Disaster Economic Vulnerability and Recovery Programs Experience from Tanzania

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Chapter 3
Disaster Economic Vulnerability and Recovery Programs Experience from Tanzania

Neema Penance Kumburu

Abstract Disaster risk is described as "the probable damage of life, injury, or demolished or spoiled properties that might happen to a network, organization, or a communal in a particular time, influenced probabilistically as a role of hazard, exposure, vulnerability, and ability," while economic recovery program is a means by which a community advances and competently executes its ability to engross an early tremor using extenuation and to counter-react and acclimatize subsequently so as to preserve activities and fasten rehabilitation and again to be in an improved situation to lessen fatalities from upcoming disasters. No organized examination has been endeavored to comprehend disaster economic vulnerability and recovery programs in Tanzania; thus there is knowledge gap in this area. It is for this reason that this section documents and shares knowledge on disaster economic vulnerability and recovery programs using Tanzania as a case under investigation. The development of this section was founded on the hypothetical and ancient work study. To ensure an extensive hypothetical and experiential foundation for this work, desk review has been carried out to gather information from numerous secondary bases. This comprised reports and project papers and registrations. Secondary databases have been gotten from writings regarding disaster, economic vulnerability, and recovery programs. Furthermore the desk review reviewed reputable journals related to the discipline. Finally, the information gathered were scrutinized, polished, and modified to match the requirement of this article. Concepts and frameworks on tragedy economic susceptibility and repossession agendas as well as indices that are used to measure susceptibility and pliability to natural threats are also offered; this is shadowed by econometric model: influences and measures of economic susceptibility. The chapter also illustrates disaster economic vulnerability and retrieval programs experience from Tanzania whereby efforts that have been made so far and economic recovering program, namely, macroeconomic stability, microeconomic market efficiency, governance, and social development, have been presented.

Keywords Disaster · Economic vulnerability · Recovery programs · Risk

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1 Introduction

Among 1970 and 2012, the worldwide direct economic losses (DELs) triggered by climate-correlated disasters amounted US$ 2.4 trillion (in 2012 prices), and deaths surpassed 1.94 million (WMO, 2014). On the other hand, universally, 91% of altogether disasters throughout 1998–2017 were triggered by overflows, tempests, droughts, heatwaves, and other life-threatening incidents (CRED, 2018). These incidents caused death in human life and major harm to possessions, infrastructure, and the surroundings (Formetta & Feyen, 2019); additionally the events excessively influence people in emerging countries (UNISDR and CRED, 2015). Worldwide climate-linked disaster losses have realized growing tendency in the last decades, mostly due to increased manifestation of human being and properties caused by economic progress and populace increase (Wu et al., 2018). Moreover, the susceptibility to disasters also differs particularly along the development range (Tanoue et al., 2016). Although the developing and third-world countries contribute to up 65% of global natural tragedy deaths from 1985 to 1999 (Wu et al., 2018), the hostile economic growth effect of weather disasters is more apparent in less developed countries compared to first-world countries (Klomp & Valckx, 2014). Even though obviously correlated, disaster economic vulnerability and recovery programs remain elusive (Fatemi et al., 2022).

Over 2000 natural tragedies have pretentious 460 million persons, and murder over 880,000 since 1970 in Africa (Pusch et al., 2016). Overflows are the greatest recurrent, contributing for 42% of economic costs. Yet, droughts form 78% of the vulnerable populace. Other less common hazards such as hurricanes, tremors, landslides, volcanoes, and epidemics have broad-spectrum economic and growth penalties. Capitals needed for retrieval avert deliberate growth expenses, thus causing fiscal pressures. Disasters likewise have a macroeconomic cost, such as damage and deceleration growth of GDP (Pusch et al., 2016). Harm and fatalities triggered by natural disasters counting unhurried beginning ones such as droughts have produced an attrition of considerable percentages of GDP, and noticeable slowing down in GDP growth, in African economies over the last few years. Tragedy fatalities and people's contact to dangers are cumulative in Africa. This is attributed to quick development, unplanned dwellings frequently in dangerous areas, unmanageable land usage, infrastructure pressure, cumulative climate inconsistency, and increasing populace. Environmental dilapidation, deficiency, and battle further worsen the dangers and decrease the adaptability ability of communities.

Comparable to other nations in sub-Saharan Africa, Tanzania is principally susceptible to the influences of life-threatening weather, such as extensive floods, recurrent and lengthy droughts, and seaside storm surges (Watkiss et al., 2011). These incidents have been allied straight to substantial social and fiscal effects counting deteriorating harvest yields, augmented occurrences of produce pests and illnesses, loss of livestock, reduced water obtainability and upsurge in the last few years, and water-borne diseases (Msemo et al., 2021). Practices specify that communicable illness outbreaks habitually follow dangerous climate activities, as

microorganisms, sources, and pool animal hosts exploit the troubled communal and ecological situations of dangerous weather (McMichael, 2015). Human health also is affected due to heat stress, changes in weather condition, and water-borne contagions, air impurities, and conflicts motivated by the utilization of scarce natural resources (Ncube & Tawodzera, 2019).

Feeble recovery ability and dependence on rainfed agriculture brand Tanzania tremendously susceptible to climate variation effects (Msemo et al., 2021). It is predictable that by 2100 Tanzania will realize upsurges in flows and sea level rise, exposing majority of persons at risk of seaside overflowing (Mkonda & He, 2018). Msemo et al. (2021) noted that the Tanzanian government has continuously devoted millions of US dollars circumventing the effects of unadorned weather and climate variation, but the efforts have never been successfully partly due to postponements and official drawbacks in integrating the healthier application of climate information (Pardoe et al., 2018). It has been forecasted that climate alteration might cause net fiscal charges that are equal to a cost of nearly 2% of GDP each year by 2030 (Watkiss et al., 2011). It is recognized that the government of Tanzania has enacted, designed, and implemented policies and programs supportive to disaster and economic vulnerability. These policies and programs include Disaster Relief Coordination Act No. 9 of 1990. The Act was also reviewed in 2015. Among others, the Act recognized an Inter-Ministerial Committee, namely, the Tanzania Disaster Relief Committee (TANDREC), to superintend, organize, and control the general release processes and disaster administration functions in the republic.

Despite the efforts, the study by Msemo et al. (2021) found that a sum of 498 tragedies were noted in the tragedy records from the Prime Minister Office Disaster Management Department (PMO-DMD) amid 1872 and 2019, out of that 363 happened among 2000 and 2019 whereas 135 arose in the period of 1872 and 1999. Weather-linked disasters amounted for 250 (69%) of the 363 detected tragedies in Tanzania. The span of 2000–2019 has an alike occurrence of tragedy type as the entire time of 1872–1999. Flooding is the greatest happening occurrence, ascribing to 35% to the entire-natural tragedies in both periods. Strong winds amount to 8.1%, and drought contribute to 4.4% of the whole catastrophes, during the 2000–2019 period. With regard to actions often linked to bad climate (directly or indirectly), speats and maritime fates accounted for 21.2 and 16.2%, respectively, of entire-natural tragedies in the last 20 years. Climate influences are observed as a fundamental feature in a number of speats such as cholera, dengue, and plague (Chersich et al., 2018; Fadda, 2020), although bad climatic actions and deprived attention to climatic circumstances are among the determinants contributing to naval accidents (Fig. 3.1).

It was further revealed that the magnitude of occurrence of flood is in the northeastern part of the country, Lake Victoria washbowl, northeastern uplands, and the middle parts of Tanzania. Disasters related to deficiency of water are high in Arusha, Mara, Shinyanga, Dodoma, Tanga, and Lindi regions. On the other hand, strong winds are prevalent in Dar es Salaam, Pwani, and Mafia Island; Lakes Tanganyika, Rukwa, Njombe, Ruvuma, and Mtwara; Dodoma; Lake Victoria basin; and Mara, Mwanza, and Kagera regions. Coastal areas of the Indian Ocean are more affected

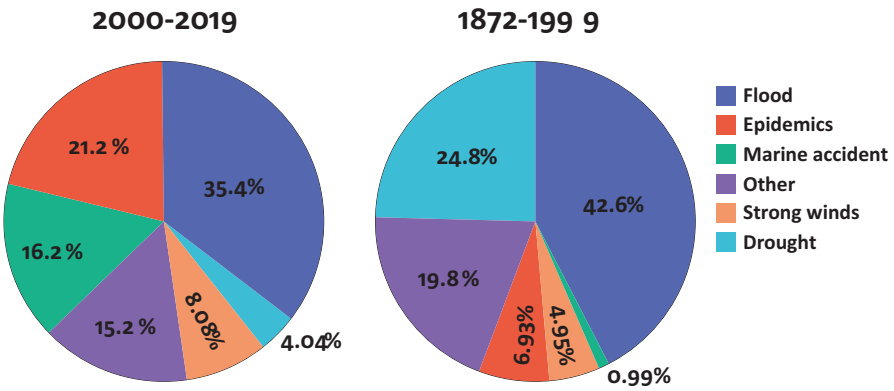

Fig. 3.1 Classification of weather-related and other non-meteorological disasters in Tanzania for the period of 2000–2019 and 1872–1999. (Source: Msemo et al. (2021))

by disasters because of amalgamation of many factors like population density, poor infrastructure, land usage variations, and poverty (Anande & Luhunga, 2019). Substantial precipitation is prevalent in Dar es Salaam, Pwani, Mtwara, Mara, Mwanza, Kagera, and Singida regions, while landslides were common in Kilimanjaro and Mwanza. Nautical fates were reported over Zanzibar Island and single occurrence in Mwanza (Lake Victoria).

Over 20.5 million dollars were spent by the government to control major disasters that destroyed over 35,700 habitats and 1000 critical infrastructures (roads, bridges, schools, and hospitals), displaced over 572,600 people, and resulted in over 240 damages and 450 deaths. See Fig. 3.2 for further information.

While these statistics are correct, there is currently little research on Disaster Economic Vulnerability and Recovery Programs in the third-world countries, particularly in Tanzania. CRED (2018) used the CRED's Emergency Events Database to examine the worldwide position on economic fatalities, deficiency, and catastrophe in the period of 1998–2017 (EM-DAT). The document grouped disasters, based on the kind of danger that activates them where hydrological, climatological, and atmospheric incidents were cooperatively labelled weather-linked plus geophysical disasters (CRED, 2018). Furthermore, the document compares the effects among developed and developing countries with emphasis on human impact rather than pecuniary effects. On the other hand, Msemo et al. (2021) on their study What Do Weather Disasters Cost? An investigation of climate influence in Tanzania uncovers the space spreading of climate-associated disasters and their impacts and proposes mechanism to advance creation and acceptance of climate data by climate delicate sectors. No organized scrutiny has been attempted to understand disaster economic vulnerability and recovery programs in Tanzania; thus there is knowledge gap in this area. It is for this reason that this chapter will document and share knowledge on disaster economic vulnerability and recovery programs using Tanzania as a case under investigation.

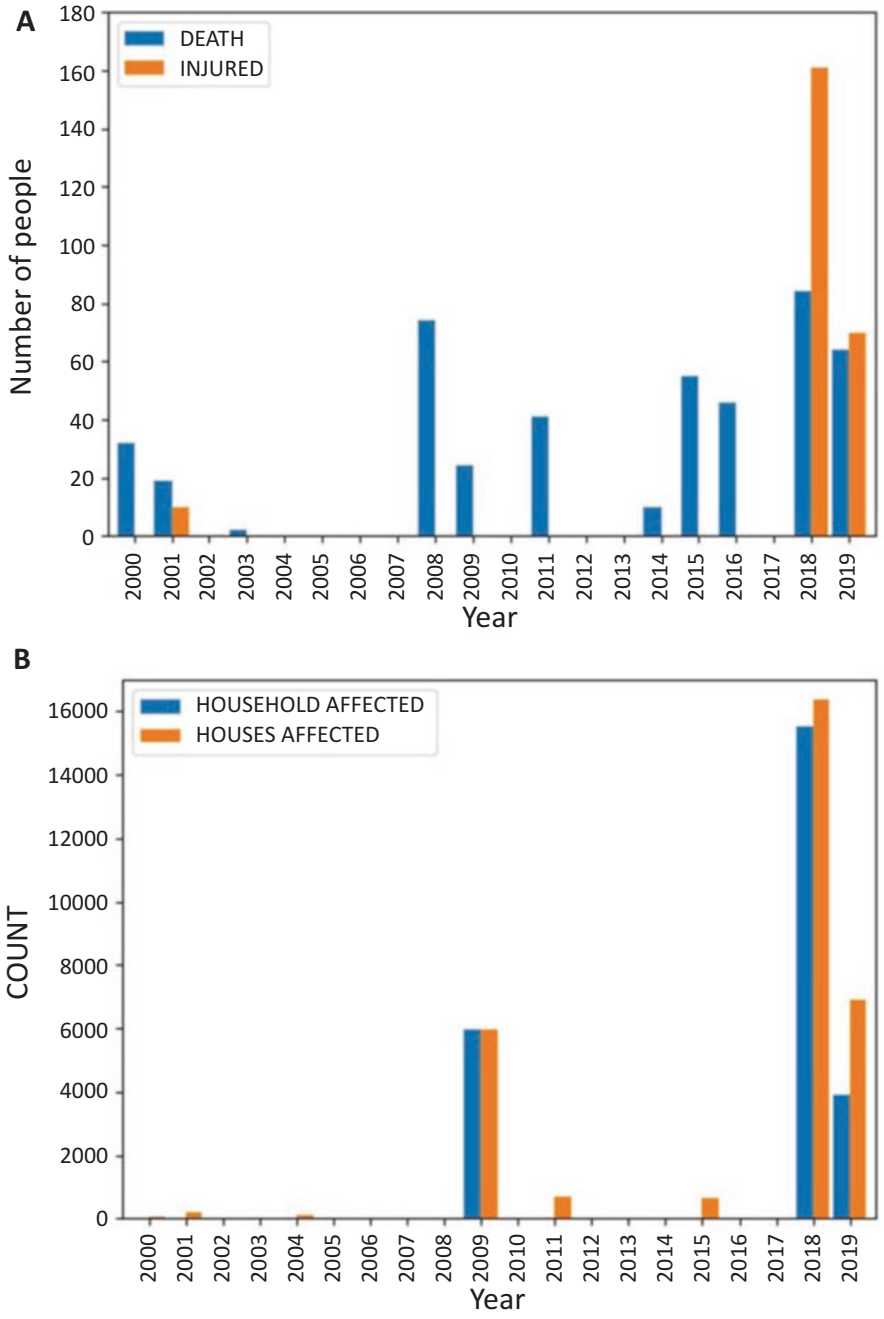

Fig. 3.2 (**a**) The yearly number of deaths and injuries. (**b**) The yearly number of persons impacted and homes destroyed or damaged by weather-related catastrophes. (Source: Msemo et al. (2021))

Development of this work was based on the hypothetical and pragmatic literature study. To ensure extensive hypothetical and empirical foundation for this study, desk review has been carried out to obtain data from numerous secondary foundations. This included reports and project documents and policies. Secondary data sources have been gained from literatures about disaster, economic vulnerability, and recovery programs. Furthermore the desk review reviewed reputable journals related to the discipline. Finally, the information gathered were scrutinized, polished, and modified to match the requirement of this article.

2 Overview of Key Concepts and Frameworks on Disaster Economic Vulnerability and Recovery Programs

2.1 Conceptual and Theoretical Frameworks

What is described as disaster today was not there 10 years past; the dissertation on tragedies was mainly concerning natural threats and their faces. Disasters were regarded as outcomes of procedures of the geophysical biosphere (Cavallo & Noy, 2011). In such situation governments' recovery programs were largely mechanical, in particular hazard defense actions such as flood resistance (Van Westen et al., 2009). The mechanical approach provided inadequate solution to the changing effects of disaster on individuals and community (Noy & Yonson, 2018). Over the years, using the practices of third-world nations, the notion of susceptibility arose in the disaster treatise. Disasters activated by natural threats have been extensively regarded as unnatural incidences invited by a convergence of communal influences sideways these natural hazards (Van Westen et al., 2009). Based on that, that disasters were the outcome of the interface among natural threats and societal issues seemed as early as in the 1970s (Noy & Yonson, 2018); however the opinion has not voluntarily gain extensive recognition at that moment. Consequential to this transformation is the keen curiosity by an array of disciplines in attaining adeptness of the vital fundamental issues that permit hazards to convert to disasters. From this thoughtful of vulnerability arose a similar recognition of the dissimilar role of resilience in determining the effects that tail from the subsequent disaster impacts.

At the moment enormous theoretical and pragmatic works on susceptibility and resilience to natural dangers are available. Though mainstream of these literature are from varied social disciplines, the economic measurement of susceptibility and of resilience is typically covered. Scholars in economics began later, principally in 2000 (Noy & Yonson, 2018); nevertheless the inventive description on the economics of disasters arose much earlier by the works of Dacy and Kunreuther (1969) and Albala-Bertrand (1993). On their study Dacy and Kunreuther (1969) assessed the factors of long-run recovery, such as infrastructure networks, insurance, and public policy. Meanwhile, Albala-Bertrand (1993) designed a framework for examining disasters in third-world countries and contends that in the sphere of progress

influences the prevalence of a disaster, disasters are not impediment toward development. Thus, it can be said that economic susceptibility and adaptability, interacting with the hazard and the revelation of populaces and physical possessions, are regarded as crucial elements of the resulting disaster damages and losses. As a matter of fact, disasters are determined mostly by economic forces, so that existence of disasters is an economic event (Cavallo & Noy, 2011).

Innumerable research adopts numerous procedural approaches within and external the economics discipline. Complex adaptive system is one of the prominent methodology which offers sympathetic increasing effects of natural dangers by captivating an evolutionary approach (Holland, 2006). Other relevant and crucial approaches include the general equilibrium methods and the partial equilibrium analysis.

Complexity theory is about unpredictable associations in altering, chaotic systems whose steadiness is transitory (Norberg & Cumming, 2008). It tries to comprehend how multifaceted behavior changes or arises from fairly modest resident connections amid system parts over time. Complexity theory thus brings into line well with the context of susceptibility studies assuming that, distinct to conservative systems theory founding, intricacy approach hypothesizes that frameworks are not in a persistent state of symmetry and are created relationally (Preiser et al., 2018).

This avoids the stationary characterization of interconnected procedures and outcome by concentrating on determinants including expansion of feedback circles, the crossing of verges, and the variety of performers and procedures utilized. To comprehend the system as a whole as well as how its parts fit together, it is thus crucial to scrutinize changing associations on different foundations of a system with time and the movement of stocks and flows among its sub-parts. Complex systems appeared to be utilized in continuous sciences and the examination of human-environment connections by the eye of Complex Adaptive System (CAS) (Preiser et al., 2018). CAS and complexity theory often utilize together a number of assumptions in such both contend that systems are made up of varied parts that are autonomous but whose small connection and possessions advance to emergent wider behaviors (Cairney, 2012). CAS, however, are attentive, upon adaptation, and have the capacity of systems to self-organize and adjust their behaviors; as a result, they can acclimatize to deviations in their surrounding and establish co-evolutionary capacity. Furthermore, CAS theory declares that systems are integrally managed by economies of scale and that minor relations are frequently ruled by greater-scale trends. Main ideas inside CAS theory are modulation (i.e., the extent to which bulges of a network can be dissociated into comparatively separate parts and reconvened), redundancy (i.e., the extent to which bulges can substitute for one another), ranked endogenous-exogenous interface (i.e., the system is exposed and can interrelate with outside factors), and emergence (the source and growth of unforeseen or erratic phenomena) (Naylor et al., 2020.) CASs are too understood to have the aptitude to not only acclimatize but also study, know, and respond to reactions both institutionally and ecologically. CAS theory is built upon some surrounds of risk and some elementary doctrines which are not comprehensively sufficient to fit within practically any susceptibility approach or framing. Examples notion that a

system can self-organize after a perturbation to recur its initial role when a stressor is applied, which reduces its subsequent susceptibility through an increase in its coping range. Figure 3.3 presents the details.

A general equilibrium approach (GEA) is a valuable framework to assess the economic impact of disaster and its policy response at micro and macro levels (Huang & Hosoe, 2014). The model is a multi-market simulation approach based on the optimization behavior of individual households and firms, as well as competition in markets following the GEA developed by Hosoe et al. (2010). Overall, the aim of the GEA approach is to estimate a community's regional economy at a particular point in time (e.g., a "snapshot" of the economy after investing in resilience) and to examine how the community responds to exogenous changes (or "shocks") to the economy relative to that particular point in time. For that matter GEA is an ideal option for discovering the effects of large disruptive events, such as recessions and natural disasters, on a community's economic activity and the impact of resilience planning on reducing these effects. GEA imitates the working of a market economy in that prices and amounts supplied and demanded are regulated to clear all markets (Helgeson et al., 2018). The economy is assumed to be in equilibrium when markets are clear. Figure 3.4 presents the typical associations in the economy as prescribed by a CGE. Households increase their welfare, firms boost their profits, the state is assumed to have a balanced budget, and resources are scarce but again costly. Effectively, a GEA stipulates the probable behavior of enhancing consumers and producers; the community and government (e.g., taxes) are included as an agent to capture transactions in the circular flow of income (Shultz & Elliott, 2013). GEA models allow for a geographic distribution of the impacts from shocks to an economy. Thus, GEAs are ideal for exploring the distributive effects (in particular, the

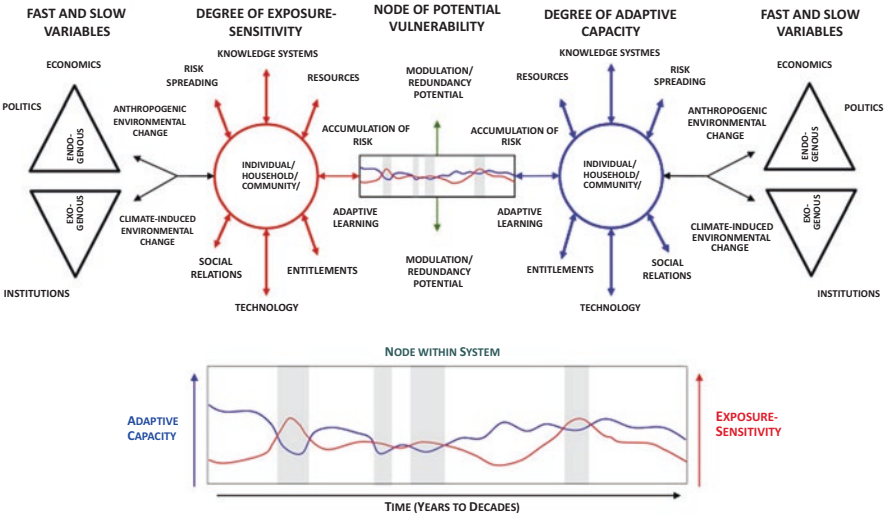

Fig. 3.3 Complex adaptive system and vulnerability. (Source: Naylor et al. (2020))

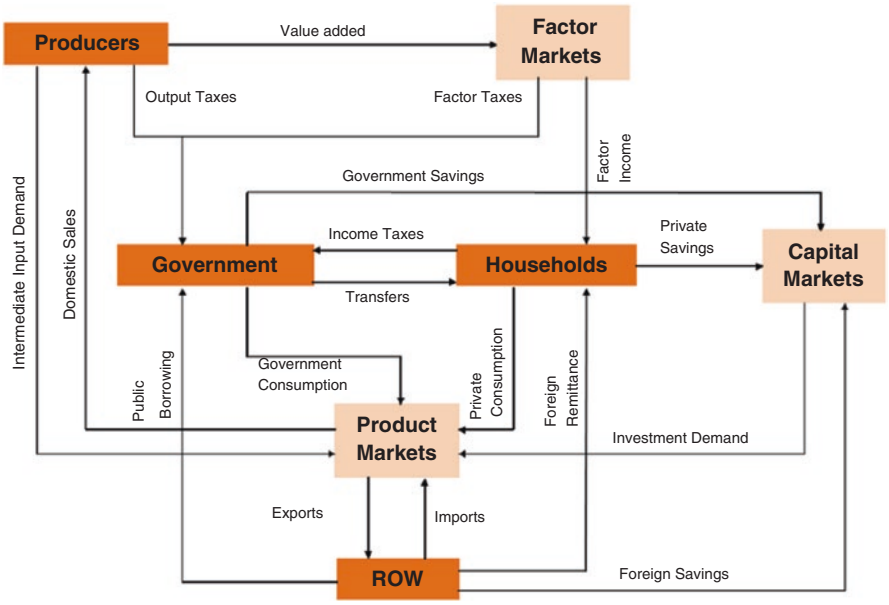

Fig. 3.4 Main components in a GEA. (Source: Helgeson et al. (2018))

resilience dividend) of resilience planning against large-scale shocks across a community such as floods and drought.

The partial equilibrium technique associates supply and demand in single or multiple marketplaces in order that prices are steady at its symmetry level. Utilizing this method, the prices convert endogenic in difference to the demand purposes. This method is differentiated from GE models for the reason that it fails to reflect all production and consumption state in an economy. It also fails to reflect all markets and prices in an economy and fails to capture the influence of variations in one market on additional main markets in the economy. Fractional symmetry analysis is more appropriate for assessing sectoral improvements. Precise equipment for fractional equilibrium includes "multi-market models" and "reduced form methods." The multi-market models approximate mechanisms of demand and supply relations and assess the influence of regulations in subdivision which can be interpreted into other linked segments. Multi-market models are applied in a numeral of settings to scrutinize the well-being effect of mechanical vicissitudes in farming, e.g., input grants in India (Binswanger & Quizon, 1984) and receivers and losers in business reorganization in Morocco (Ravallion & Lokshin, 2004).

Condensed form practices are applied to activate the influence of dissimilar regulation parameters on social consequences, such as deficiency and nourishing condition. A situation of reduced form technique for Tanzania was realized in quick per capita GDP advance between 1995 and 2001. Yet, domestic surveys displayed the weakening in poverty was comparatively minor. Understanding this state, Demombynes and Hoogeveen (2004) contended that a conceivable clarification for

this consequence was because poverty augmented through beginning of the 1990s, whereas economic progress might only counterbalance a portion of the initial increase in poverty.

They presented that, underneath a diversity of situations, poverty occurrence first enlarged to above 40% at the beginning of the 1990s and then deteriorated to less than 36% by 2000–2001. Their sectoral imitations recommended that the poverty reduction influences economic growth in Tanzania which was more important in town than in villages. Their sectoral rottenness of the poverty consequences designated that a minor portion (11.6%) of the weakening in headcount poverty at the country might have been clarified by a change in the populace from the inferior village areas to the rich town areas. They decided that attaining the Sustainable Development Goals would thus need altering designs of growth in the village areas. More recently, Holmes and Dharmasena (2016) utilized the monthly national US data for the period 1997–2012 to investigate the connections among macroeconomic tremors and involvement in food support programs. Their modelling included polynomial dispersed lags, vector autoregression methods, and directed acyclic graphs. Such methods can be applied to develop improved forecasts of involvement rates in food support programs at the time of shocks persuaded by macroeconomic parameters, can help in better valuation of the costs involved in food support programs, and can save government capitals through creating the intervention cost-effective.

2.2 Synthesis of the Findings from Econometric Studies

Synthesis of the findings from econometric studies is presented in order to offer comprehensive understanding of disaster economic vulnerability and recovery programs. In this context a model specification of the four-component disaster risk formulation is specified as:

$$\text{Disaster Risk} = f\left(\text{Hazard, Exposure, Vulnerability, Capacity}\right)$$

This equation was approved by the United Nations General Assembly as fragment of the worldwide effort to create parameters for the Sendai Framework for Disaster Risk Lessening 2015–2030; in addition the variables are in line with the pointers for the Sustainable Development Goals (UN, 2016) According to UN (2016), disaster risk is likely demise, damage, or demolished or spoiled assets that might happen in a certain period of time to an organization, culture, or community, as influenced probabilistically as a function of hazard, exposure, vulnerability, and capacity." A technique, object, or human deed that may result in loss of life, injury, or other health effects, property damage, social and economic disruption, or environmental degradation is defined as a hazard in this context.

On the other hand, exposure is when individuals, infrastructure, habitat, production capacities, and other palpable human assets are exposed in hazard-prone

environments, whereas vulnerability refers to situations exacerbated by physical, social, economic, and environmental influences or procedures that increase an individual's, a community's, assets, or systems' defenselessness to the effects of hazards. Finally, capacity is a combination of all the high-caliber attributes and properties accessible inside an organization, community, or society to manage and reduce disaster risk while also strengthening resilience (UN, 2016).

In this context, capacity refers to both adaptive and coping capacities, as defined by the IPCC (1996) and the UN (2016) and the UNISDR, respectively (2006). The capacity of an organization, neighborhood, or community exposed to catastrophe to fight, engross, host, change, and recuperate from the impact of a hazard in a right time and effective manner, applying the conservation and refurbishment of its vital elementary structures and purposes using risk management, is referred to as resilience.

2.3 Frameworks on Vulnerability and Resilience

There is distinct operationalization of susceptibility and pliability apiece of the disciplines and societies intricate in the discussion of natural threats (Birkmann, 2006; Thywissen, 2006). Villagran de Leon (2006), on the other hand, shows how a range of different activities have resulted in a shift in sympathy, if not misconception, toward these beliefs (Miller et al., 2010). That's why individually discipline is probable to preserve its exact meanings and disciplinary contexts when investigating natural hazards and disasters, without creating the alterations and contextualization to line up with other disciplines. Regardless of the contributions of numerous academic disciplines (e.g., sociology, geography, economics, planning, or public health), the meanings and frameworks of disaster risk reduction (DRR) and climate change continue to evolve as a result of their application within the DRR and climate change communities. Before the four-item disaster risk formulation described in Sect. 2.2, the disaster risk community's most common and longest stand-up disaster risk formulation was as follows:

$$\text{Risk} = \text{Hazard} \times \text{Exposure} \times \text{Vulnerability}.$$

The dual-items risk formulation, i.e., Risk = Hazard × Vulnerability, is added variant. It seizures the two contrasting mechanisms under the Pressure and Release (PAR) framework (Wisner et al., 2004). Concentrating on individuals, vulnerability is described in this context as the features of an individual or cluster in terms of their ability to antedate, contend with, counterattack, and recuperate from the impact of a natural hazard (Blaikie et al., 1994). In this operationalization, it is true that vulnerability includes exposure. This description imitates what usually are regarded to be the parts of resilience, as demarcated by UNISDR (2006) and UN (2016). Notwithstanding this clarification, the system touches the means that disaster happens when a natural menace comes close to the weak. The PAR framework is also

shown in the Evolution of Vulnerability Framework. This concept distinguishes between three stages of vulnerability development: the economic and social networks that determine the ways by which capitals, prosperity, and authority are dispersed, governance ideologies, and antiquity and culture are all examples of "root causes." "Dynamic pressures" are defined as shortages in society's economic, social, and political processes, as well as macro-forces such as rapid population growth and urbanization, desertification, and a decrease in soil throughput, to name a few (Noy & Yonson, 2018). These serve as the means by which the origin gives rise to a result in delicate livelihoods in dangerous sites that is the last level in the advancement (Wisner et al., 2004). There are a slew of other previous definitions of vulnerability that contain either or both familiarity and pliability. Pelling (2012), for example, recognizes three types of vulnerability: exposure, resistance (the ability to withstand hostile impact), and resilience (i.e., the ability to cope and acclimatize).

Sensitivity, exposure, and adaptive capability are all factors that influence vulnerability (IPCC, 1995). It divides the advantageous and disadvantageous characteristics that influence susceptibility into binary groups: sensitivity and resistance. Furthermore, the IPCC (1995) proposed that resilience is the polar opposite of vulnerability. Meanwhile, Holling (1973) describes the resistance of ecological systems' scenery to shocks. He defines resilience as a system's ability to absorb vagaries and persevere in the face of them. Similarly, the capacity to survive the occurrence of the danger while suffering only tolerable amounts of losses is articulated in the geoscience disciplines (Mileti, 1999). The length of time it takes to recuperate from the harmful effects of a tremor is emphasized in engineering (Correia et al., 1987). Pimm (1984) defined resilience as the speed with which a disorder is recovered in an ecological context, which is analogous to engineering. Apart from disasters, the idea of vulnerability is used in economics to describe tetrad extents of concern: poverty, food security, asset vulnerability, and sustainable development (Alwang et al., 2001). Vulnerability is regularly assessed in the dynamics of poverty, with a focus on the "risk of slipping into poverty" (Moret, 2014). Resilience is also applied in three different sections of the research: economic tremors, sustainability, and organizations (2009).

Briguglio et al. (2009) are among the first to examine the association amid economic susceptibility and economic pliability, hypothesizing that the two influence a country's danger of being amplified by outside earthquakes. Economic vulnerability is demarcated as a country's exposure to external disturbances as a result of intrinsic economic features such as economic openness, export concentration, and reliance on strategic imports. These are considered structural and so hard to alter by intelligent strategies. Economic resilience, on the flipside, denotes to the economy's capacity to cope, which might be changed by policy (Briguglio et al., 2009). Policies that promote and encourage recovery programs improve macroeconomic constancy, upsurge market efficacy, advance administration, and enlarge social progress. Rose (2009) noted numerous extents of economic recovery programs that are given scant attention and that are ignored in the current operationalization. They argue that, despite everything, there is a necessity to discriminate among

injury to stocks (i.e., property damage) and destruction of flows (i.e., destruction of production of goods and services). While stock losses are felt completely at the time of the shock, flow losses begin almost immediately after the danger occurs and endure to be felt until the complete retrieval is realized. As a result, according to Rose (2009), flow damages are more pertinent to the economic retrieval apprehension.

3 Assessment of Economic Vulnerability and Economic Recovery Programs

There are various efforts that have been made by researchers and academicians to translate these theoretical approaches into applied tools to analytically recognize the elements of the numerous scopes of economic susceptibility and retrieval program.

3.1 Indices of Vulnerability and Recovery Program

The index methodology is one of the most commonly used methods for assessing vulnerability and adaptability to natural disasters. These scales are designed to capture a wide range of susceptibility and pliability, as well as their economic components. The most well-known economic metric includes outcome (GDP or regional output), revenue, employment, price increases, consumption, expenses, savings, local and international financial transfers, public money, and trade (Rose & Krausmann, 2013). These scales differ in terms of motivation (e.g., assessment of susceptibility and/or pliability), geographic scope (e.g., global, provincial, local), examination scale (e.g., governments, resident authorities, enterprise-level, household), and methodological approach (e.g., government, resident authorities, enterprise level, household) (e.g., deductive, inductive, econometric). The recognition of gauges is based on relevant theoretical frameworks and/or recognized essential factors in the preceding pragmatic literature, and the majority of these measures use an inductive method. The most common methods for combining indications into a merged scale are spontaneous arithmetic or regular mean, and calibration is usually done before the combination. When weights are used, they are often based on expert judgment, participatory procedures, or a combination of the two. Econometric algorithms, such as data-reducing techniques like principal component analysis (PCA) and factor analysis, are another ordered tool for recognizing relevant indicators and allocating weights (FA). One of the first indexes to use the PCA was Cutter et al.'s (2003) social susceptibility index (SoVI). In sectoral level investigation, the SoVI and its offspring are commonly used. Two global indices are presented in the following subsections.

(a) **The Disaster Risk Index**

The Disaster Risk Index (or DRI) is the first index to use an arithmetic technique to try to validate the mechanism by which human sensitivity and disaster risk are affected by growth (Pelling, 2012). The DRI is handled on a global scale and has a national level of examination. The DRI was custom-made by the United Nations Development Program to be used by global and national policy formulators to make direct choices. The DRI used an inferential technique to identify a variety of economic, social, and environmental variables that were examined for their relationship to disaster deaths (Pelling, 2012). The basic risk equation is reflected in the DRI equation:

$$R = H \times \text{Pop} \times \text{Vul}$$

where
R = is the disaster risk, calculated in the form of quantity of deaths
H = is the proxy for hazard, calculated in the form of incidence of happening
Pop = is the amount of persons staying in the part affected by hazard
Vul = is the vulnerability

Vulnerability is a type of risk that explains why people who are exposed to the same amount of danger have different levels of risk (Peduzzi, 2006). As previously stated, the DRI only uses statistics on deaths attributed to hazard. For each danger type, a total of 32 socioeconomic and ecological pointers were evaluated as potential important susceptibility factors. Depending on the findings of different regression requirements, the final collection of susceptibility indicators varies among dangers. The GDP per capita for tropical cyclones, droughts, and floods and town growth for tremors are among the economic metrics that have emerged as critical. The results show that while growth does have an impact on susceptibility to natural dangers, the aspects of development that have an impact on each hazard differ. For example, the level of advancement as measured by per capita GDP affects vulnerability to hydro-meteorological hazards, whereas vulnerability to earthquakes is induced by the growth procedure.

(b) **InFORM**

The InFORM risk management index is designed for a global examination of charitable risk, with philanthropic groups, donor agencies, country governments, and development shareholders as target operators (De Groeve et al., 2015). Despite the fact that the InFORM considers the four mechanisms in the UN's (2006) definition of risk, risk is not "probabilistically determined" here. The InFORM, like the DRI, uses a multiple risks framework. InFORM, unlike the DRI, which only protects against natural hazards, also protects against man-made dangers. The DRI uses a deductive approach to variable selection, whereas the InFORM uses an inductive method. The InFORM is a composite index comprised of more than 50 parameters that are classified and calculated as follows:

$$\text{Risk} = \text{Hazard \& Exposure}^{\frac{1}{3}} \times \text{Vulnerability}^{\frac{1}{3}} \times \text{Lack of copingcapacity}^{\frac{1}{3}}$$

The InFORM defines vulnerability as people's sensitivity to hazards, as defined by the UNISDR (2006) and the UN (2016), and it is represented in two classifications in the index's creation: socioeconomic vulnerability and vulnerable groups (De Groeve et al., 2015). Economic vulnerability is measured by socioeconomic class, which is based on a mathematical average of variables measuring growth and denial, disparity, and reliance on aid. It is renowned that pliability is apprehended, nevertheless not in its sum, under absence of surviving ability that denotes to the existing capitals that aid individuals to "engross the tremor" (Mechler, 2009). Governance, institutional, and infrastructure parameters (such as access to health systems) are used for this element. Although both scales offered overhead are at the macro-level, there are also micro-level scales that are designed to assess economic susceptibility or pliability at the household or business level. In Cutter et al. (2003) and Rose and Krausmann (2013), several helpful appraisals of the macro- and micro-level scales may be instituted.

3.2 *Determinants and Measures of Economic Vulnerability: An Econometric Approach*

Cross-section or panel data frameworks are the most commonly used in the economics sector to rigorously recognize the underlying farces that define vulnerability and resilience. Deductive econometric frameworks are the most common, according to Pelling (2012), since they are more practical than inductive frameworks. These methodologies are used in two types of studies on the economics of tragedy. The first component aims to assess the influences that determine disaster effects on individuals and properties. The models can be described in the following way:

$$Y_{it} = \alpha_0 + \beta_1 H_{it} + \beta_2 E_{it} + \beta_2 X_{it} + \varepsilon_{it};$$

where:

Y_{it} = is the estimate of real effects either on persons or on possessions in spatial unit i at time t

H_{it} = is a vector of hazard features

E_{it} = is an estimate of the acquaintance of persons or properties

X_{it} = is the vector of the features of the exposed components, including the social, economic, and physical environments

These experiential models produce understandings on the factors underlying the susceptibilities of the discovered by controlling for hazard aspects and the familiarity of individuals and properties. The second component aims to examine the financial impacts in the short term (months to years) as well as the long term (at least

3–5 years). These researches also try to comprehend the issues that drive these influences in order to provide insight into the elements of economic pliability. According to Cavallo and Noy (2011), most models have the below specifications:

$$Y_{it} = \alpha + \beta X_{it} + \gamma \mathrm{DIS}_{it} + \varepsilon_{it};$$

where:

Y_{it} = is the effect of a spatial unit i on economic flows at time t. These effects are quantified, among other things, in terms of GDP (or growth), GDP per capita, the human development index, poverty, and employment.

DIS_{it} = is the disaster's immediate effect on properties and/or people. This provides the hazard features in various researches.

X_{it} = is a vector of control variables that influence Y_{it}.

As previously stated, resilience means the ability to reduce health-related losses (Wu et al., 2018). This drive necessitates the selection of appropriate wellness indicators to employ. The use of production and output variables, such as GDP and its variants, as a substitute for well-being is common, while consumption is debatably a healthier proxy. There exists economic work that argues on numerous welfare assessments. One of the prior recommendations on the limits of production and development parameters as welfare measures comes from Nordhaus and Tobin (1972). Overall, production refers to how much is made available, whereas consumption refers to amount that actually spent (expended). As a result, the economic conceptions of utility and way of life are seized by the healthier. Consumption, rather than work and production, is important to utilitarians (Cavallo and Noy) (2011).

4 Disaster Economic Vulnerability and Recovery Programs Experience from Tanzania

Tanzania, officially the United Republic of Tanzania, is a country in East Africa. In 2018, its population was estimated to be 54.2 million, including a considerable proportion of people residing in rural areas (68%). The annual population growth rate has been over 3%, and the population is expected to grow even more to 129.4 million in 2050. The services sector accounts for the largest portion of Tanzania's economy (47.6%), followed by the industries sector (28.6%). However, the agricultural sector, with a share of 23.4%, employs the majority of the workforce, accounting for roughly 67% of the total employment (Delloitte, 2017; URT, 2019). Tanzania's gross domestic product (GDP) in 2018 was $58.0 million, and the economy has seen rapid growth in recent decades, averaging 6.76% between 2002 and 2018 and continuing to expand steadily (5.4% in 2018). Naturally, fiscal incomes account for between 10% and 12% of national GDP. Budget deficits have been decreasing in recent years. In most industrialized republics, disaster attentiveness and response

are well established pre-disaster, with strong plans of deed advanced by a team representing multiple sectors. Contempt misery from some of the fatal disasters, disaster planning is often absent in most developing countries. In Tanzania, the quantity of disasters has augmented considerably in the past decade. These disasters have costed the life of numerous people, leaving some with enduring incapacities and causing disturbance of infrastructure and settlement.

Responsibility for Disaster Risk Management

Tanzania DRM began with the Disaster Management Department (DMD), in the Prime Minister's Office (OPM). The National Disaster Management Policy of 2004, the Disaster Management Act (DMA) No. 7 of 2015, and the Disaster Management Regulations of 2017 are the driving forces behind it. The Tanzania DMA formed the Tanzania Disaster Management Council to supervise the department's functions (Fig. 3.5). The DMA again establishes a legislative structure for the formation of a state Podium for Disaster Risk Reduction and disaster management committees at all levels.

Though the Act was launched in 2015, it is important to note that it has yet to be completely implemented. Inadequate capitals mean that the government failed to carry out all of the Act's functions, such as the functioning of functional disaster management committees. The National Forums are formed by the DMD. Despite the efforts, there is urgent necessity to advance DRM capability and competences, particularly at the grassroots level, where disasters are most likely to occur. In its areas of operation, a Regional Secretary, as defined by the Regional Administration Act, operates as a Regional Disaster Management Committee. Meanwhile, Council Management Committees are recognized as District Disaster Management Committees in their areas of operation under local government acts. Ward Management Squads, created under the Local Government Act and acting as Ward Disaster Management Committees, and Village Management Teams, acting as Village Disaster Management Committees, are responsible for disaster management at the local level.

The council is in charge of ensuring that DRR is aligned with pertinent government guidelines and regulations. The National Disaster Management Fund (NDMF)

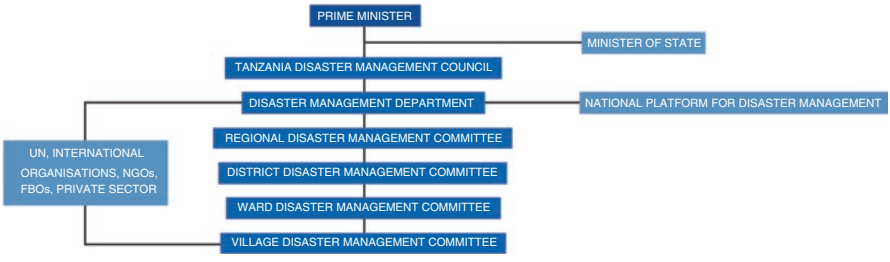

Fig. 3.5 Disaster management governance structure in Tanzania (Source: Disaster Management Department, Government of Tanzania (2019))

Fig. 3.6 Budget allocations to the NDMF, 2013/2014–2019/2020 ($ millions). (Source: Office of the Prime Minister (2019))

was established by the Act to carry out DRR and humanitarian assistance. The country budget is the primary source of funding for the NDMF.

The quantities allotted for the years 2013/2014 to 2019/2020 are shown in Fig. 3.6. The money allocated to NDMF has deteriorated over time, which could be linked to changes in government policy in response to the country's economic difficulties. Many intrinsic economic topographies, such as high degrees of economic openness, export concentration, and reliance on strategic imports (Briguglio et al., 2006), as well as disasters activated by natural hazards such as drought and floods, are thought to contribute to a country's susceptibility to exogenous shocks.

Economic Openness The ratio of international commerce to GDP determines economic openness. A high level of economic openness exposes a country to external economic conditions over which it has no direct control. Economic openness is a more intrinsic feature of an economy, determined mostly by a country's ability to properly generate the diversity of goods and services required to meet its collective demand. If a country's productive base is limited to a small number of products, it will have to rely on imports to meet a large portion of its spending needs and on exports to pay its import bill. Tanzania economy is highly import dependence especially on strategic import, thus is highly susceptible to the obtainability and price of those imports. For economies that most rely on exports, the instability in both export earnings and economic growth allied with economic tremors exposing Tanzania tremendously defenselessness. Tanzania's terms of trade have been growing over time since 2014, demonstrating augmented competitiveness with key business partners. Subsequently, the economy has been opening up persevering with the transaction share of external trade be around 43.0% of GDP between 2000 and 2017, having augmented from 33.5% in 2000 to the peak of 53.3% in 2011 before weakening to 32.0% in 2017. The mounting motion of importations and exportations chiefly since 2002 describe the trade openness. However, the trade openness index has sustained underneath average of 50.0% globally, 49.0% for East Asia, and 70.0% for sub-Saharan Africa, partially elucidated by a substantial deterioration in global product prices, chiefly for coffee, tea, tobacco, and gold. On the other hand, amplified use of domestic natural gas has substantial lower oil import bill. This is

supported by Peduzzi (2006) who use GDP per capita as a proxy for economic progress and discover that it is adversely correlated with fatalities from tropical cyclones, droughts, and floods. Similarly, Kahn (2005) found that first-world countries have fewer earthquake fatalities than emerging ones. As a result, he contends that economic expansion acts as a "implicit blanket" that protects people from the negative effects of disasters.

Export Concentration Reliance on a limited range of exports exposes growth to risks associated with a lack of divergence, worsening susceptibility associated with economic openness. This situation is, once again, largely the result of inherent traits in the Tanzanian economy's manufacturing foundation. The UNCTAD scale on merchandise trade can be used to assess export responsiveness. Briguglio and Galea (2003) invented a substitute scale which accommodates services. It is vital to note that in Tanzania, complete utilization of some of the profits given by the global connection like the new worldwide economic retrieval was affected by a number of mechanical problems. These are in association to attentiveness of export markets to insufficient destinations (mainly India and South Africa), thin exports base, low value adding, and reliance on instable transfers/official development aids (ODAs) as the main exterior sources of finance.

Reliance on Strategic Imports Another aspect of the exposure dispute is the reliance on strategic imports, which may cause an economy to tremor due to the obtainability as well as price of such imports. The ratio of energy, food, and manufacturing supply imports to GDP can be used to measure this variable. This scenario is intrinsic and so dependent on country size, resource availability, and import replacement capability.

There are various disaster economic vulnerability and recovery programs that can be and are used in Tanzania to ensure that Tanzania recuperate rapidly from a tremor; endure the effect of a shock; and evade the shock. Furthermore, the financial recovery programs circumvent from nation's proneness to exogenic shocks emanating from intrinsic financial features, such as high notches of economic openness, export attentiveness, and reliance on strategic imports as well as disasters activated by natural hazards such as drought and floods. The recovery programs are discussed hereunder.

4.1 Macroeconomic Stability

The interface between an economy's total demand and total supply is referred to as macroeconomic consistency. If an economy's total spending moves in lockstep with total supply, the economy can be classified as having both interior and exterior balance, as evidenced by a stable fiscal position, low inflation, and an unemployment rate close to the natural rate. These can be measured as characteristics that are

heavily influenced by economic laws and may serve as a legitimate variable in an economy's recovery program when faced with negative shocks. The macroeconomic stability component of the flexibility scale is thus based on a trio of indicators: the fiscal shortfall to GDP ratio, the rate of unemployment and inflation, and the external debt to GDP ratio. The government budget position is acceptable for inclusion in the pliability index because it is the result of fiscal policy, which is one of the most important tools available to government, and it denotes shock-absorbent pliability. This is because, in the event of a negative shock, a strong fiscal position would allow for modifications to taxing and spending policies. The fiscal shortfalls, as a percentage of GDP, price inflation, and unemployment, are all appropriate measures of pliability, and they may also contribute additional data to the fiscal discrepancy parameter. This is because additional types of fiscal policy, such as monetary and supply side measures, have a significant impact on price rises and unemployment. They are linked to pliability because when an economy already has high unemployment and inflation, opposing tremors are likely to charge significant prices on it. If on the other side, the economy has low levels of inflation and unemployment, then it may endure adverse tremors to these indicators without extreme welfare costs. In this regard, consequently, unemployment and price rises designate pliability of a shock-ingest nature. Taking Tanzania as an example, the shove of economic policy has been to withstand macroeconomic constancy by upholding comparatively solid financial progress; following fiscal steadiness by cumulative national income enlistment; governing the growth of comprehensive money supply reliable to economic development and price rise targets; and upholding satisfactory levels of forex reserves. Real GDP development, which is around 4.6% in 1996–2001, increased to 6.2% in 2002 and is projected at 5.2% in 2003. The estimate for 2004 is for 4.8% and 4.7% in 2005. The constancy in growth between 2004 and 2005 is predictable to be sponsored by robust export performance of mutually agricultural exports and gold, also through constancy in economic administration. Tanzania has preserved judicious financial policies that have produced constancy in budgetary results, little and steady price rises, and the steadying of lending rates. The exterior payments state again endured mainly steady, with vicissitudes in the structure of export configuration leading to augmented export revenues. This is supported by Noy and Yonson (2018), results that disclose that nations with an advanced income per capita, superior trade openness, and literateness rate increased state of public spending, and healthier institutions are capable to endure the early influences of tragedies and are too capable to avert spillovers. They further subscribe this to the ability for resource deployment to execute the essential rebuilding.

4.2 Microeconomic Market Efficiency

Markets, and their effective operation via the pricing device, were pinioned as the best means to allocate capitals in the economy by the study of economics. If markets change quickly enough to achieve symmetry, the effects of shocks like floods and

droughts may be easily absorbed into the system, and comparable modifications can be made willingly ostentatious. If, on the other hand, market imbalances persist, particularly in the form of unfriendly shocks, capital will not be allocated properly in the economy, resulting in welfare costs, as evidenced by wealth discharges, jobless resources, waste, or shortages in the product markets. Consider the state of Tanzania's financial markets, for example. If markets reply effectively in the face of an opposing tremor with higher interest rates and lower asset values, capital may be reserved in the economy, causing the opposing tremors to be reproduced in price parameters. If, on the other hand, prices in the monetary markets fail to properly regulate, capital may be more likely to flee the economy during a hostile tremor, affecting economic conditions and employment. Similar considerations might be made regarding the approach of balancing the economy's labor and goods markets. These difficulties may have substantial implications for the shock-absorbing type's pliability.

4.3 Good Governance

For an economic plan to function properly and to be resilient, good governance is required. The term "governance" refers to topics such as the rule of law and property rights. Contrary tremors may be comparatively easy to cause economic and social unrest and discontent if such devices are not available. The impact of susceptibility would be exacerbated in the future. Good governance, on the other hand, can strengthen an economy's adaptability. The Global Economic Liberty Index features an element that focuses on the legal structure and protection of property rights. This is said to be useful in determining present workout in the origin scale of good governance. The scales protect judicial independence, court neutrality, intellectual property rights defense, rule of law, partisanship, and the legal system's authenticity. In Tanzania good governance and institutional failure are the origin cause for underdevelopment and susceptibility to disasters. While there are well-established structures and governance mechanism to ensure effective resilience and recovery programs, the established governance mechanisms are not functioning properly, for example, disaster management in Tanzania is guided by the National Disaster Management Policy of 2004, the Disaster Management Act No. 7 of 2015, and the Disaster Management regulations of 2017. But they were established contingent upon a country's governance structure permits the application and execution of public policies favorable to a republic's economic and social growth that can sustainable attained livelihoods and vulnerability to tragedies be condensed. Accountability, participation, predictability, and transparency are recognized as crucial factors of a governance structure that nurtures growth and braces risk decrease. This is supported by Briguglio et al. (2006) who noted that on the contrary, economic pliability denotes to the economy's managing capability that may, in distinction, be prejudiced by policies. Policies that persuade and fostering pliability are the ones that improve macroeconomic constancy, upsurge market efficacy, advance governance,

and enlarge social advancement. Singapore that was among the most adaptive economies on economic standards positions 14th in rapports of governance. Susceptible economies incline to get inferior positions on this matter; nonetheless it still seems to be the situation that the susceptible economies relishing an advanced per capita GDP also incline to have healthier schemes of ascendency.

4.4 Social Development

Social development is an added vital constituent of economic resilience. This influence designates the degree to which social relatives in a community are correctly established, allowing an actual working of the economic device with absence of the interference of civil unrest. Social consistency may too designate the degree to which real social discussion happens in an economy, which in turn facilitates cooperative methods in responsibility of remedial measures in time of hostile tremors. It is thus conjectured that social growth is straight connected to social cohesion, though this declaration can't be verified analytically due to absence of data. Social growth in a republic may be assessed in a diversified means. Parameters linking to revenue such as its dispersal and the amount of populace staying in poverty; immortal unemployment rate, showing the quantity of people with little skills and insufficient engagement prospects; and amount of the people having low level of education might be valuable parameters. Still additional conceivable tactic might be to assess the amount and degree of cases of industrial or civil unrest. This is reinforced by Noy and Yonson (2018) who documented that admittance to finance such as microfinancing, global transmittals, and social payments is regarded as a noteworthy contributor to pliability. Yet, in communities with whichever more equal allocation of spending (as estimated by a commune's Gini coefficient of expenditures) or advanced level of mean per capita spending, families are realized as more pliable. Additionally, families with high level of schooling are also more adaptable to the bad impact of overflows and aridity.

5 Conclusions

A disaster is a solemn disturbance of the functioning community or society that has far-reaching human, material, economic, or ecological consequences that exceed the capacity of the current society or community to cope with using its own resources, while an economic recovery program is the procedure that a society establishes and competently executes its ability to engross early tremor through extenuation, responding, and acclimatization afterward in order to uphold function and speed retrieval, also to be in a healthier state to decrease sufferings from upcoming tragedies. Tanzania is principally susceptible to the influences of life-threatening weather, such as extensive floods, recurrent and lengthy dry period, and seaside

hurricane flows. Reduced crop harvests, increased occurrences of yield vermin and illnesses, animal damage, reduced water accessibility, and rise in vector-borne and water-borne illnesses are only some of the societal and economic consequences of these episodes.

There has been no systematic analysis of catastrophe economic vulnerability and recovery initiatives in Tanzania, resulting in a knowledge gap in this area. It is for this reason that this chapter documents and shares knowledge on disaster economic vulnerability and recovery programs using Tanzania as a case under investigation. Concepts and frameworks on disaster economic vulnerability and recovery programs as well as indices that are used to assess vulnerability and resilience to natural hazards are also presented; this is followed by econometric approach: determinants and measures of economic vulnerability. The chapter also presents disaster economic vulnerability and recovery programs experience from Tanzania whereby efforts that have been made so far and economic recovering program, namely, macroeconomic stability, microeconomic market efficiency, governance, and social development, has been presented. Understanding disaster economic vulnerability and recovery programs experience from Tanzania has several implications to the attainment of Tanzania vision 2015 as well as Sustainable Development Goals. It is important to remember that 10 of the 17 Sustainable Development Goals (SDGs) contain particular targets connected to disaster risk reduction, including No Poverty, Zero Hunger, Good Health and Well-Being, and Climate Action. Quality education; safe drinking water; and sanitation, industry, innovation, and infrastructure; sustainable cities and communities; climate action; life below water; and life on land are just a few of the issues that need to be addressed. As a result, disaster preparedness and risk reduction are seen as key strategies for achieving the SDGs and Tanzania's development goal 2025.

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