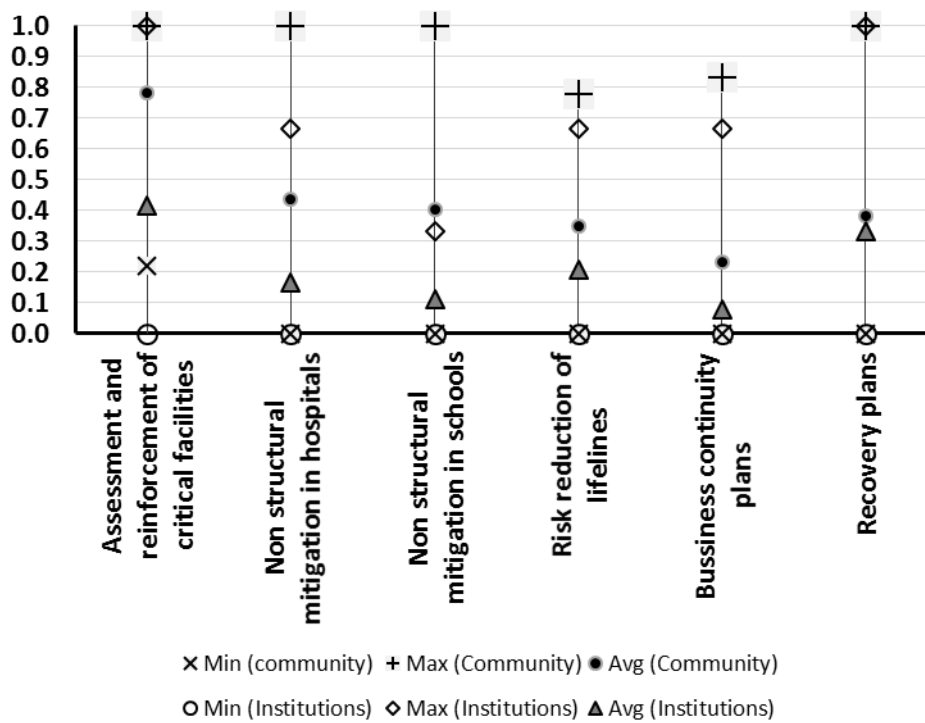
Critical services and public infrastructure resilience

About this dimension, Figure A6 shows the need to concentrate more on the creation or updating of the business continuity plan. Other areas that may require attention are the overall mitigation measures for educational, health and critical lifelines.

Lowest score Availability of a business continuity plan.

Highest score Assessment and reinforcement of critical facilities.

Score differences between groups Scores given by public officials were much lower than those given by the community representatives.



A 6 Critical services and public infrastructure resilience.