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ABSTRACT

Place-based resettlement capacity assessments to identify potential resettlement places for climate migrants are needed to guide climate change related resettlement programs. The authors propose and validate a conceptual climate change resettlement capacity (CCRC) framework that could be used to identify potential resettlement places for climate change migrants. The CCRC framework focuses on livelihood reconstruction, as this is the primary aim of most resettlement programs, as well as ensuring successful resettlement and mitigating impoverishment of resettled people and communities. The framework has two main dimensions – assets and conditions – as its foundation with a set of subdimensions and generic indicators identified for both of them. Expert evaluation was used to validate the framework. The framework is designed to assist international organizations, governments, planners, and policymakers in identifying both the most suitable and least suitable places to resettle communities in the face of actual or anticipated displacements due to climate change. In addition, the framework can be used by researchers to undertake theoretical and empirical studies on climate change induced resettlement. With minor modifications, the framework can also be applied to resettlement capacity assessments for non-climate resettlement programs and research.

1. Introduction

Many places in the world will become less and less inhabitable due to the increasing frequency and severity of climate change related hazards such as floods, droughts, salinization, coastal erosion, and heat stress (Mathur 2015; Bukvic 2018; Rigaud et al. 2018). By 2050, climate change is expected to cause either temporary or permanent displacement of as many as hundreds of millions of people (Barnett and Webber 2010; Rigaud et al. 2018) as in situ adaptation strategies aiming to build resilience become increasingly ineffective and expensive (Bukvic 2018). Therefore, countries most vulnerable to climate change must incorporate resettlement in their climate change adaptation plans (López-Carr and Marter-Kenyon 2015). This will require identification of places with high potential for the resettlement of climate migrants.

While both temporary and permanent migration by individuals, households, and even entire communities is acknowledged as an ex-ante response or ex-post coping strategy to climate change hazards and stressors (Black et al., 2011; McLeman 2011; Mueller et al., 2014; Gemenne and Blocher, 2017), the poor in particular are often unable to move due to barriers to migration (Black et al. 2011; Wilmsen and Webber 2015). As a response to the magnitude of the predicted displacement in the most adversely affected countries and to overcome barriers to migration, planned resettlement of people and communities affected by climate change may become inevitable (de Sherbinin et al., 2011; Brookings et al. 2015). Planned resettlement is therefore increasingly reframed as an adaptive strategy to climate change and its consequences, albeit often as a last resort (Arnall 2019). In some places that are vulnerable to climate change (e.g., China, Ecuador), people and communities have already been resettled either in response to climate change related natural hazards or in expectation of them (López-Carr and Marter-Kenyon 2015).

However, the few existing climate change related resettlement programs have failed to restore or improve the livelihoods of the resettled communities. In some cases, the programs have even worsened impoverishment and livelihood vulnerability among the resettled people and communities (e.g., Rogers and Xue 2015; Connell and Lutkehaus 2017). As a consequence of their worsened conditions, the resettled people tend to return to their original home place or migrate further to other places, while others opt to remain at the resettlement place, where they face poor prospects of rebuilding their livelihoods (Artur and Hilhorst 2012; Connell and Lutkehaus 2017). Evidence also shows that climate change resettlement programs have caused other undesirable social and economic problems, such as

environmental degradation, violence, and conflicts due to increased competition over resources, jobs, and public services at the resettlement places (e.g., Brzoska and Fröhlich 2016; Getahun et al. 2017; Rigaud et al. 2018).

As the success of a resettlement program depends on limiting impoverishment risks and providing opportunities to reconstruct the livelihoods of resettled people and communities, a good understanding of available resources and enabling contextual factors are the key to choosing high-potential resettlement locations during the planning phase (Cernea 2000; Correa et al. 2011; Sipe and Vella 2014; Wilmsen and Webber 2015; Bukvic 2018). However, little attention has so far been paid to the resettlement places (e.g., Findlay 2011; Bukvic 2018). Most resettlement programs have mainly focused on moving the vulnerable or affected communities away from their original place of residence without good understanding of destination places and overlooked vital livelihood elements beyond engaging in the construction of housing in the resettlement areas (Gebauer and Doevenspeck 2015; He et al. 2019). Moreover, many programs have been sidelined by governments to meet political goals, for example, to weaken or control political resistance, rather than keeping focus on identifying the most suitable locations for the displaced people and communities (Correa et al. 2011; Gebauer and Doevenspeck 2015; He et al. 2019).

Identification of suitable locations for climate-migrants' resettlement requires a conceptual framework that could form the basis of assessments of the resettlement places (Bukvic 2018). To this end, Bukvic (2018) proposed a conceptual framework to assess the suitability of resettlement places for the resettlement of climate migrants, based on limited set of economic and physical aspects (e.g., housing, employment rate), but which overlooked many relevant aspects of resettlement capacity (e.g., conflicts and violence, availability of natural resources, disease outbreak, soil quality, physical and human capital infrastructures). Therefore, further conceptual resettlement assessment frameworks that more exhaustively encompass elements of resettlement capacity are needed, not only for improving the planning and implementation of climate change resettlement programs and rebuilding the livelihoods resettled people and communities, but also to support the adaptation of the host communities to the new situation (de Sherbinin et al., 2011; López-Carr and Marter-Kenyon, 2015).

In this paper, we develop a conceptual framework for climate change resettlement capacity (CCRC), to assess the resettlement capacity of places to accommodate displaced people and communities in the face of climate change. In acknowledging that the primary objective of

climate change resettlement programs is to reconstruct and improve the livelihoods of the displaced people and that there are risks associated with resettlement (e.g., joblessness, homelessness, food insecurity), the CCRC framework draws on (i) the sustainable livelihood (SL) framework (Ellis 2000; Scoones 2015) and the impoverishment risks and reconstruction (IRR) model (Cernea 1997, 2000; Correa et al. 2011), (ii) international protocols and guidelines for resettlement (e.g., Brookings et al. 2015; UNHCR 2018; World Bank n.d.) and (iii) other empirical and theoretical studies based on the above concepts, models, protocols, and guidelines (e.g., Winters et al. 2009; Angelsen et al., 2014; Rogers and Xue 2015).

The remaining part of this paper is organized as follows. Section 2 provides a brief review of studies of resettlement programs. Section 3 presents the theoretical and conceptual work that form the basis for the CCRC framework. Section 4 presents the methods employed to validate the components of the framework and Section 5 the CCRC framework. Section 6 identifies and discusses major issues that need to be considered when applying the framework. Section 7 presents our conclusions.

2. Experiences from resettlement programs for climate and non-climate induced displacements

Resettlement can be defined as a process by which displaced people and communities are assisted to restore or improve their livelihoods at their resettlement places (World Bank 2015). Resettlement has been a popular strategy by national governments and transnational development agencies, such as the World Bank, to promote local and national development (Gomersall 2018; Rogers and Wilmsen 2019). Typically, people and communities have been resettled when their land is needed for alternative uses, including infrastructural development (e.g., dam or road construction) (e.g., Cernea, 2008; Tilt and Gerkey, 2016; Asiama et al. 2017), large-scale natural resource extraction (e.g., Owen and Kemp 2015; Yang et al. 2017; Owen et al. 2018), and conservation of nature (e.g., nature reserves and ecological restoration) (e.g., Agrawal and Redford 2009; Torri 2011; Karanth et al. 2018). In all of these cases, resettlement is a secondary outcome of other projects, which force people and communities to leave their home (Gomersall 2018).

Resettlement to reduce poverty has been incorporated in national poverty reduction programs and food security programs in some countries, including China and Ethiopia. The programs aim to move people and communities from resource-poor areas to locations with better livelihood opportunities and better public infrastructure (e.g., Lo et al. 2016; Lo and Wang

2018). Contrary to resettlement induced by infrastructure construction, natural resource extraction, and conservation schemes, the primary aim of poverty reduction and food security resettlement projects is to improve the living standards of the resettled persons, and their resettlement is not a secondary outcome of any other project.

In most resettlement schemes, resettlement is involuntary and often involves controversies among stakeholders, particularly between government bodies and the resettled people and communities (Gomersall 2018). The controversies can be due to limited consultation and engagement of resettled people and communities in the planning and implementation of the resettlement program (e.g., Mathur 2015; Lo and Wang 2018) and the prevalence of hidden motives, often political, that compromise the rebuilding of and improvements to the livelihoods of resettled people and communities in their new place (e.g., De Wet 2012). Furthermore, compensation for lost assets tends to be inadequate, as non-economic aspects of livelihood rebuilding (e.g., social capital within the community) are overlooked (Wilmsen and Webber 2015; Arnall 2019) and additional financing needed for infrastructural development in resettlement areas is insufficient (Cernea 2008). Hence, most resettlement programs have so far been associated with negative outcomes, such as an increased risk of landlessness, joblessness, and increased morbidity (Cernea et al. 2000; 2008; Correa et al. 2011). Consequently, the resettlement literature has concluded that planned resettlement is a complicated developmental process that requires rigorous planning, implementation, and follow-up (Wilmsen and Webber 2015).

Due to the increasing frequency and intensity of climate change induced hazards, communities have increasingly been resettled, temporarily and permanently, from places exposed to actual or anticipated slow onset climate related hazards (e.g., drought, sea level rise) and rapid onset climate related hazards (e.g., floods, storms) to places with better environmental conditions (Rogers and Wilmsen 2019). Resettlement programs for climate change migrants primarily aim to reduce human and economic losses in the exposed areas, to move communities closer to public infrastructures (e.g., health centers, schools, roads), and to provide support for the continuation of peoples' livelihood strategies and the creation of new livelihood opportunities at the resettlement place (e.g., Brookings et al. 2015; UNHCR et al. 2018).

Although climate change can pose a direct threat to human livelihoods, well-being, and even life, people and communities rarely consent to resettle voluntarily in climate change related

programs, as has been found for people and communities in other types of resettlement programs (e.g., Brookings et al. 2015; Bukvic et al. 2015). There are various reasons for this. First, people's and households' exposure to and perception of climate change induced hazards, even those occurring within a community, can vary considerably, as can their socio-economic situation and dependence on livelihoods sensitive to climate change. As a result, the need and urgency for resettlement is likely to vary from person to person and from household to household within a community, with some people being more positive towards being resettled and others being less positive. Second, people who are considering relocation may be uncertain about whether the assets (e.g., land) that are to be provided at their resettlement place will be adequate and of good enough quality to enable them to rebuild their livelihoods (Gebauer and Doevenspeck 2015; Lindegaard 2018). Third, people may also be uncertain about whether their existing social capital (such as local institutions and networks) and place attachment can be restored at their resettlement place (Tilt and Gerkey 2016; Vanclay 2017; He et al. 2019).[1]

Research and policymaking relating to climate change induced resettlement can benefit from the experiences gained from other resettlement programs (Wilmsen and Webber 2015; Arnall 2019). Key aspects of a successful resettlement program are sufficient engagement with people and communities in all aspects of their resettlement process to ensure that they feel they have a certain amount of control over the process (Brookings et al. 2015), and the allocation of sufficient funding to provide compensation to the resettled people and communities, as well as infrastructural development at the resettlement places (Cernea 2008). Most importantly, unlike other resettlement programs, most climate-related resettlement programs to date have occurred as ad hoc responses to disaster events and planners have had little time to plan and prepare for long-term solutions due to the need to implement the relocation of people quickly (Wilmsen and Webber 2015).

One of the most important aspects in advanced planning and preparation for climate change induced resettlement programs is the identification of suitable host places (Sipe and Vella, 2014; Bukvic 2018). This involves an objective assessment of places' potential for resettlement, which in turn would benefit from a conceptual framework to identify

[1] As the framework focuses on the potential of the destination places, it cannot include aspects on the place of origin. However, the framework includes components that represent local institutions and place attachment at the resettlement place.

dimensions and indicators for resettlement capacity in the context of climate change to guide and ensure consistency in assessments.

3. Approaches to understanding resettlement outcomes

Several approaches have been used to study socio-economic consequences of resettlement. One such approach is the impoverishment risks and reconstruction (IRR) framework, developed by Cernea (2000) on the basis of experiences of dam resettlement programs and their effects on the resettled people and communities. The IRR framework is used to identify and predict impoverishment risks among resettled persons and to guide research towards reaching an understanding such risks and resettlement outcomes and thus to mitigate potential problems of resettlement and improve livelihood outcomes (Wilmsen et al. 2019). The framework has been used in the planning and implementation of resettlement programs by national governments and international organizations, and in studies of the impact of such programs on the livelihood of resettled people and communities (Rogers and Wilmsen 2019; Wilmsen et al. 2019).

The IRR framework integrates risk, impoverishment, and reconstruction, which are three fundamental aspects of resettlement. The model identifies joblessness, landlessness, homelessness, marginalization, food insecurity, increased morbidity, loss of access to common property resources, and community disarticulation as the major challenges faced by displaced people and communities and which can result in impoverishment. The IRR framework demonstrates that overcoming the challenges (e.g., from landlessness to land-based reestablishment; from joblessness to re-employment; or from homelessness to house reconstruction) is the key to successful resettlement outcomes (Cernea 2000).

The IRR model has been criticized for five reasons: (1) it focuses on economic losses, (2) limited emphasis is placed on complex issues, such as political context, (3) it downplays heterogeneity in people's, households' and communities' willingness to participate in resettlement programs, (4) it overlooks people's and communities' degree of engagement in resettlement planning and implementation, and (5) its poor identification of beneficiaries eligible for resettlement (Rogers and Wilmsen 2019; Wilmsen et al. 2019). However, the climate change literature has acknowledged the relevance of the IRR model and its empirical applications for understanding the effect of climate change induced resettlement programs on the livelihoods of resettled people and communities (Wilmsen and Webber 2015; Arnall 2019).

In response to both the weaknesses of the IRR model, especially its focus on economic losses and lack of emphasis on a wider perspective on people's livelihoods, and the growing recognition of importance of livelihoods in successful resettlement (Warner 2010; de Sherbinin et al., 2011; Arnall 2019), a holistic approach to livelihoods,[2]—the sustainable livelihood (SL) framework—has increasingly been applied by researchers and policymakers alike to understand resettlement outcomes (e.g., Wilmsen 2016; Owen et al. 2018). The SL framework has been instrumental in researchers' understanding of people's livelihoods and it has shaped poverty reduction policies, particularly in developing countries (e.g., Angelsen et al. 2014; Scoones 2015; Walelign et al. 2017).

Different versions of the SL framework exist, but all tend to identify four major attributes of a sustainable livelihood: assets (e.g., land, infrastructure), contextual and institutional processes (e.g., shocks, local institutions), livelihood activities and strategies (e.g., crop production, diversification), and outcomes (e.g., income, consumption) (Walelign and Jiao 2017; Ellis 2000). While the SL framework and literature have been criticized for not paying due attention to the issues of dynamics, power, politics, and knowledge (de Haan and Zoomers 2005; Scoones 2009), they have been acknowledged in both climate change and non-climate change resettlement literature for having the potential to contribute to understanding and improving resettlement outcomes through identifying mechanisms and necessary conditions for the reconstruction of the livelihoods of resettled people and communities (Arnall et al. 2013; Wilmsen 2016; Chen et al. 2017; Liu et al. 2018; Owen et al. 2018).

In this paper, the IRR and SL literature form the basis of the CCRC framework for assessing the resettlement capacity of potential resettlement places for climate change induced displaced persons. Although the IRR literature explains resettlement outcomes through impoverishment risks and the SL literature through livelihood elements, both bodies of literature underscore the importance of rebuilding and improving the livelihoods of resettled people and communities. For the CCRC, the IRR literature identifies the potential resettlement risks and what is needed to reverse such risks at resettlement places. Using the IRR literature as guidance, we have drawn on the SL literature to identify the components of

[2] Chambers and Conway (1992, p. 7) define livelihood as "the capabilities, assets (stores, resources, claims and access) and activities required for a means of a living" and sustainable livelihood as "a livelihood that copes with and recovers from stress and shocks, maintain and enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation; and that contributes net benefits to other livelihoods at the local and global levels in the short and long-term."

the CCRC framework. Other strands of resettlement literature were also consulted when choosing the generic indicators and examples of specific measurable indicators for the CCRC framework. These include resettlement literature in relation to human rights and ethical issues in planning and implementing resettlement programs (e.g., Gromilova 2014; O'Sullivan 2016; Draper and McKinnon 2018), as well as resettlement guidelines and protocols from different institutions (e.g., World Bank 1990;2004; IFC 2012; Brookings et al. 2015; UNHCR et al. 2015; UNHCR 2018).

4. Climate change resettlement capacity (CCRC) framework

4.1. Overview

Figure 1 displays the CCRC framework. The framework depicts two dimensions that are highly relevant for a place's capacity to resettle climate change migrants: assets and conditions. Assets capture the availability of the necessary inputs (resources) for viable livelihoods for resettled people and communities at their resettlement places. Conditions capture the factors that can promote or constrain the successful translation of assets into livelihood activities, strategies, and outcomes by the resettled people and communities.

Together, assets and conditions form a system that determines a place's resettlement capacity, which in turn determines the livelihood prospects of the resettled people and communities (Figure 1). Assets and conditions can interact with each other both positively and negatively in many ways. Further, if one dimension is weak or absent, it seriously impairs livelihood restoration or improvement at the resettlement place, even if the other dimension is strong. For example, if limited livelihood resources are available to the resettled people, the livelihood outcomes (e.g., income, consumption) are likely to be bad at the resettlement place, regardless of how good the conditions are.

Thus, combined effect of the assets and conditions, i.e., overall resettlement capacity of a place, on livelihoods is mainly a result of the interaction between the two dimensions (the solid downward arrow in Figure 1), is stronger than each dimension's direct effect (the dashed arrows in Figure 1). Depending on the context of the study, the two dimensions can either be added or multiplied, resulting in an overall additive or compounded model, respectively.

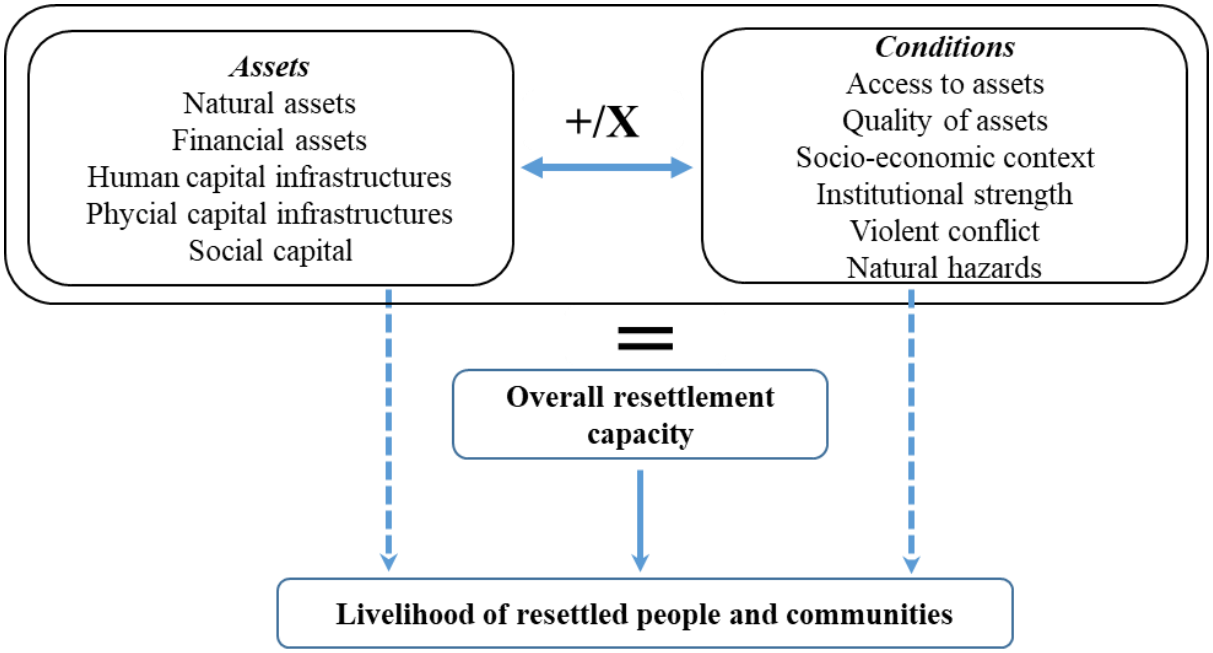

Figure 1. Resettlement capacity assessment framework of a place (Note: the solid and dashed arrows indicate respectively stronger and weaker relationships, +, X and = stand for addition, multiplication and equality, respectively).

The framework is hierarchical: the assets and conditions are further disaggregated into 11 subdimensions (five and six for assets and conditions, respectively) (Figure 1; Table 1) and each subdimension in turn is represented by a set of general indicators (Table 1). For each general indicator we provide examples for specific measurable indicators (see Appendix A and C). The general indicators are kept general, but we provide examples of specific measurable indicators for three main reasons: the specific set of indicators will need to be context-specific, the assessment will in many cases be limited by data availability, and the selection of specific indicators may depend on the unit of analysis. Further, the example specific measurable indicators for each generic indicator ensure clarity about how each generic indicator can measured, which was a concern noted by the surveyed experts.

4.2. Dimensions and subdimensions

4.2.1. Asset dimension

Assets are the building blocks of people's livelihoods (DFID 1998; Scoones 2015). Additionally, assets help to undertake production, engage in labor-sharing arrangements,[3] and

[3] An arrangement whereby two or more households pool their labour to carry out agricultural work or other activities.

provide employment opportunities (Ellis 2000). Assets can also function as a form of wealth or as safety nets during unexpected shocks (Winters et al. 2009; Walelign et al. 2017). Furthermore, assets include a spectrum of private and communal natural, physical, human, financial, and social capital (Bebington 1999; Winters et al. 2009) and having a combination of one or more of these assets is crucial for maintaining or improving one's livelihood (Li et al. 2017; Manlosa et al. 2019). The resettlement literature acknowledges the importance of assets in rebuilding the livelihoods of resettled people and communities (e.g., Sina 2019a).

People and communities inevitably lose part of their livelihood assets when they migrate due to climate change hazards (Dietz et al. 2016; Alam et al. 2017; Forzieri et al. 2018). Furthermore, resettled people and communities may not be able to continue their previous livelihoods (in which they may have had many years of experience) at their resettlement places, as they may not have access to necessary assets (Rogers and Xue 2015; Dias 2016). Hence, restoring households' lost assets and providing them with new assets, both in the short term and medium term, is crucial for securing sustainable livelihood opportunities (Dias 2016; Kura et al. 2017).

Furthermore, a diversified asset portfolio is of major importance for a diversified livelihood (DFID 1998; Li et al. 2017; Walelign et al. 2017) and is a common strategy to spread risks within a household. The strategy also enhances the prospects of viable livelihoods for resettled households and communities (Ellis 2000; Arnall et al. 2013; Asravor 2018). Hence, the more varied and more abundant assets are at the resettlement place, the more likely are the migrants to avoid the impoverishment risks identified by the IRR model (Cernea 2000).

Thus, resettlement capacity assessments need to account for a spectrum of sub-assets to better reflect the resettlement capacity of resettlement places in terms of livelihood assets. For this reason, the CCRC framework draws on a broad definition of assets (e.g., Bebbington 1999; Rogers and Xue 2015; Arnall 2019) and identifies a number of asset subdimensions (Table 1).

Table 1. List of subdimensions and generic indicators relating to assets and conditions dimensions of the climate change and resettlement capacity (CCRC) framework

Dimension	**Subdimension**	**Generic indicators**
Assets	Natural assets	Agricultural land (including pasture), forest and fish resources, subsoil resources, fresh water, and residential land

	Financial assets	Credit availability and employment opportunities
	Human capital infrastructures	Education and health facilities
	Physical capital infrastructures	Housing, energy (electricity), communication outlets, irrigation facilities, market centers, and modes of transport
	Social capital	Nature of networks, community participation, avenues for socializations, and institutions for help and support
Conditions	Access to assets	Property rights, distance, and affordability
	Quality of assets	Quality of natural assets, human capital infrastructures, physical capital infrastructures, and financial assets
	Socio-economic context	Social and economic factors
	Institutional strength	Voting, corruption, enforcement of laws and regulations, and regime type
	Violent conflict	Internal armed conflict (including one-sided violence), and international armed conflict
	Natural hazard	Geophysical, biological, and climatic, hydrological and meteorological hazards

4.2.2. Asset subdimensions

We have identified the availability of natural, human capital infrastructure, physical capital infrastructure, financial, and social assets as the five major asset subdimensions. For each subdimension, we have identified a number of generic indicators (Table 1) and examples of potential specific measurable indicators (Appendix A).

Natural assets*:* Natural assets support all livelihood activities (Winters et al. 2009; Gashu and Muchie 2018). They encompass land (agricultural land, residential land[4] and forests), subsoil resources, and water. Natural assets form the basis for primary livelihood activities (e.g., agriculture, extraction of forest products and minerals) either directly or through wage employment, they serve as a collateral for credit and they support other livelihood activities and people's daily necessities (e.g., fuel, drinking water, oxygen) (Winters et al. 2009; Jackson et al. 2016). Natural assets and natural asset-based resettlement have been posited as important components of improved resettlement outcomes at resettlement places (Kura et al.

[4] Residential land was added as generic indicators because some of the experts were concerned that the original generic indicators focused on rural settings. Although residential land is useful in both rural and urban settings, it is more relevant to semi-urban areas.

2017) and as reversing the risk of landlessness among resettled persons (Cernea 2000; Correa et al. 2011).

Financial assets: Financial assets in the form of credit or cash income are a means of establishing viable livelihoods. Such assets can be used to buy agricultural inputs, to transport agricultural products to a market, or to send a household member to a city where there are better wage employment and/or business opportunities. Financial assets can also be used in human capital (health and education) investments, to diversify household livelihoods, and to improve a household's capacity to adapt to climate and other changes and its ability to repay debts (Fenton et al. 2017; Asfaw et al. 2018). Securing financial assets at resettlement places can thus directly or indirectly help in reversing many of the resettlement risks, particularly joblessness, homelessness, increased morbidity, and landlessness.

Human capital infrastructures: Human capital infrastructures in the form of educational and health facilities broaden people's livelihood opportunities through human development (Winters et al. 2009). Educational facilities provide services for basic skills education (i.e., writing, reading, and mathematics) and continuous training to build skills and knowledge, and thus increase returns from livelihood activities. Additionally, education enables people to shift more easily from farm-based activities to more remunerative non-farm based activities (Winters et al. 2009; Bhandari 2013). The availability of health facilities reduces households' health-related shocks caused by sickness or death (Angelsen et al. 2014; Walelign et al. 2017). Thus, the availability of human capital infrastructures at resettlement places are important for enabling the displaced persons to gain new skills and knowledge in order to benefit from the livelihood opportunities, avoid intergenerational impoverishment (Bird 2013; Reddy 2015) and stay healthy (Angelsen et al. 2014; Walelign et al. 2017). In turn, these benefits decrease resettled people's risk of homelessness, morbidity, and food insecurity.

Physical capital infrastructures: Physical capital infrastructures are assets that broaden people's livelihood opportunities (Winters et al. 2009), and they include housing, transport, communication outlets, energy, and irrigation facilities. Housing provides for one of three basic needs, namely shelter. Transport infrastructure provides improved access to inputs for livelihood activities, to markets to sell outputs, and to employment opportunities (Barrett 2008; Jayne et al. 2010; Brashares et al. 2011; Faiz et al. 2012; Walelign et al. 2019). Communication infrastructure (e.g., mobile networks, television, radio stations) can

transform livelihoods through expanding and strengthening social networks, increasing people's ability to deal with emergencies, and enhancing the efficiency of livelihood activities (Chapman et al. 2003; Sife et al. 2010; Duncombe 2014). A reliable energy source is a key input for many non-agricultural activities (Winters et al. 2009). Irrigation facilities in arid and semi-arid regions can substantially increase agricultural production, allow for year-long agricultural production, and increase people's adaptation and resilience to climate variability and change (Zou et al. 2012; Buisson and Balasubramanya 2019; Cao et al. 2019; Zheng et al. 2019). Availability of physical capital infrastructures facilitates resettlement processes and has thus been posited as one component of successful resettlement at resettlement places, and to directly and indirectly mitigate the risk of homelessness, morbidity, and food insecurity associated with resettlement.

Social capital: Social capital strengthens a household's social bonds within the community and improves its status and access to help, and thus builds trust within the community (e.g., Abbay et al. 2018a, 2018b). Particularly, social capital in the form of networks enables exchanges of resources, information, and financial assets, and is thus a critical component of livelihood security (Banerjee et al. 2013; Baird and Gray 2014; Johny et al. 2017). Social capital in the form of community participation enables people to take part in and influence decisions in community affairs, such as the development of sustainable management of key community assets (Abbay et al. 2018), and can be used to avoid and solve conflicts in the community arising from, for example, use of community resources (Apipalakul et al. 2015). Social capital in the form of institutions for help and support facilitates access to livelihood assistance, information, and safety nets during periods of stress and shocks (Linnerooth-Bayer and Mechler 2007; Hassan and Noor 2015). Thus, availability of social capital at the resettlement place can help to reduce the risks related to community disarticulation, increased morbidity, food insecurity, and marginalization.

4.2.3. Condition dimension

To reestablish and improve livelihoods of resettled people, the available assets need to be transformed into viable livelihood activities. The transformation is mediated by a number of conditions that encompass social, economic, policy, and institutional factors that can enable and constrain the transformation (Ellis 2000; Scoones 2015). A resettlement place with good enabling conditions can promote asset accumulation and successful transformation of assets into livelihood activities by resettled people and communities (Correa et al. 2011) and thus

improve resettlement outcomes (Kim 2016; Tan 2017) and mitigate the impoverishment risks of resettlement, particularly homelessness, landlessness, and loss of access to common property resources or assets (Cernea 2000; Correa et al. 2011). Therefore, it is important to consider a number of enabling and constraining factors when assessing the resettlement capacity of potential resettlement places (Table 1).

4.2.4. Condition subdimensions

Based on the literature on livelihoods and resettlement, we identified a number of subdimensions of the conditions. These included access to assets, condition of the assets, socio-economic conditions, institutional strength, and exposure to conflicts and natural hazards (Table 2) (for examples of measurable indicators see Appendix C).

Access to assets: Access to assets embeds property rights (laws, customs, conventions) that describe who controls and has access to assets (Ribot and Peliso, 2003). In addition to its institutional aspect, access to assets has a physical aspect (e.g., distance to assets) and an economic aspect (e.g., price and costs of owning and accessing assets). Secured access to a set of assets and their services is pivotal for people's successful engagement in livelihood activities, for broadening household's technology options and livelihood opportunities, and for improving households' technology adoption and welfare (Zezza et al. 2011; Wossen et al. 2017). Choosing a resettlement place that has regulated access to assets and with reasonable costs and distances for accessing assets is important for reestablishing the livelihoods of resettled people and communities, and for overcoming resettlement risks, particularly homelessness, landlessness, and increased morbidity.

Quality of assets: Quality of assets determines the potential of assets and the services they provide to maintain, improve, and support the livelihoods of resettled people and communities. For instance, land in good physical condition (e.g., fertile soil, gentle slope) enhances the return from farm-based activities. Similarly, good quality health and educational services promote improved human capital. Assets with good conditions promote the accumulation of assets, and the maintenance and expansion of livelihood opportunities for resettled people and communities, as well as helping them to overcome resettlement risks, particularly increased morbidity, community disarticulation, and food insecurity. By contrast, low quality assets at resettlement places hinder these processes (Gray 2011; McNamara and des Combes 2015; Lindegaard 2018).

Socio-economic context: Socio-economic context encompasses the prevailing social and economic aspects of people's quality of life. Good social and economic conditions (e.g., high gender equality and low poverty rates) promote good community integration, create a conducive climate for viable livelihoods, and promote accumulation of livelihood assets (Molarius et al. 2007). By doing so, good social and economic conditions in resettlement places can facilitate livelihood reconstruction (Arnall 2019), and help in overcoming resettlement risks, particularly homelessness, increased morbidity, community disarticulation, and food insecurity.

Institutional strength: Institutional strength captures the capacity of formal and informal institutions to enforce laws, protect human rights, ensure security, and deliver public services. Strong and good institutions are the main tools to design and implement sound policies, for example to improve people's living standards, develop public infrastructure, provide improved public services, promote existing livelihood strategies, and broaden livelihood opportunities (DFID 1998; Ellis 2000). Thus, availability of strong institutions increases a place's capacity to resettle people and communities through empowerment, and securing access rights and protection from potential conflicts (Sipe and Vella 2014; Connel and Lutkehaus 2017; Sina et al. 2019b).

Violent conflict: Violent conflicts are social shocks that disrupt the normal life of people and communities. Violent conflict hinders livelihood maintenance or improvement through restricting people's normal daily movements and access to assets, and can even cause the destruction of personal, household, and community assets. Violent conflict also weakens institutions, destroys public infrastructure, and denies people's access to important public services, which in turn affects people's educational attainment, health status, and other aspects of their lives (Brück and Schindler 2009; Justino 2011). Thus, violent conflict disrupts people's livelihood and results in negative livelihood outcomes through lower incomes, high incidences of poverty, food insecurity, and low resilience in terms of livelihoods (Justino 2011; Brück et al. 2019; Brück and d'Errico 2019). Rebuilding and improving the livelihoods of displaced persons and resettled communities in resettlement places affected by violent conflicts is a daunting task, and the process of resettlement itself may worsen existing conflicts and tensions (Connell and Lutkehaus 2017; Getahun et al. 2017; Rigaud et al. 2018). Thus, resettlement in conflict-affected areas should be avoided at all costs and potential resettlement places need to be carefully screened for their suitability based on the prevalence and risk of violent conflicts.

Natural hazards: The subdimension natural disaster captures the slow and rapid onset of natural shocks due to geophysical hazards (e.g., earthquakes, volcano eruptions); climatic, hydrological, and meteorological hazards (e.g., flooding, drought, sea level rise); and biological hazards (e.g., disease outbreak, infestation). Natural hazards have already affected the livelihoods of millions, claimed many lives and destroyed billions of US dollars' worth of private and public assets (Correa et al. 2011; Francescutti et al. 2017; Xu et al. 2017). Natural hazards also cause resource scarcity and lead to grievances that may result in violent conflict (Xu et al. 2016). Further, if people are resettled in areas prone to natural hazards, they will remain vulnerable and less resilient to climate and non-climate related natural hazards as well as to social disasters. Even worse, the resettled people could become more vulnerable in the resettlement places, as their recovery from the resettlement would not materialize. To avoid these repercussions, the potential resettlement places need to be carefully assessed for exposure to natural hazards both currently and in the future (i.e., consideration should be given to changes in climate-related hazards).

5. Framework validation

To validate the CCRC framework, we conducted a survey among experts to acquire their judgment on the relevance of the framework's components (i.e., its dimension, subdimension, and generic indicators) (see Appendix E for details on the survey and expert characteristics). The survey results show that most of the experts (92% and 83%) rated assets and conditions, respectively, as either extremely relevant or very relevant for assessing the resettlement capacity of places (Figure 2).

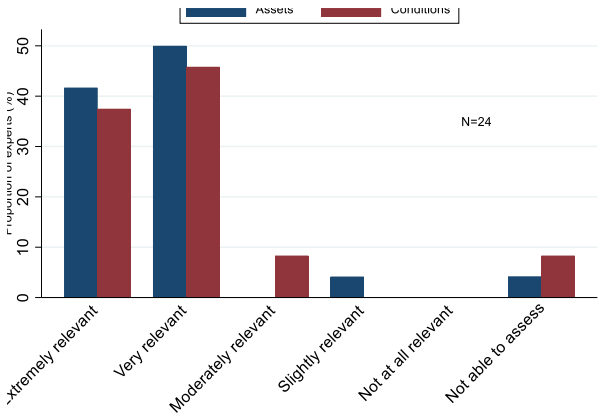

Figure 2. Experts' assessment of assets and conditions as two dimensions of the climate change and resettlement capacity (CCRC) framework.

Regarding the asset subdimensions, most of the surveyed experts rated the subdimensions as either extremely relevant or very relevant (ranging from 75% for natural assets to 88% for physical capital infrastructures) while the remaining experts rated them as moderately relevant, with the exception of natural assets, which was rated as slightly relevant by one expert (Figure 3). Of the generic indicators, the indicator for subsoil resources was considered extremely relevant or very relevant by 21% of experts (the lowest share for all generic indicators), while 92% of the experts considered health facilities and housing generic indicators either extremely relevant or very relevant (highest share) (Appendix B).

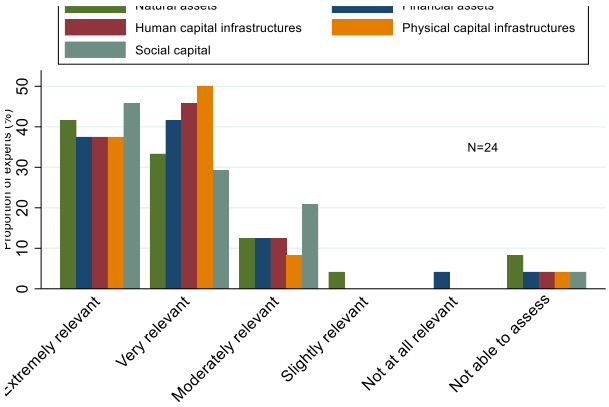

Figure 3. Expert assessment of the asset subdimensions of the climate change and resettlement capacity (CCRC) framework.

Regarding condition subdimensions, most of the experts considered the condition subdimensions as either extremely relevant or very relevant (ranging from 83% for quality of assets to 100% for violent conflict for those experts who assessed the subdimension question), while the remaining experts rated them as moderately relevant, with the exception of natural hazards, which was rated as slightly relevant by one expert) (Figure 4). Similarly, most experts rated most of the generic indicators in the condition subdimensions as either extremely relevant or very relevant (ranging from 50% for regime type to 88% for climatic, hydrological, and meteorological hazards), with the exception of voting, which most experts rated as either moderately relevant or slightly relevant (50%) (Appendix D).

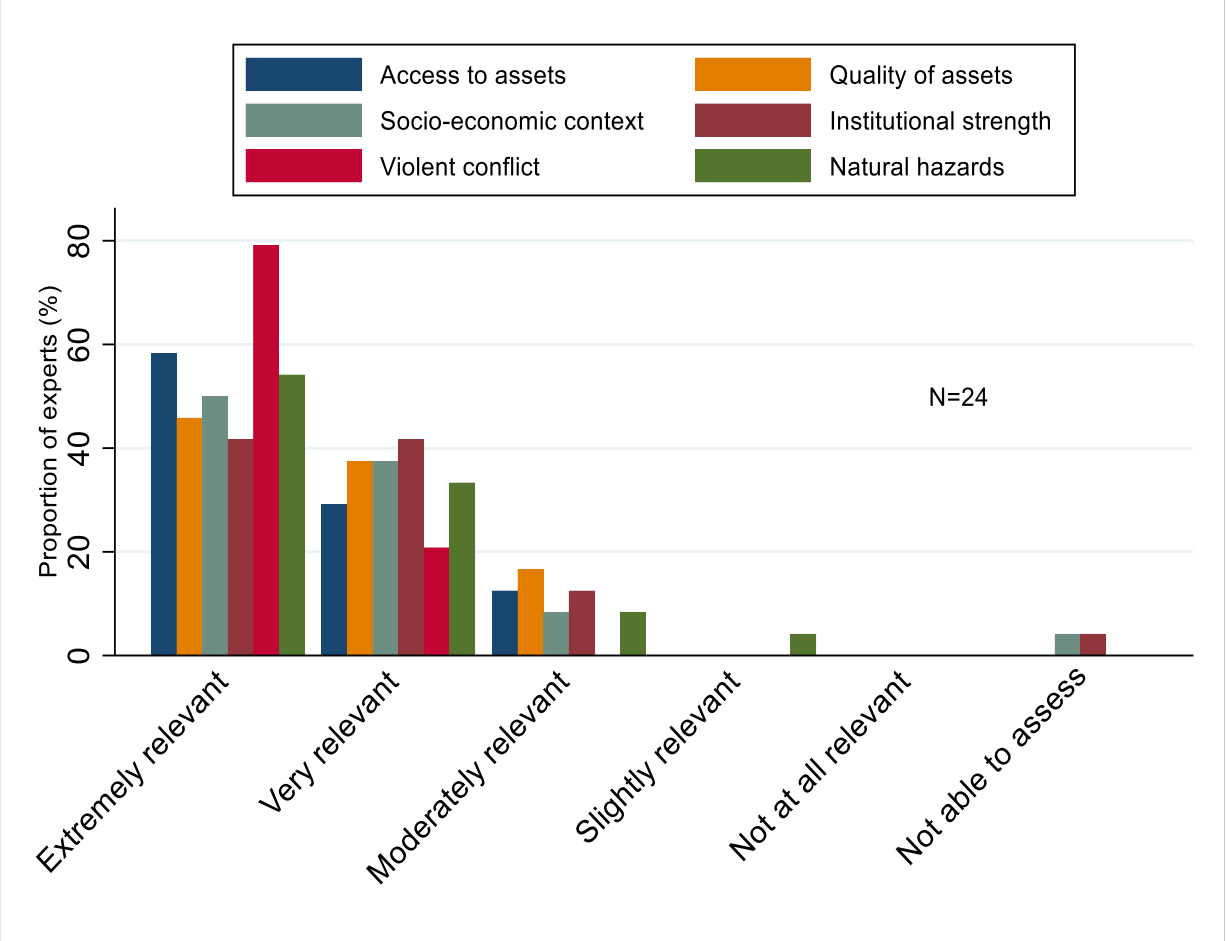

Figure 4. Expert assessment of the asset subdimensions of the climate change and resettlement capacity (CCRC) framework.

6. Issues in applying the framework

6.1. Holistic approach and contextual adaptation

Any effort to apply the CCRC framework should include the two dimensions (assets and conditions), ideally all subdimensions, and as many relevant generic indicators as possible, and treat them as a system in which each component interacts with the others to determine the resettlement capacity of resettlement places. Such a holistic approach is crucial, as reconstructing the livelihoods of people and communities at resettlement places is always a multidimensional process, involving a number of physical, economic, social, political, and institutional aspects (Cernea 2000; Correa et al. 2011; Sina et al. 2019a; 2019b). The CCRC framework seeks to preserve this complexity, accounting for the interaction between the dimensions and subdimensions, and acknowledging that their combined effect is greater than individual components' effect in determining the overall resettlement capacity of resettlement places.

Some of the CCRC frameworks' components are context-specific, in which case the framework needs to be adapted. The adaptation process may involve the accommodation of concepts, as concepts may change in content and even in directionality when used in different settings (Holand and Lujala 2013). For example, institutional strength can be conceptualized variously in terms of informal institutions in societies in which such institutions dominate, formal institutions in societies in which such institutions dominate, or both formal and informal institutions in societies in which such institutions coexist. Ethnic diversity is an example of an element that may change directionality: ethnically homogenous communities can be potentially very suitable on occasions when they are to accommodate people from the same ethnic group but potentially even disastrous if they are used to resettle people from other ethnic groups. Furthermore, specific components of the CCRC framework may be irrelevant in certain contexts. For example, agricultural land is relevant for assessing resettlement capacity of rural areas, but less relevant if the objective is to assess urban areas only. By contrast, some components are likely to be relevant for assessing resettlement capacity in most contexts (e.g., presence of prolonged armed conflict, exposure to climate change hazards).

6.2. Unit of analysis

The CCRC framework can be applied to resettlement capacity assessments using different units of analysis, such as grid cells of different sizes or administrative units at various levels. The choice of a relevant unit of analysis is an important step in the resettlement capacity assessment process as it determines the extent of the assessment's spatial disaggregation (by smaller administrative units or grid sizes) for policymaking. For example, if the unit of analysis is the country, the assessment will not provide information on specific locations or regions in that country, while an assessment using subnational units (e.g., ward) or smaller grid cell size could identify specific locations with better prospects for resettlement in the country. A gold standard approach is not available for the choice of unit of analysis; the choice depends on many factors, including the purpose and setting of the assessment, spatial variation in indicator values,[5] and what data are available and at what resolution (Arsenault et al. 2013). This also means that the optimal size for the unit of analysis may differ across the framework's components, and it may therefore be wise to consider different spatial scales for different components in order to improve the quality of overall resettlement capacity

[5] For example, if there is substantial spatial variation in indicators' values over short distances, the unit of analysis needs to be small for it to be able to capture the spatial heterogeneity in the data.

assessment, as observed by previous studies using such an approach (e.g., for soil property modeling, see Miller et al. 2015).

6.3. Data availability, processing, and analysis

Application of the CCRC framework requires data on the specific measurable indicators that can be continuous (both absolute and relative), dichotomous, or ordinal. The data can be historical, current, or predictions for the future, depending on the purpose of the study, the nature of the specific indicator, and data availability. Data availability often depends on the unit of analysis (many variables only exist for country level or higher administrative levels). Data can come from maps, satellite images, georeferenced databases and surveys, and databases that provide information for different administrative units, or it can be generated from other sources (e.g., reports).

Several data sources are available for wider application of the framework. We group the sources into four. First, websites hosting event level or subnational global datasets exist. This includes, among others, Peace Research Institute (PRIO-GRID), Socio-economic Data and Applications Center (SEDAC), Humanitarian Data Exchange (HDX), and Resource Watch. Second, event level or subnational datasets on a specific information are increasingly available. Good examples for this are Armed Conflict Location & Event Data Project (ACLED) and Uppsala Conflict Data Program (UCDP) on conflict events, US Geological Survey (USGS) on major mineral deposits, Global Active Archive of Large Flood Events on flood events, Global Risk Data Plateform on (non)climate change hazard events. Third, geocoded survey and census datasets, such as the Demographic and Health Survey (DHS), World Bank's Living Standard Measurement Survey (LSMS), Afrobarometer survey, and population and housing censuses, are also good sources of data. Four, national level global indices, such as global corruption perception and happiness index, can also be useful for global application of the framework.

Processing the data will often be necessary to make it suitable for the purpose of the study. This may include aggregation or disaggregation of data to the intended spatial unit. The data may also need to be standardized, using total population living or total land area in the unit of analysis as a denominator in order to make comparisons across locations of different sizes (Reckien, 2018). In some cases, dasymetric techniques may need to be used to consider, for example, areas that cannot be inhabited, such as large lakes or deserts.

Once the available data is processed, the data should be combined to reflect the resettlement capacity of places. The data can be combined using data reduction approaches, such as principal component or factor analysis (e.g. Cutter and Finch 2008; FAO 2016), structural equation modelling (a combination of data reduction with regression modelling) (FAO 2016), additive approach (e.g., Cutter et al. 2014; Scherzer et al. 2019), or multiplicative approach (e.g., Welle and Birkmann 2015). No approach is superior over the other, and the choice depends on the purpose and the context of the study. For instance, data reduction approach is good for generating one or more scores that contains the highest variation of the components of the framework, structural equation modelling for understanding causal relationships, the multiplicative approach for assigning larger effects when higher values of two or more components exists, and the additive approach for calculating the contribution of each components on the overall index. An attractive advantage of the additive approach is its simplicity to interpret and construct (Cutter et al. 2014).

6.4. Predictions

Predicting the resettlement capacity of resettlement places in the future is relevant as climate change induced resettlement programs aim at building sustainable livelihoods at resettlement places that are suitable for resettlement both currently and in the future. Two approaches can be used to make assessments for the future when using the CCRC framework. First, future suitability can be included by using specific measurable indicators projected to some point in time in the future (e.g., projected population, exposure to climate change, productivity changes, extent of desertification). Second, it is possible to generate a resettlement capacity index using current data on indicators and then predicting the resettlement capacity index in the future based on plausible scenarios of change. Scenarios for climate change research that consists of four greenhouse gases emissions trajectories and five global socioeconomic development trends (van Vuuren et al. 2011; O'Neill et al. 2014) can form a basis for the predictions and potential uncertainties.

7. Conclusions

In this paper we have proposed a new framework, the climate change resettlement capacity (CCRC) framework, to guide resettlement capacity assessments of resettlement places for climate change induced displacement. The CCRC framework emphasizes the ability of resettlement places to support the reconstruction of viable livelihoods.

The proposed CCRC framework includes two main dimensions—assets and conditions—that are crucial for livelihood reconstruction. Assets encompass the resources available for forming the basis for rebuilding livelihoods at the resettlement place, whereas conditions reflect contextual factors that can both constrain and enable the successful translation of assets into livelihood activities, strategies, and outcomes. The CCRC framework identifies 11 subdimensions of 2 dimensions: 5 for assets and 6 for conditions. The subdimensions focus on detailed key aspects of the two main dimensions. We also provide a set of generic indicators for each subdimension and examples of specific measurable indicators for each generic indicator as a first step to operationalize the framework. Experts who were used to validate the dimensions, subdimensions, and initial selection of generic indicators found the identified elements highly relevant for assessing the resettlement capacity of resettlement places.

The CCRC framework can be used in the following ways: (i) to guide research on climate change induced displacement and resettlement, (ii) to help policymakers when choosing the best places to resettle communities in the face of actual or anticipated climate change related displacements and to prevent their resettlement in unsuitable areas, (iii) to guide climate migrants to move to places with higher potential for livelihood reconstruction and (iv) to help international organizations and governments at national, regional and local levels to channel infrastructural and public service investments to more suitable resettlement areas. The framework can also be used to assess resettlement places for non-climate change related resettlement programs, as most of its components reflect what displaced and resettled people and communities need at the resettlement place to reconstruct their livelihoods, irrespective of the cause of their displacement. However, studies that adapt the framework to other resettlement programs may need to include program-specific subdimensions and generic indicators.

The framework and accompanying resettlement capacity assessments should not be used to justify resettlement or to discourage in situ adaptation strategies, as resettlement should in most cases be used as a last resort when all feasible in situ adaptation strategies have been exhausted (see e.g., de Sherbinin et al., 2011; López-Carr and Marter-Kenyon 2015; Wilmsen and Webber 2015; Arnall 2019). If resettlement is found necessary, rebuilding the livelihoods of resettled people and communities should be the major aim of resettlement programs, resettlements should be voluntary, and other aims (e.g., political motives of weakening opposition) should not influence the planning and implementation of the programs.

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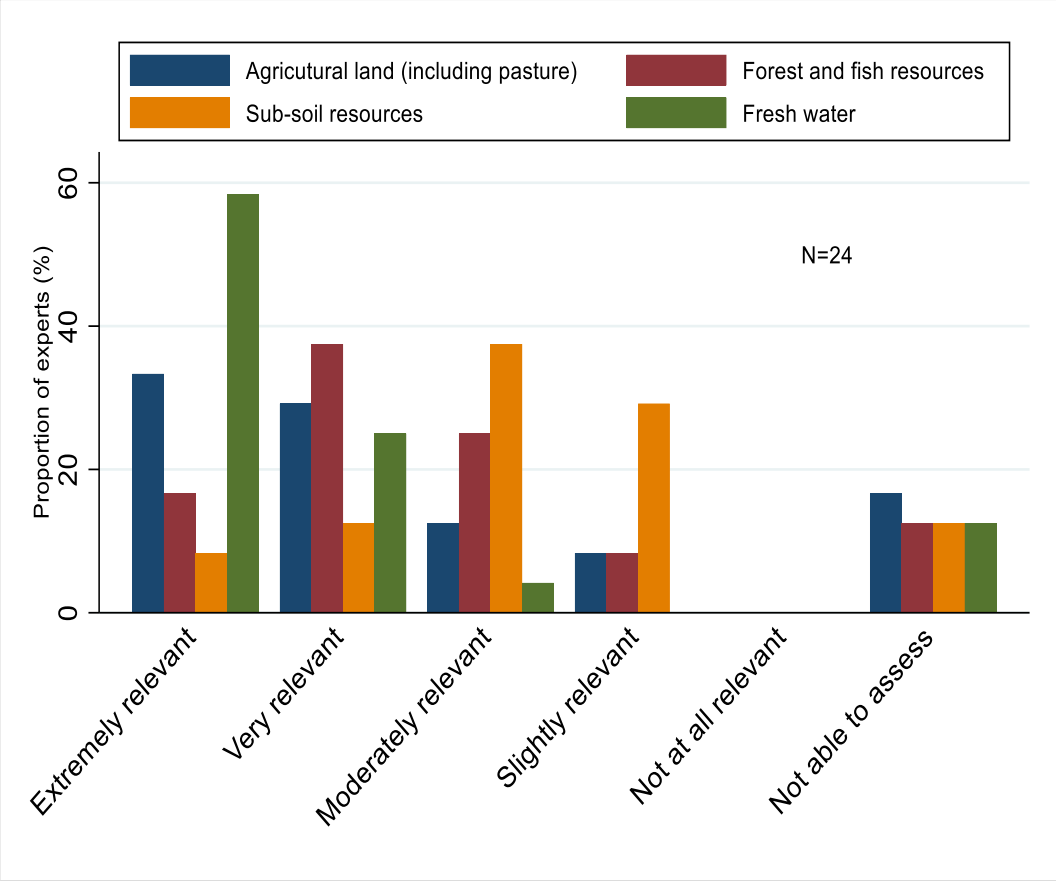
Appendix A: Generic indicator justification and examples for specific measurable indicators, asset dimension

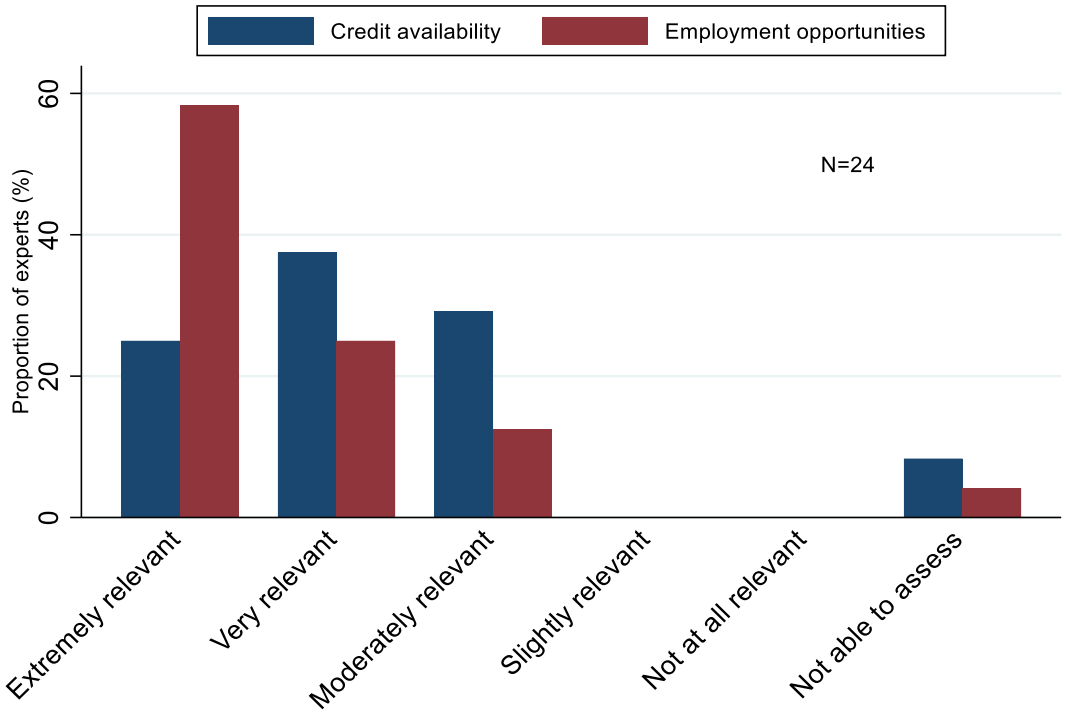
	Generic indicators	Examples of measurable indicators	Justification
Natural assets	Agricultural land (including pasture)	Cultivated land per capita (pc); grazing land pc; fallow land pc; land suitable for agriculture but not yet in use pc	Provides input for all crop and livestock production; decreases the risk of landlessness and joblessness
	Forest and fish resources	Area of forest land pc; fish stock pc	Provide construction material and food, source for commercial fish and timber production; support other livelihood activities (e.g., crop, livestock production); decrease the risk of joblessness
	Sub-soil resources	Oil and gas reserves pc; high-value mineral reserves pc; other sub-soil reserves pc (e.g., stones, clay)	Provide input for extraction activities, wage employment, business opportunities, and construction materials; decrease the risk of joblessness
	Residential land	Residential land pc	Provides land for housing; decreases the risk of homelessness
	Fresh water	Volume of surface water pc, volume of ground water pc, annual rainfall/precipitation (amount)	Provides water for drinking, cooking, and other household necessities; source of services that support livelihood activities (e.g., crop, livestock production)
Financial assets	Credit availability	Number of (#) formal financial institutions (e.g., banks, micro credit institutions) pc; # informal financial institutions (e.g., rotational saving groups) pc; average level of borrowing (debt rate) per household	Provides capital for purchasing inputs for crop and livestock production, to start business, and for transport; decreases joblessness risk of resettlement
	Employment opportunities	# large size companies pc; # medium size companies pc; # micro and small size companies pc; # commercial farms pc	Provide employment and wage income; decrease risk of joblessness
Human capital inf.	Education facilities	# primary and secondary schools pc; # higher institutions pc, # teachers per pupil/capita	Improve human capital
	Health facilities	# clinics pc; # hospitals pc; # health practitioners pc	Improve human capital (in terms of health); decreases the risk of morbidity
Physical capital inf.	Housing	# housing units pc; # vacant houses pc	Provides shelter; decreases the risk of homelessness
	Energy (electricity)	Electricity grid density per km^2 of inhabited areas; % houses/buildings/villages with electricity; % buildings/houses with solar panel	Provides energy for household and business activities
	Communication outlets	Mobile phone network stations pc; # radio and television stations pc; % households/adult population with mobile phone; % households with TV	Provides access to information (e.g., market information); facilitates knowledge sharing
	Irrigation facility	% agricultural land under irrigation; % agricultural land with potential to be irrigated	Increases agricultural production; decreases vulnerability to drought
	Market centers	# daily markets per km^2, % urban area of total area/inhabited area	Provide access to buy and sell agricultural and other livelihood inputs and products and business opportunities
	Modes of transport	Road density per $km^2$of inhabited area; navigable waterways density per km^2 of inhabited area	Provide access to market and employment opportunities
Social capital	Nature of networks	# social groups pc (e.g., self-help groups)	Promote community integration; decrease risks of community disarticulation and marginalization
	Community participation	# meetings between local people and government; # meetings in the local community	
	Avenues for socialization	# sport clubs pc; # religious places pc (e.g., churches, mosques); # places for sports pc; # meeting halls	
	Institutions for help and support	# local NGO offices pc; # international NGO offices pc; # civic institution offices pc; # local civic institutions pc	Facilitates the resettlement process; promotes livelihood rebuilding

Appendix B: Expert assessment of the assets dimension's generic indicators

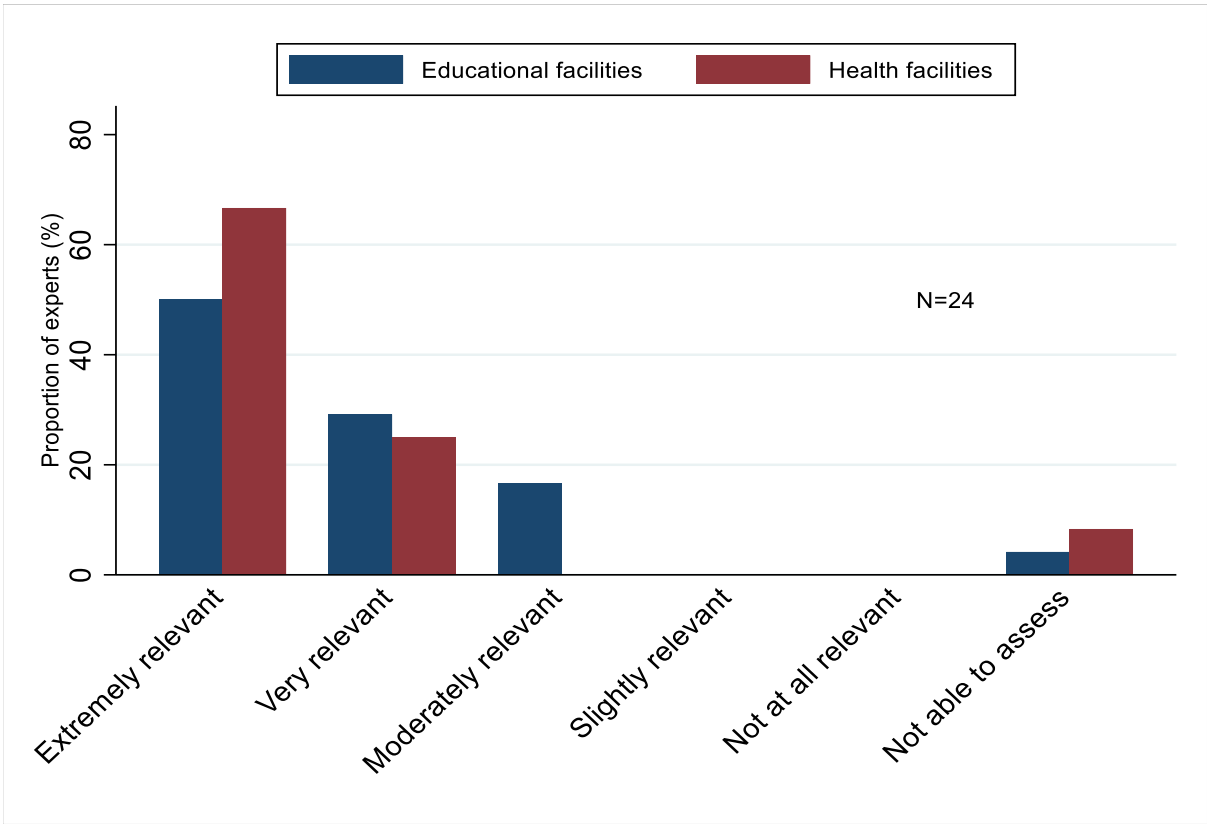
a) Natural assets



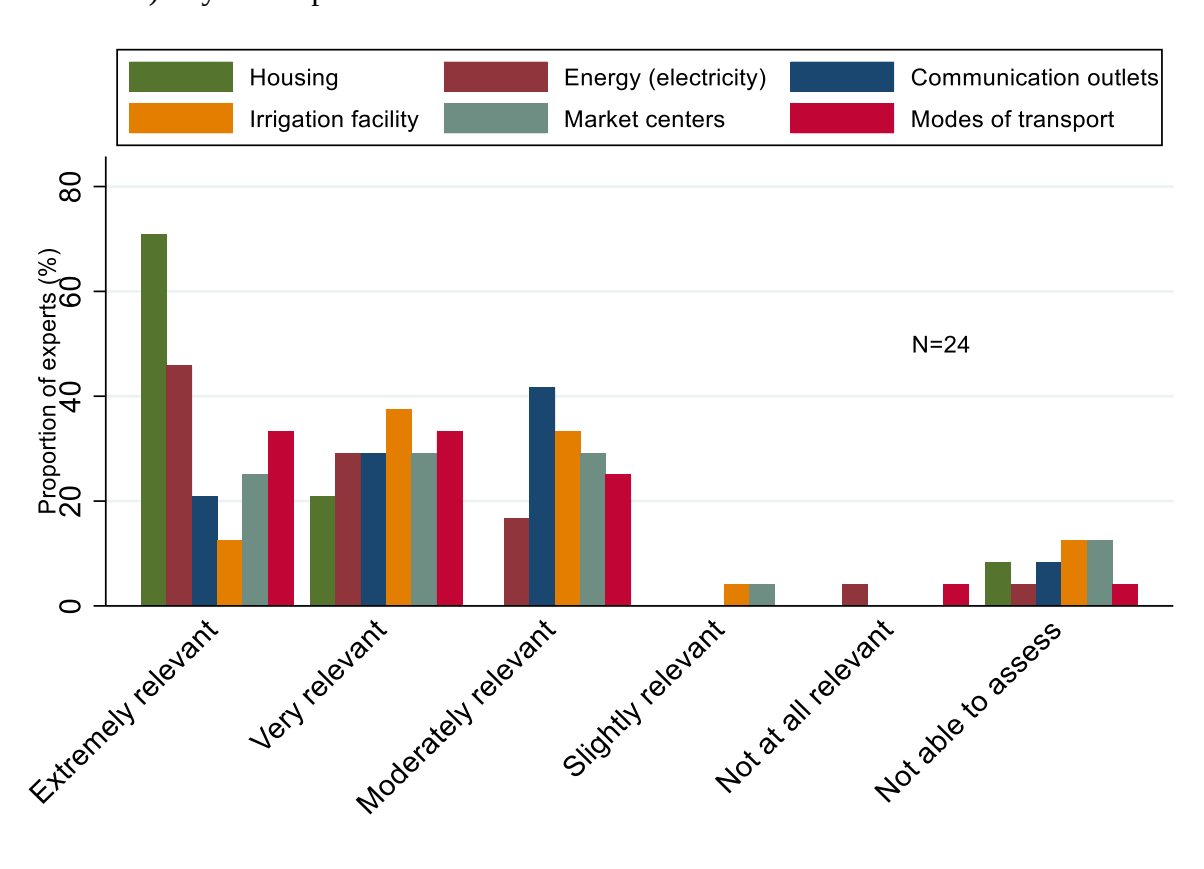
b) Financial assets



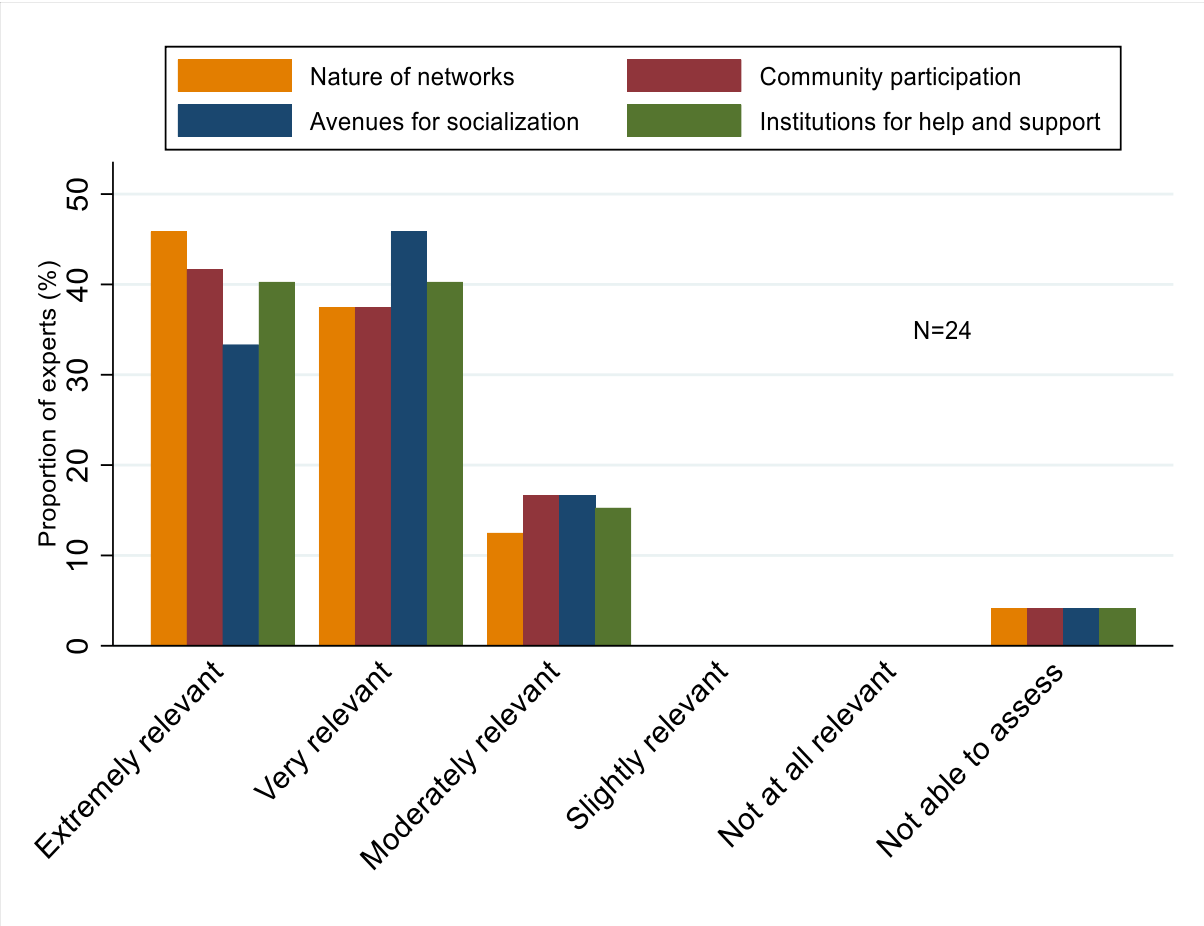
c) Human capital infrastructures



d) Physical capital infrastructures



e) Social capital

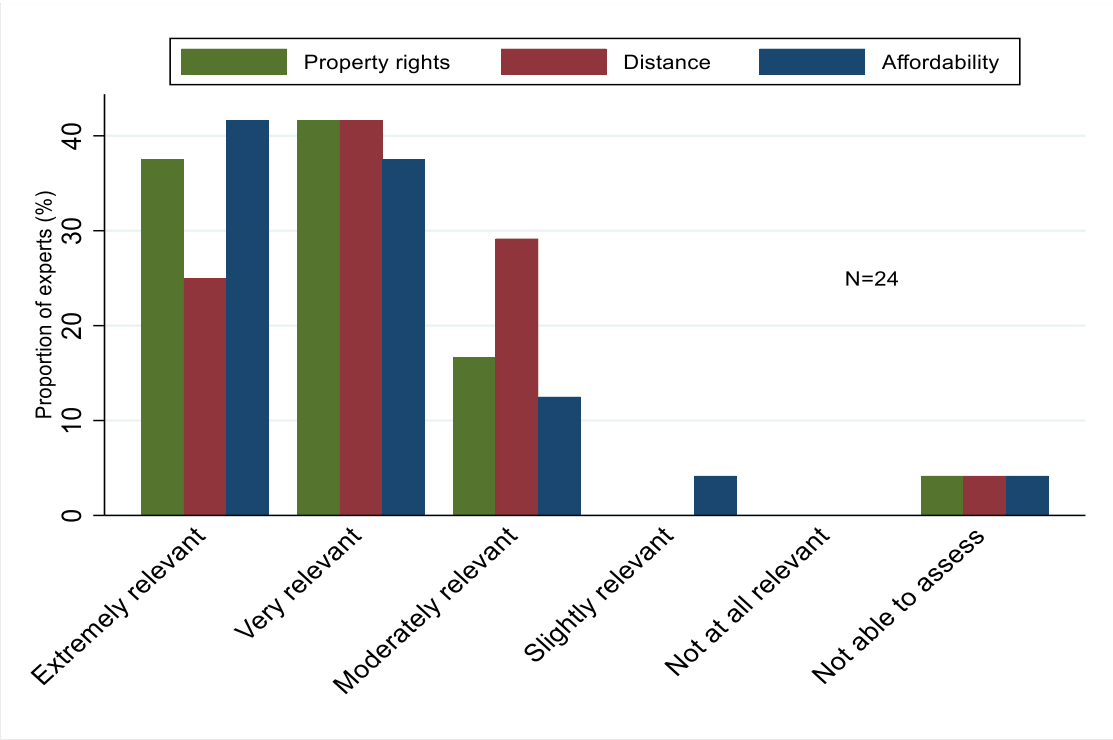

Nature of networks
Community participation
Avenues for socialization
Institutions for help and support
Proportion of experts (%)
0
10
20
30
40
50
N=24
Extremely relevant
Very relevant
Moderately relevant
Slightly relevant
Not at all relevant
Not able to assess

Appendix C: Generic indicator justification and examples for specific measurable indicators, condition dimension

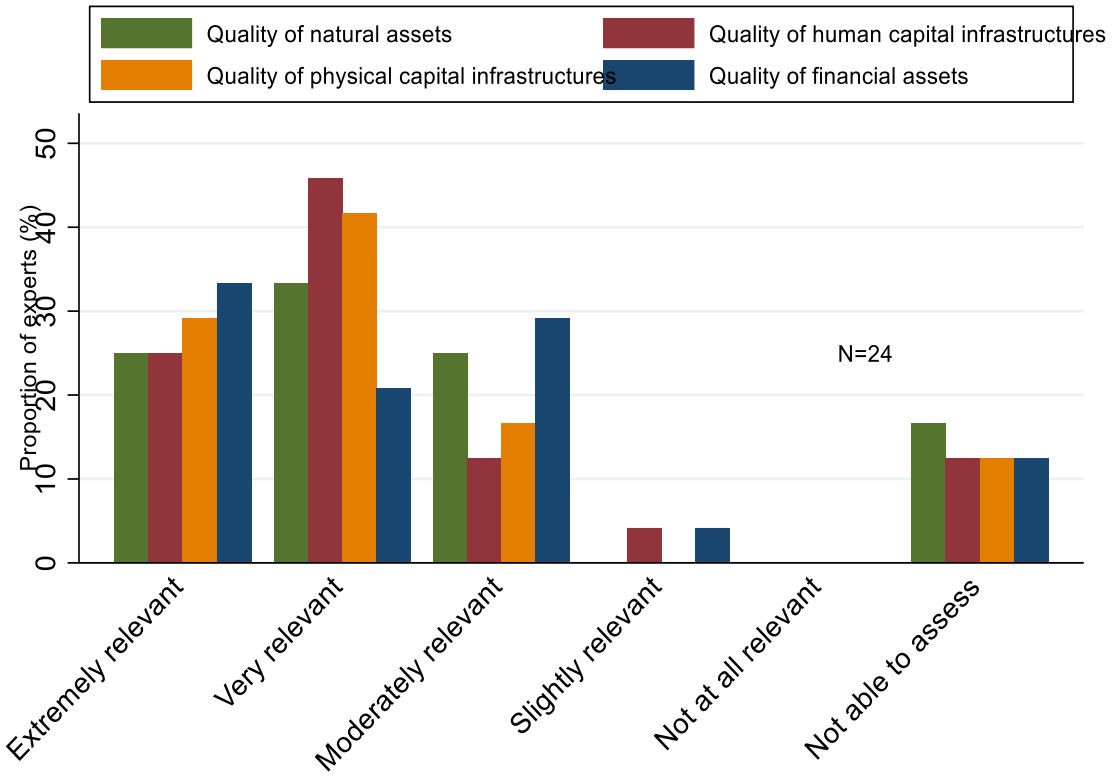
	Generic indicators	Examples potential specific measurable indicators	Justification
Access to assets	Property rights	% households with land certificates; # court cases over ownership or use of resources/assets pc; prevalence of conflicts between people over property rights; perceptions over resource/asset security	Enable/disable secured access to assets; decrease/increase risk of conflict over the use of resources, joblessness, and landlessness
	Distance	Distance to the nearest school, distance to the nearest health center, distance to urban centers	Hinders access to assets and services provided by them
	Affordability	Cost of schooling per child; cost of visiting a health center per patient; interest rate; house rent per room; land rent per hectare; land price per hectare	Influences ownership and access to assets and the services that are provide by the assets
Quality of assets	Quality of natural assets	Soil quality; slope; share of waste land/desert; rainfall/precipitation variability; normalized difference vegetation index (measure for greenness of vegetation); forest density per km^2, air quality	Influences viability of natural asset-based livelihood activities
	Quality of human capital infrastructures	Life expectancy; literacy rate; infant mortality; health burden (death and loss of health due to disease)	Affects human capital; decreases/increases risk of morbidity
	Quality of physical capital infrastructures	# electricity outages per specified period; % tarmac roads of all roads; % improved housing; signal strength of mobile networks	Influences access to markets; reliability of electricity and other infrastructure
	Quality of financial assets	Wage rate; total capital of financial institutions; average loan per creditor; length of repayment period	influences access to credit and other financial services
Socio-economic context	Social factors	Ethnic diversity; religious diversity; crime rates	Decrease/increase the risk of community disarticulation
	Economic factors	Income inequality; poverty incidence; income level; economic growth; dependency ratio; population density; livestock density per km^2;	Influence community integration; decrease the risk of joblessness if good economic condition prevails
Institutional strength	Voting	% registered voters; voter turnout	Influences engagement in community affairs
	Corruption	# reported bribe cases pc; perceptions on corruption	Influences trust on institutions and officials
	Enforcement of laws and regulations	Share of decision per total number of cases per year; share of implemented policies per proposed ones per year	Affects security; influences the resettlement implementation process
	Regime type	Level of democracy; stability of the regime	Influences planning and implementation of resettlement programs
Violent conflict	Internal armed conflict (including one-sided violence)	# internal armed conflicts/genocides over a specified period; # affected people and victims over a specified period; # conflict/genocide years over a specified period	Destroys livelihood assets and social infrastructure; restrict free movement and exchange of information; increases the risk of morbidity
	International armed conflict	# international armed conflicts over a specified period; # affected people and victims; duration of conflict/genocide over a specified period	
Natural hazards	Geophysical disasters (e.g., earthquakes, volcano eruptions)	Frequency of geophysical disasters (GD); proportion of GD-affected area; # GD-affected people; # GD victims; economic damage pc; probability of GD occurrence; # active volcanoes; # inactive volcanoes	Destroy livelihood assets and public infrastructures; increase the risk of morbidity
	Biological disasters (e.g., disease outbreak, infestation)	Prevalence of livestock and human infectious diseases (e.g., malaria, trypanosomiasis); # major biological disasters (BD) over a specified period; # BD people affected; # BD victims	Claim human lives; destroy human capital; increase the risk of morbidity
	Climatic, hydrological, and meteorological disasters (e.g., flooding, drought, sea level rise)	Frequency of climatic, hydrological, and meteorological disasters (CHMD); proportion of CHMD-affected area; # CHMD-affected people; # CHMD victims; economic damage pc; probability of CHMD occurrence; area permanently covered by sea level rise	Destroy livelihood assets and public infrastructures; increase the risk of morbidity

Appendix D: Expert assessment of the condition dimension's generic indicators

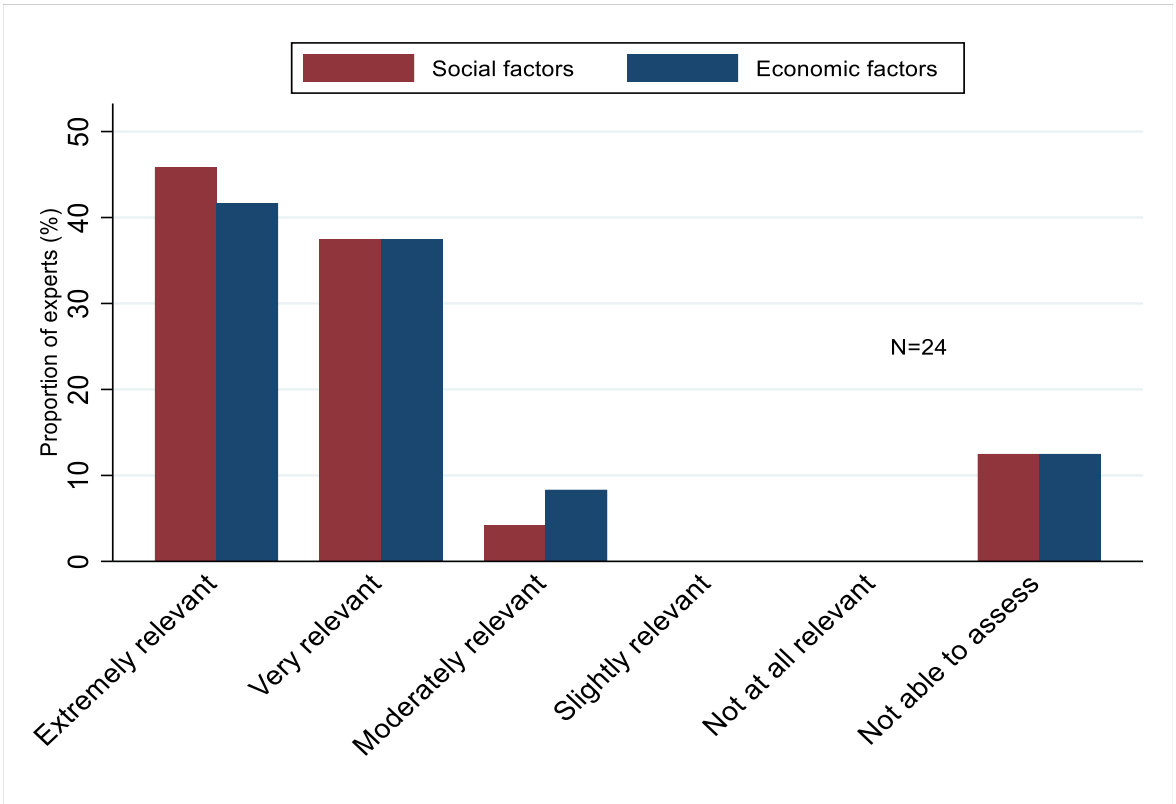
a) Access to assets



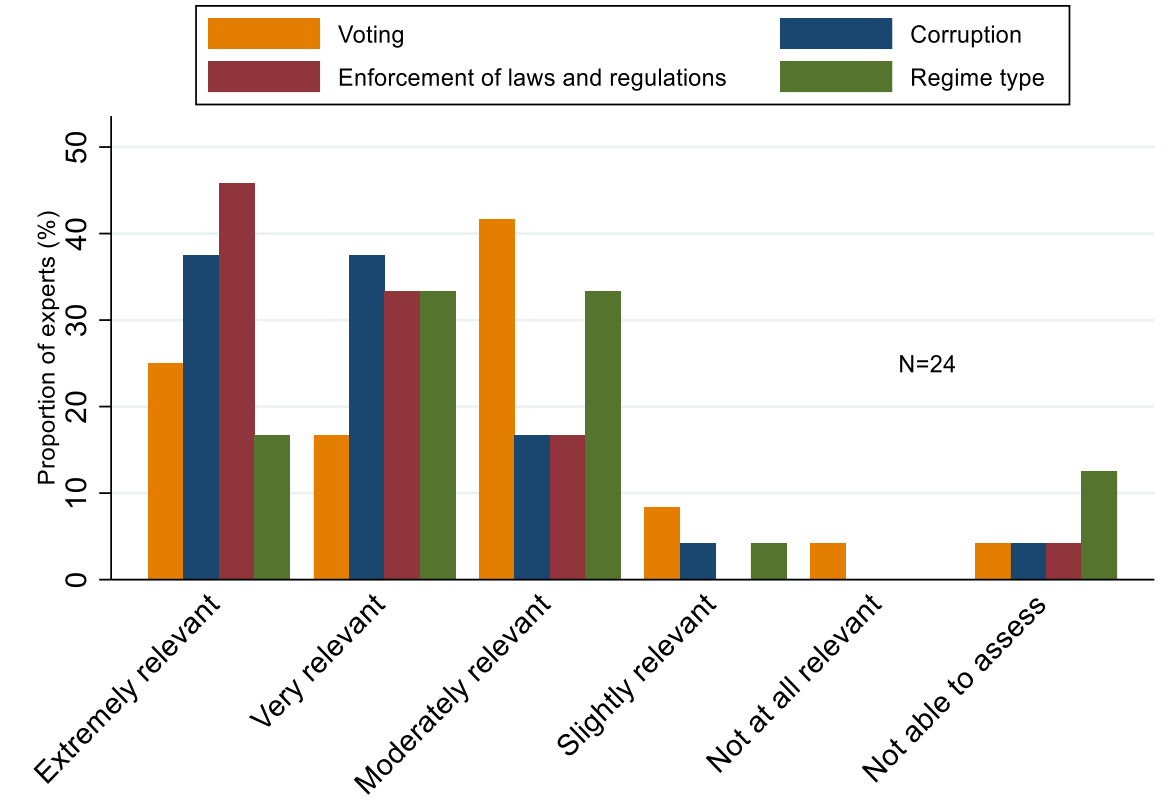
b) Quality of assets



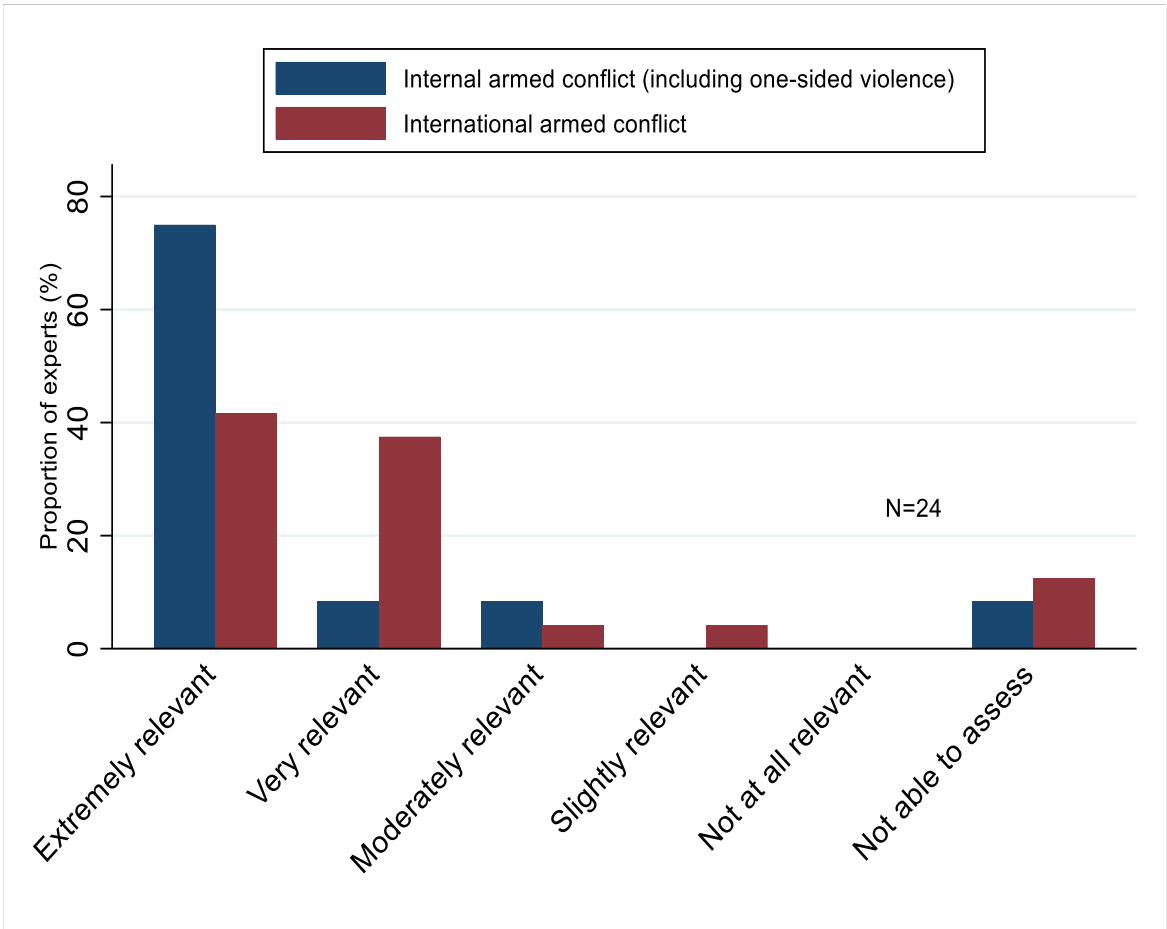
c) Socio-economic context



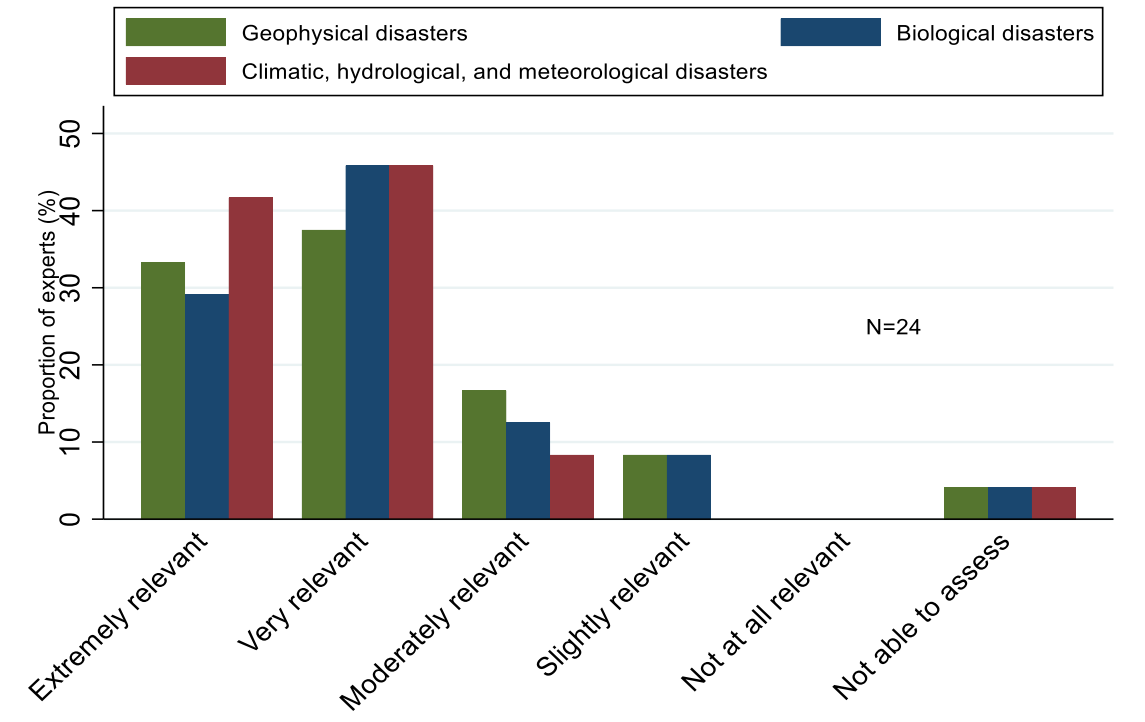
d) Institutional strength



e) Violent conflict



f) Natural hazards



Appendix E: Description of expert survey and characteristics

The survey among experts in the period June–September 2019. In addition to acquiring an expert judgment on the relevance of the framework's components (i.e., its dimension, subdimension, and generic indicators), we aim to receive suggestions for components that had not been included in the original version of the framework. The assessment used a 5-point unipolar Likert scale, ranging from "extremely relevant" to "not at all relevant", with an option to opt out of providing an answer if the expert was unable to make an assessment of a particular element). The survey data were analyzed by calculating the percentage of the experts who indicated that a specific component was either extremely, very, moderately, slightly, and not at all relevant, and taking into account those who were unable to assess the component. The experts suggested the addition of residential land and air quality in the framework and hence we added residential land as a generic indicator to natural capital subdimension and air quality as a specific measurable indicator to quality of natural capital generic indicator. These were the only relevant elements recommended by the experts for addition to the CCRC framework and since they were included in CCRC only after the survey, we cannot provide assessment results for these elements.

Most of the experts were selected using snowball sampling: an initial set of relevant experts was chosen from participants at the Nordic Geographers Meeting (NGM) in Trondheim, Norway, (June 2019) and World Forum on Climate Justice in Glasgow, Scotland, UK (June 2019), and these experts then suggested additional experts. A total of 24 experts participated in the survey, which was conducted using an online cloud source solution, Survey123, for ArcGIS. The experts had an average of 12 years (range 1–40 years) of research experience or professional experience in one or more fields relating to climate change, resettlement, livelihoods, migration, and disaster management.

Place-based resettlement capacity assessments to identify potential resettlement places for climate migrants are needed to guide climate change related resettlement programs. The authors propose and validate a conceptual climate change resettlement capacity (CCRC) framework that could be used to identify potential resettlement places for climate change migrants. The CCRC framework focuses on livelihood reconstruction, as this is the primary aim of most resettlement programs, as well as ensuring successful resettlement and mitigating impoverishment of resettled people and communities. The framework has two main dimensions – assets and conditions – as its foundation with a set of subdimensions and generic indicators identified for both of them. Expert evaluation was used to validate the framework. The framework is designed to assist international organizations, governments, planners, and policymakers in identifying both the most suitable and least suitable places to resettle communities in the face of actual or anticipated displacements due to climate change. In addition, the framework can be used by researchers to undertake theoretical and empirical studies on climate change induced resettlement. With minor modifications, the framework can also be applied to resettlement capacity assessments for non-climate resettlement programs and research.

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