

Financing climate-induced disaster management: Models for engaging the formal financial sector

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Abstract

Climate change is a leading cause of natural disasters. The human civilization is already experiencing the significant damage to physical resources due to climate change induced disasters. Effective adaptation to and mitigation of climate change-induced physical damages necessitates adequate funds flowing towards appropriate directions, i.e., to the ones who need them the most. However, global finance flows towards climate change-induced disaster management (CDM) is largely inadequate and mostly contributed by governments and international assistances in developing countries. Recent studies suggest that private finance, if designed and connected appropriately, can be the key to financing CDM activities. The fundamental challenge however is the 'for-profit' attitude of the formal financial institutions. This paper discusses the issue of how formal financial sector players can be transformed into the lead supplier of finance for CDM activities, particularly in the context of developing countries. The paper first reviews the available evidence on climate change and resulting disaster impacts and provides an account of the current state of finance flows targeting CDM. The paper then proposes novel models for engaging three key potential sources of formal CDM financing, namely securities markets, banks, and insurers, which accommodate the triangular interests of community, the state, and the institutions. Finally, the paper briefly discusses potential challenges and necessary policies in realizing the transformation sought. The assessments and the proposed models could serve as a basis for developing testable frameworks for engaging formal private sector financing agents with CDM activities, particularly in developing countries. In general, the paper could help deepen the understanding about the need for and process of building a sustainability-oriented financial system.

Keywords: climate-induced disaster management, sustainable financial system, disaster finance, climate finance, impact investment

1.0 Introduction

The frequency and intensity of natural disasters around the world display an increasing trend at an alarming rate in the recent periods. Climate change and global warming are considered the key reasons behind the increase in both the frequency and intensity of natural disaster events. According to the World Bank (2017), about 26 million people globally are forced into extreme poverty trap every year (Living with 1.90\$ per day or less) due to natural disaster (World Bank, 2017). Annual average losses from direct impacts of disaster between 2003 and 2013 are estimated at US\$ 184 billion (Munich RE, 2014). These estimates do not include indirect losses, inclusion of which could make the figure substantially larger (Lovell & Masson, 2014). Lives lost as a result of disaster impacts have significantly increased over the last 30 years. Developing countries experience the biggest hits from natural disasters. About 91% of total deaths caused due to natural hazards in these countries between 1996 and 2015 are found to be within the territory of the developing countries, in which about 69% occurred in poorer economies (UNISDR, 2016). In terms of demography, disasters disproportionately affect the elderly, disabled, women, and children; evidence indicates that disasters generally cause death of more women than men (Lovell and Le Masson, 2014).

Considering the serious threats and damages to lives and assets, it is fundamental to develop mechanism to minimize the adverse impacts of natural disaster. Two courses of action could be part of the mechanism, one is employing preventive measures and the other is minimizing the natural disaster impacts when they occur. Prevention of natural disaster perhaps is difficult or to some extent impossible unless we can completely stop the driving factors such as climate change. Furthermore, natural disasters often occur out of its own as a result of very natural process and humans have no control over them. Therefore, the second approach - minimizing the potential impacts - perhaps is the most feasible course of action, which requires an enormous level of investment to develop resilience and mitigation and adaptation strategies (IPCC, 2012).

Natural disasters are like common goods and therefore, are faced by almost every country in different forms. Rich countries essentially can better manage the impacts as they can divert greater financial and physical resources before, during, and after disasters strike. However, the situation is opposite in developing economies, particularly countries that are resource-scarce, poor, and largely dependent on overseas assistance for economic development. The economic fragility makes the magnitude of adverse impacts larger in developing countries when natural disasters strike (Alcántara-Ayala, 2002). Most developing economies are largely reliant on public sources and Overseas Development Assistances (ODAs) to finance their disaster-related programs and projects, where in most cases public expenditure cannot fulfil the need and ODAs (e.g., aid, grants, concessional loans) come as a rescue measure. However, public sources and ODAs together are often found to be significantly inadequate to divert adequate financing and investments in addressing natural disaster related activities, particularly in building resilience and impacts mitigation and adaptation. The overreliance of developing countries on foreign assistances from overseas governments or agencies in many cases result in a loss of national economic and financial freedom (DFID, 2004).

A remedy to this complex reality could be utilizing the domestic private financial market to mobilize the funds necessary for disaster finance and investments. This however is a really difficult task as the traditional financial sector players are often 'profit-oriented' and not interested in putting money for social cause if there is no return opportunity. In this regard, two fundamental questions remain critical: (i) can we realign the existing business models of financial institutions to align with social causes like natural disaster? and (ii) can we redesign the financial sector architecture as a whole so that financial institutions are incentivized to finance disaster-related activities? This paper tries to respond to these questions. The paper outlines how financial institutions could be aligned with social needs like disaster and be utilized as a key source of disaster-related financing and investments. In doing this, the paper primarily focuses on climate-induced disaster management (CDM) financing, since climate change is considered the leading cause of increases in natural disasters around the world. Based on the existing literature, the paper reviews the historical records and projections about climate change and natural disaster events. With a particular focus on financing, the paper analyses the available records of climate and CDM related financing and highlights the financing and investment gap. Finally, the paper proposes and elaborates some possible mechanisms of how formal financial markets and institutions, particularly, debt and equity markets and banks and insurance companies, could be utilized for generating CDM related financing.

The paper provides contribution to the literature by being the first effort to develop a possible link between the formal financial sector and natural disaster impacts faced in a country. The paper could provide policy-makers, particularly in developing countries, a food for thought on how to properly utilize their formal financial sector for financing CDM activities and thus avoid overreliance on foreign sources and protect sovereign economic freedom. In the next parts of the paper, section 2 presents a brief overview on the climate-induced disaster impacts and their management; section 3 outlines the roadmap to activate formal financial institutions as key sources of CDM finance; section 4 provides implications for policy-makers and development practitioners, with a conclusion in section 5.

2.0 Climate change and extreme events

The world has already started to feel different facet of impacts of climate change on environment, health and economy. Data used in the Intergovernmental Panel on Climate Change (IPCC) 2014 report identifies the period from 1983 to 2012 as the warmest 30-year in the last 800 years of Northern Hemisphere, with a global average surface temperature increase by 0.85 °C (ranging from 0.65 to 1.06 °C at 90% confidence interval) over the period 1880 to 2012. The IPCC report also revealed that global temperature increase between the average of periods 1850–1900 and 2003–2012 is 0.78°C (ranging from 0.72 to 0.85°C at 90% confidence interval) which signifies quicker warming in the recent decades. Complementing the IPCC (2014) report, other estimates suggest an increase in global surface temperature at about 0.25 °C from 1960 to 2000 (Mendelshon, 2007) and 0.15 to 0.20 °C increase per decade (Hansen et al., 2010).

According to IPCC (2014), in addition to temperature, observed precipitation changes show that land regions with heavy precipitation event has significantly increased than that where it has decreased, and global level of precipitation has likely increased since 1901 with higher degree confidence after 1951. The report shows that between 1901 and 1951, confidence in average global land area precipitation changes is low while it is medium afterwards. It indicates an increased changes of precipitation levels since 1951 and onwards. There is strong evidence that the increases in observed precipitation are complemented by increases in extreme events such as storms (Trenberth, 2011).

Munich RE data (Löw, 2018) shows a rapidly increasing trend of extreme geophysical, meteorological, hydrological and climatological events globally, particularly since 2005. Worldwide increases in the number of extreme events other than geophysical events have been appalling. In 2017, 710 events recorded making the year with the highest number of natural disasters since 1980 (with some 250 events). Floods accounted for roughly half (47%) of the total loss events. Almost two thirds of all the natural disasters registered occurred in North America, the Caribbean, Central America or Asia. While all extreme events have increased over time, storms and floods particularly occur more frequently than other events. It is worth-noting that floods, storms, and extreme temperatures, droughts and wildfires are primarily caused by adverse climate change.

IPCC (2014) also shows the projected changes in climatic conditions such as changes in temperature and precipitation by 2100 and 2300 under different Representative Concentration Pathways (RCP) scenarios. The global mean surface temperature change for the period 2016–2035 relative to 1986–2005 is likely to be in the range from 0.3°C to 0.7°C at medium confidence and expected to increase by more than 1.5°C at the end of this century (2081-2100) with high confidence (IPCC, 2014). Houghton et al. (2001) predict that temperature may rise by about 1.5°C to 5.8°C and precipitation patterns to shift significantly by 2100. Alongside, changes in precipitation, coupled with global warming, is expected not be uniform and precipitation intensity is likely to increase significantly by the end of this century (IPCC, 2007; 2014).

In line with the projected climate change scenarios, there is a likelihood that frequency and intensity of extreme events will increase in the days to come. Sousounis and Little (2017) show that frequency and intensity of all types of extreme events such as tropical cyclones, extratropical cyclones, severe thunderstorms, wildfires, inland floods, and coastal floods are likely increase significantly. The estimates of Sousounis and Little (2017) also suggest that thunderstorms and wildfires have a greater likelihood of occurrence in a greater frequency with strong to extreme intensity by the end of the 21st century.

3.0 Climate-induced disaster impacts and their management

Table 1 summarizes the different types of climate-induced disasters and their impacts compiled from different sources. The Table also presents some major events in the recent times. Climate change is responsible for most of the natural disaster that happens today. Much of these disasters occur across countries regardless of economic status – developed or developing; for example, Hurricanes are frequent extreme events in the US while Typhoons in Japan. However, some countries and regions are more vulnerable to some specific types

of disaster and extreme events; for example, due to lack of financial resources, coping with the disaster impacts is much harder in developing countries. In addition, many developing economies are more prone to natural disaster due their geophysical location. Countries along the coastal belts are more exposed to sea level rise that causes severe damage and loss of lives every year on a regular basis; for example, Bangladesh. On the other hand, wildfires, drought, and windstorms are more frequent in countries with dry weather and very high temperatures; for example, Australia. Table 1 shows that the impacts of these events are multifaceted, ranging from damage to physical properties and infrastructure to loss of lives.

Table 2 shows the top 10 most affected countries according to the Climate Risk Index (CRI). As a clear indication of a greater vulnerability of developing countries, 7 out of the 10 countries are developing economies along the coastal lines, particularly from Asia (Sri Lanka, Nepal, Vietnam, Bangladesh, and Thailand), the Caribbean (Dominica), and Africa (Sierra Leone). This reaffirms that developing and least developed countries, particularly in coastal belts, bear the greatest burden of climate-induced disasters.

Table 1: Types of climate-induced disasters and their impacts

Disaster type	How climate change causes it	Likely disaster impacts	Major events/impacts
Earthquakes		<ul style="list-style-type: none"> - Surface faulting - Tsunami - Soil liquefaction - Ground resonance - Landslides - Social impact - Building damage - Loss of life - Loss of cattle and livestock - Damage of public infrastructure 	<p>- On January 23rd, a 7.9-magnitude earthquake struck off the coast of Kodiak Island in Alaska, triggering a tsunami warning</p> <p>- An 8.2-magnitude earthquake hit the Mexican state of Chiapas on September, 2017, killed 61 people in Mexico (Sheffer, 2019).</p>
Floods		<ul style="list-style-type: none"> - Loss of livelihoods - Damage to infrastructure - Disrupts supplies of clean water - Disruptions to electricity, transport, communication, education and health care 	<p>In 2018 Exceptionally powerful monsoon in Southern Asia claimed the lives of almost 2,700 people and caused severe damage to the region's agriculture. (Kron, 2018)</p>
Storms - Tropical cyclone - Tornado - Thunderstorm - Blizzard etc.		<ul style="list-style-type: none"> - Infrastructural damage - Damage of building and dwellings - Increase in sea level due to the cyclone - Destroy crops - Destroy communities 	<p>Globally, tropical cyclones have caused losses totaling US\$ 1.3tn since 1980 (Faust, 2019)</p>

Source: Author developed from various sources (National Geographic, 2019)

Table 1 (continued): Types of climate-induced disasters and their impacts

Disaster type	How climate change causes it	Disaster impacts	Major events
Wildfires		<ul style="list-style-type: none"> - Destroy forests - Building damage - Loss of life - Loss of cattle and livestock - Damage of public infrastructure - Destroy tourist spots - High levels of air and water pollution - High levels of soil erosion - Extinction of species - Increases vulnerability to other natural disasters 	<p>In 2019, Amazon experienced 133000 fires during the first 8 months of the year</p>
<p>Extreme weather</p> <ul style="list-style-type: none"> - Drought - Heat wave - Windstorms 		<ul style="list-style-type: none"> - Urban heat island effect - Higher rates of hepatitis C, SARS, and hantavirus -Increased health care costs - Loss of life 	
Sea level rise		<ul style="list-style-type: none"> - Loss of land - Loss of cattle and livestock - Damage of public infrastructure - Increases Vulnerability To Other Natural Disasters <p>(Nunez, 2019)</p>	<p>From 1995 to 2015 there has been a sea level variation of 80(mm) ("Sea Level NASA Global Climate Change", 2019).</p>

Source: (CCFA, 2019), (National Geographic, 2019)

Table 2: The Climate Risk Index (CRI) for 2017: 10 most affected countries

CRI Rank 2017 (2016)	Country	CRI Score	Death toll	Deaths per 100000 Inhabitants	Absolute losses (in million US\$ PPP)	Losses per unit GDP in %	Human Development Index 2017
1 (105)	Puerto Rico	1.5	2978	90.242	82315.24	63.33	-
2 (4)	Sri Lanka**	9.0	246	1.47	3129.35	1.14	76
3 (120)	Dominica**	9.33	31	43.662	1686.89	215.44	103
4 (14)	Nepal**	10.5	164	0.559	1909.98	2.41	149
5 (39)	Peru	10.67	147	0.462	6240.63	1.45	89
6 (5)	Vietnam**	13.5	298	0.318	4052.31	0.63	116
7 (58)	Madagascar	15.0	89	0.347	693.04	1.74	161
8 (120)	Sierra Leone**	15.67	500	6.749	99.10	0.86	184
9 (13)	Bangladesh**	16.0	407	0.249	2826.68	0.41	136
10 (20)	Thailand**	16.33	176	0.255	4371.16	0.35	83

**Least developed countries

Source: (Eckstein, 2019)

Given the reality of capital scarcity in developing and poor economies and their greater vulnerability to climate-induced disasters, managing disaster impacts becomes a real difficult task. Generally, pre and post disaster expenditure and investments require mobilization of funds to the affected regions and people. When such disaster impacts are frequent and faced regularly, financing their management becomes a seriously daunting task, particularly in developing economies. Till date, most of the funds for disaster management are mobilized from either public sources or ODAs, which often falls substantially short of what is needed. A vital question remains largely unanswered with respect to the increasing shortfalls in developing countries: how to mobilize greater finances from domestic private financial institutions to satisfy this gap and reduce overreliance on ODAs and public sources.

4.0 Financing CDM: Suppliers, needs and gap

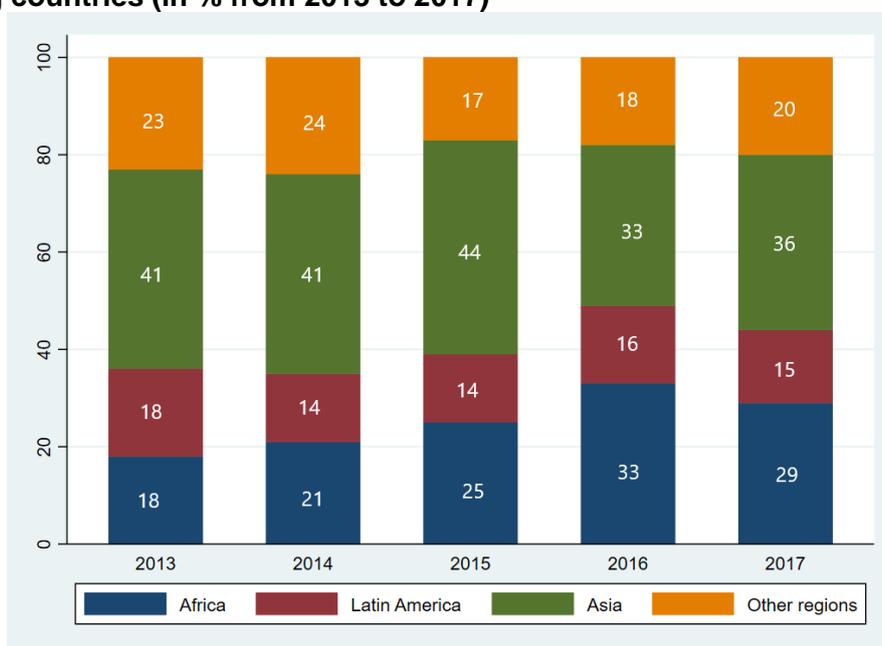
The finance flows targeting particularly climate-induced disaster management is difficult to trace. However, finance flows targeting climate change related activities, particularly impacts mitigation and adaptation, could well represent the current level of CDM financing, its suppliers, and existing gap. Different accounts mapping climate finances globally are yet not comprehensive and therefore provide only partial picture. The World Investment Report (WIR) (2014) suggests that net investment requirements at the world level for climate impact mitigation could range between US\$ 550 and 880 billion, while that for climate impacts adaptation could be between US\$ 80 to 120 billion. Currently, roughly US\$ 170 billion and US\$ 20 billion flow targeting climate impacts mitigation and adaptation, respectively. Therefore, current finance flows can satisfy only a maximum of 40% and 20% of investment needs for climate impact mitigation and adaptation, respectively. This leaves an investment gap in the range of US\$ 380-680 billion for mitigation and US\$ 60-110 billion for adaptation activities.

Table 3 reports the summarized mapping of climate finance flows globally from 2010 to 2014, as tracked and recorded by Climate Policy Initiative (CPI). The Table shows that as of 2014 about 75% of global climate fund flows are mobilized from domestic sources and only 25% arise from international sources like foreign governments ODAs and multilateral financial or development agencies. Of the total global flows, majority (about 60%) comes from

international private sector sources such as the multilateral finance or development agencies (e.g., the World Bank or United Nations). The funds however are flowing to both developed and developing economies at a roughly equal share; it means developing countries perhaps are not receiving a higher share that they deserve due their extreme vulnerability and capital scarcity. Majority of the funds target climate impact mitigation; in 2014 for example, about 93% flew targeting mitigation activities and about 25% target impacts adaptation activities, while only 1% targeted both activities. In terms of geographical distribution, Asia appears to receive greater share over time compared to the other regions. Among all, East and South Asia appear to be the leading recipient of the global climate finance flows.

Figure 1 shows the amount of climate financing directed to the developing countries (region wise) from the developed countries in the year 2013-2017. Asia, Africa and Latin America (including the Caribbean) to a smaller extent constitute the highest quantities of bilateral climate finance. Depending on the year, the Middle East, non-EU Europe, and Oceania account for 1% to 6% each.

Figure 1: Regional developed countries' bilateral public climate finance flows to developing countries (in % from 2013 to 2017)



Source: Adapted from OECD (2018)

The accounts presented in Figure 1 and Table 3 provide a very important message that the suppliers of global climate finance flows is still public (e.g., national government and ODAs) and international private sources (e.g., multilateral agencies); this means the domestic private sources are substantially underutilized and less connected. However, studies suggest that there is an immense potential of domestic private sector in financing climate change impacts mitigation and adaptation activities. This considered, it is clear that there is a broken link between climate-related activities, projects, and programs and the domestic private sectors, particularly in developing economies. With respect to the WIR (2014) estimates, the prevailing investment gaps in climate impacts mitigation and adaptation could well be satisfied by the domestic private sector economic agents if they were effectively connected to the mainstream climate-related activities. In particular, this connectively requires linking the formal financial sector players with the climate-related initiatives and activities before everything else. Fixing the broken link could be immensely useful particularly for

developing and poor economies in satisfying the investment gap and bringing financial freedom by reducing overreliance on foreign governments and multilateral agencies.

Table 3: Global Climate Finance Flows Statistics (amounts in billion US\$)*

	2010-2011	2011-2012	2012-2013	2013-2014
<i>Total Global Finance Flows</i>	364	359	331	391
International Sources	n/r	86 (24%)	86 (26%)	101 (26%)
Domestic Sources	n/r	273 (76%)	245 (74%)	290 (74%)
<i>Sources:</i>				
a) Public	95 (26%)	135 (38%)	137 (42%)	148 (38%)
b) Private	269 (74%)	224 (62%)	193 (58%)	243 (62%)
i) International (of the private finance)	54 (16%)	54 (24%)	19 (10 %)	19 (8%)
ii) Domestic (of the private finance)	285 (84%)	170 (76%)	174 (90%)	224 (92%)
<i>Distribution:</i>				
a) Developed	244 (67%)	177 (49%)	164 (50%)	n/r
b) Developing	120 (33%)	182 (51%)	165 (50%)	n/r
<i>Uses:</i>				
a) Mitigation	350 (96%)	337 (94%)	302 (91%)	361 (93%)
b) Adaptation	14 (4%)	22 (6%)	25(8%)	25 (6%)
c) Dual/Multiple benefits	n/r	n/r	4 (1%)	4 (1%)

* Source: author developed based on Global Landscape of Climate Finance reports published by Climate Policy Initiative (CPI) in 2011, 2012, 2013, 2014 and 2015. **n/r = not reported. Some numbers are not specifically reported but inferred from the discussions presented in the reports.

5.0 Fixing the broken link between formal financial market and CDM: Some propositions

Mobilisation of capital for both pre and post CDM financing and investment can occur through the formal financial system. Players in formal financial markets such as Banks, Non-bank finance companies and asset managers, look for profit. It is difficult to divert them towards social cause like CDM if there is no financial return involved. Hence, the primary principle in linking them with CDM is attaching profit or return opportunity with CDM financing. It means the engagement needs to show the potential of achieving dual objectives – supplying the required fund for pre and post disaster management and at the same time earning a fair degree of return. However, even if a profit opportunity is attached, it may not be larger than that associated with a traditional private sector project. This is because such CDM activities are primarily social causes, which generally have no financial return feature attached. Therefore, the fundamental question remains how to attach a profit or return opportunity with CDM activities that is attractive enough to the formal financial institutions. Table 4 shows the potential connectivity of formal financial market participants with CDM financing. The Table shows that funds from different traditional sources could be mobilized through asset pooling by financial market intermediaries to CDM related projects. In the following discussion, some specific examples of how formal financial institutions and markets can be linked with CDM are elaborated.

Table 4: The investment chain and key actors involved

Sources of Funds	Assets pools and primary intermediaries	Markets	Users of CDM funds
<ul style="list-style-type: none"> - Governments - Retail investors - High-net-worth Individuals - Pensions -Insurance consumers - Firms 	<ul style="list-style-type: none"> - Banks - Non-bank financial institutions -- Pension funds -- Insurance companies -- Mutual funds -- Hedge funds -- Endowment funds -- Private equity -- Venture capital - Impact investors - Asset managers 	<ul style="list-style-type: none"> - Capital market - Money market 	<ul style="list-style-type: none"> -Governments - Non-government organizations (NGOs) - Public and semi-public organizations -Multinational and local firms/ entrepreneurs -- Impact Investors

Source: Author developed

5.1 Capital market: Issuing debt securities

Using capital market as a source of financing to generate resources to support CDM activities can be a good attempt. Green bonds and climate bonds are such examples that are currently receiving a growing attention from both securities investor and issuer ends (Chiesa and Barua, 2019; Barua and Chiesa, 2019). Capital markets, such as equity and debt securities markets, are sources for long-term capital for deficit households in an economy. One way to use capital market for raising CDM finances could be introducing a separate segment for CDM targeted securities in the traditional securities markets for equity and debt; for example, a name to such a segment could be assigned as “Sustainability Segment” or “Social Investment Segment”. This segment will facilitate issuance and trading of only those equity and debt securities that mobilize funds for social causes like CDM and delivers a fair degree of return to the investors. A fair degree of return for the investors investing in the securities should be at least equal to the risk free rate. Furthermore, investors could also be

allowed tax benefits on their return and investments as a reward for investing in social causes.

One example could be issuing 'CDM Bonds or Debentures' just like Climate Bonds or Green Bonds for financing for environmental purposes. CDM bonds can be issued by CDM relevant authorities (e.g., government, development agencies, and NGOs) and be traded just like traditional bonds, with the only difference of how the funds raised are utilized and the returns for investors are generated. Essentially, funds raised through CDM bonds would be invested for pre or post CDM activities (e.g., building infrastructure such as schools, hospitals, roads, bridges, and dams). The return feature could be modelled in a way different to that of traditional bonds; for example, if the funds are invested for CDM in a specific locality or region, each citizen with an active employment in the target community would be responsible to pay an equal share of the total repayment due to the investors annually or semi-annually. To ensure low-income or poor households are less burdened in this model, repayments could be made mandatory for working people with their incomes above a certain level as determined by the bond issuer and the issue manager in collaboration with local government authorities. As a community generally includes a large number of working people, the repayment per working person (i.e., the micro-installment) would be smaller in size. Hence, the micro-installment would be further smaller as the community size grows.

Financing government projects by issuing bonds (e.g., municipal bonds) to build bridges, roads, and large infrastructure is common. Such bonds often are backed by certain projects or infrastructure; income generated from the infrastructure after operationalizing are then used to repay the bond interest and principal. This common concept could be well utilized in financing CDM activities, in particular, in building pre and post disaster large infrastructure like bridges, hospital, schools, and housing by the government. The community using the facilities will be required to pay a minimal price over a fixed term at a regular interval, which then would be used to pay off the bond interest and principal payments.

5.2 Capital market – Issuing equity securities

Just like debt market, engaging equity markets is really difficult as CDM activities are not likely to generate any return to pay-out dividend to the investors. One way of engaging equity markets is enabling stock issuance and listing by social businesses. Social business is a recent idea, which combines the concept of social benefits or development with opportunities of return or profit (Thomas, 2007, Sabeti, 2011, Pangriya, 2019). BRAC - the largest non-government organization (NGO) in Bangladesh have successfully established and operationalized a number of social enterprises that facilitate social development modifying the traditional business models and generate returns alongside for the investors or owners of the enterprise (Jonker, 2009, British Council, 2016). These social enterprises could be allowed issuance of their stocks in a separate 'Social Business' segment of the mainstream equity markets. A social enterprise created with a view to mobilizing funds for CDM activities could issue shares to the public market and then channel the funds to pre-specified CDM related activities undertaken by the enterprise. A special purpose vehicle (SPV) set up by a financial or non-financial organization could also act as a social enterprise.

The enterprise will be responsible for ensuring proper utilization of the funds for CDM activities and generate desired management outcome. Such funds could be utilized for return generating CDM activities; for example, a new hospital reconstructed post-disaster could charge every service recipient of the community a minimal amount of charge in addition to their treatment costs, which will directly flow to the parent enterprise. This pool of money collected from all service recipients throughout the year could then be used to pay-out as dividend to the shareholders at the end of the year. In addition, investors investing in the social enterprise stock could be offered incentives such as tax benefits on the dividend received and capital gains earned in the market. Similar social enterprise models could also be adopted for financing other types of pre or post disaster CDM income-generating activities such medium and small enterprise (MSME) projects and Low-income housing.

Under MSME projects model, one large social enterprise can be set up that manages a diverse and large portfolio of micro, small, and medium scale income generating businesses or projects such as cattle farming, agro-based business, handloom, and handicrafts. A large parent social enterprise could be created by a government or development agency or an NGO based on specific locations where natural disasters frequently strike such as coastal belts or low lands. The provision is that the parent social enterprise would engage the disaster affected people as the key human resources, employees, and MSME entrepreneurs in the businesses or projects it manage. The affected community members would need to be equipped with appropriate training to ensure efficiency and productivity. The parent enterprise, being the mother entity of the MSME businesses and projects, may issue stocks in the Social Business segment of the equity markets. The investment required for raw materials and training in the MSME projects and business would be supported by the capital generated from the share issuances. On the other hand, incomes regularly generated from the businesses and project activities could be used to pay-out dividends to the investors in the shares of the parent enterprise.

Another example could be the launching of low-income housing. Similar to the MSME model above, a social enterprise, just like a traditional real-estate company, could be set up to build affordable and low-priced housing for a particular community that face physical infrastructure damage due to natural disaster. The social enterprise type real-estate entity could be allowed to sell its share to the public and be listed in the Social Business segment in the equity markets. People receiving their homes built or reconstructed will be required to pay off the cost of housing on a micro-instalment basis over an affordably longer period at a minimal or near to zero interest rates. Interests and instalments received could then be used to pay-out dividend returns for the investors in the shares of the real-estate entity.

5.3 Banks

Banks can play an integral loan in mobilizing large funds for sustainability and social purposes (Barua, 2019; Rahman and Barua, 2016). In line with that, Banks can offer loans at risk free rates or prime rates to finance CDM activities. The can organize easy and cheap financing of post disaster recovery process with a view to help the people surviving from the effect of climate change induced disasters. A variety of CDM focused loans and advances could work, some which are outlined below.

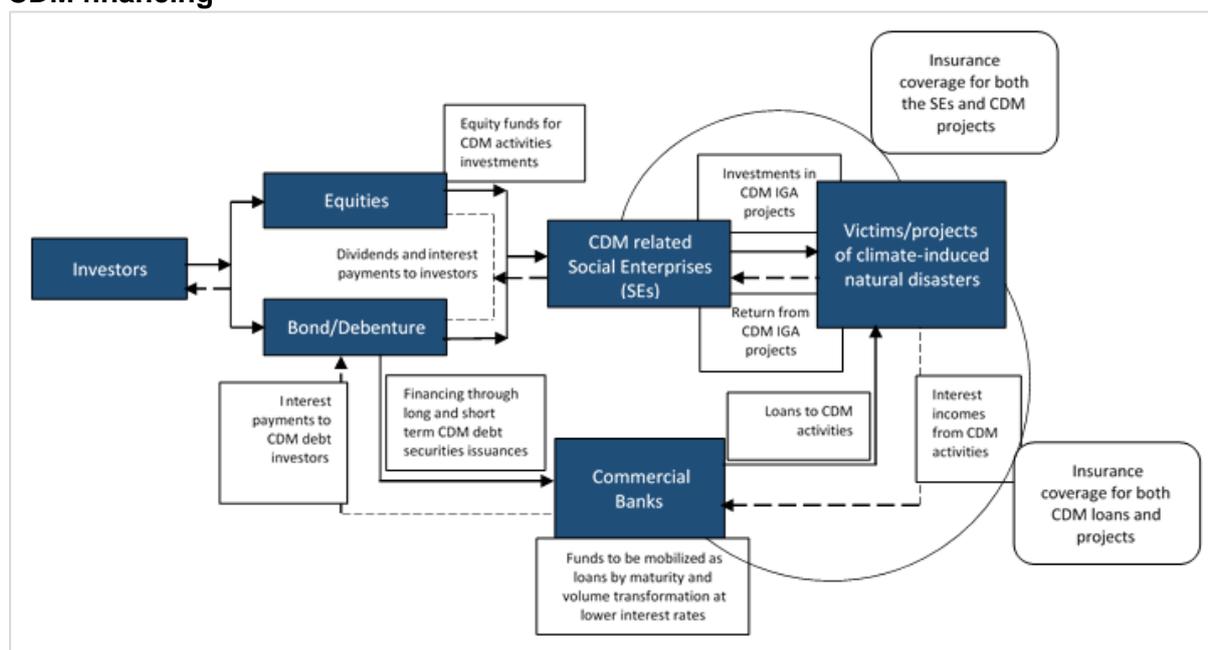
- (i) *Rehabilitation loan* - A long-term loan for housing finance for low-income people who have lost their homes due to natural disasters could be an option for banks. Breaking down the cost of housing into instalments over a span of 30-50 years at a risk free rate could substantially reduce the burden of repayment for the disaster affected low-income people. An interest-free period at the beginning of the loan term and a grace period at the end of the loan term could be offered to borrowers in order to allow enough time to psychologically, physically, and financially recover from the disaster effects and settle down with income generating opportunities. The property to be built by a borrower with a loan could be kept as a collateral or mortgage as a security against the loan granted. The mortgage will remain active until the loan is repaid fully, just like a traditional mortgage loan.
- (ii) *MSME/Farm loan* - Providing shorter or longer term loans for disaster effected people to start small farms or MSME self-employment enterprises, which would enable the disaster affected people to recover and become self-dependent rather than looking for government aids and grants. Such loans could have a longer maturity at a risk free rate compared to traditional loans to facilitate easy repayments. Borrowers need to be trained in particular trade before accessing such loans. An interest-free period at the beginning of the loan term and a grace period at the end of the loan term could be offered to borrowers in order to allow enough time to psychologically, physically, and financially recover from the disaster

effects and reset their income generating activities. Banks could ask for any related properties as a collateral or mortgage as a security of the loan granted. Until a loan is repaid fully, its underlying mortgage will remain active just like a traditional mortgage. Alternatively, banks could use the micro-credit model, under which a collective group of people in the same disaster-affected community could be responsible for the loans granted to them. In such cases, loans will be processed in groups instead of individual approaches. The mortgage will remain active until the loan is repaid.

One of the key concerns of loans to be granted to a disaster-affected community is their interest rates. These credit products need to be designed in a way that puts a lower or affordable cost burden on borrowers who are already disaster-stricken. This can be addressed in several ways. First, interest rates specifically on CDM loans could be directly (e.g., cash subsidy) or indirectly (e.g., tax rebates on incomes from specific loan programs) subsidized by governments, provided that the total cost of subsidy is lower than the direct cost (from own fund) a government would have to bear for implementing CDM activities when a natural disaster occurs. Second, without reducing the interest rates, banks could lengthen the term or the maturity of the loans so that the interval-wise interest burden is minimized and affordable for the borrowers. A third approach could be charging an interest rate that is lower than regular loans for all loans granted to borrowers from a disaster-hit community and treating the interest income forgone as a corporate social responsibility (CSR) contribution. The CSR contribution in turn could be used to avail of prevailing fiscal incentives such as tax benefits. Which approaches to follow to incentivize banks to engage with CDM financing would depend on the prevailing economic and financial sector circumstances of the country.

Combining the models described for securities markets, banks and insurance companies, Figure 2 presents a sample general framework when thinking about the link between the formal financial sector and CDM activities. In all cases of financing and investments using formal financial markets and institutions, the social enterprises and the financial institutions need to perform two key functions: maturity and volume transformation. The social enterprises will need to transform the equity financing into private equity investments into CDM projects and businesses, while financing through debt issuances with a specific aggregate maturity have to be transformed into comparable and useful maturity buckets when lending to CDM projects or businesses. Similarly, banks financing through either CDM debt financing or from its traditional sources with a specific aggregate maturity will have to transform it into comparable and useful maturity buckets when lending to CDM projects or businesses. In the cases of lending, interest rates charged on CDM projects or businesses need to be affordably low considering the socio-economic characteristics of the target community. These rates should then be used to determine the ideal interest rates to be paid to the original investors of the debt securities. In all cases, the social enterprise or the financial institutions managing the entire process need to recover its operating costs. While private sector FIs will also consider a profit margin in determining the interest rates to be charged on CDM activities and paid to the original debt financiers or investors, the social enterprises should concentrate on recovering their operating costs only. This is because the social enterprises are primarily established for serving the specific social cause of mobilizing CDM financing and investment.

Figure 2: A sample framework capturing the possible role of formal financial sector in CDM financing



Source: Author developed

6. Challenges in fixing the broken link and their mitigation

There are several challenges involved in bringing financial innovation to link the formal financial sector with CDM activities (Barua, 2020). Some of them are highlighted below.

6.1 Financial innovation and design

Linking formal financial sector to CDM will require bringing financial and design innovation as discussed in the previous sections. It may be time consuming and difficult to design such innovation financial mechanism and products due the complex interrelationships and interests between financial sector and development sector stakeholders.

6.2 Lack of awareness and interactions

There is a lack of knowledge, awareness and understanding among financial market and development stakeholders (e.g., financial institutions, regulators, development agencies) in developing countries about how the formal financial sector could be better utilized for financing and investing in CDM projects. Lack of financial innovation potential in developing countries further worsens the situation. Furthermore, often in developing countries, formal financial sector players (e.g., Banks) have a lesser degree of interactions, collaborations, and partnerships with development sector organizations (e.g., NGOs) due to their completely different functional areas and goals. CDM based formal financing mechanisms would not be possible until the two types of organizations are able to actively collaborate and work together for longer period.

6.3 High implementation cost

To keep pace with the emerging rate of natural disasters, explicit costs such as infrastructural changes, installation and operational cost of project implementation, establishment of social investment segments, and cost of issuing CDM Bonds etc. could substantially higher which could harden the way to start CDM financing. Again, associated operational costs such as cost of screening before CDM loan approvals by banks and training of employees associated with new products and operations could be very high to maintain.

6.4 Too new to implement fast

As this is a new concept in the formal financial sector, moulding or changing the existing business models, which have been traditionally practiced for decades could be quite challenging. Therefore, it could take a long time to shift towards CDM-focused operations could therefore would be slow and generate real impacts. As CDM financing tends to be a completely new idea, relevant organizations will need substantially long time to conceptualize the value of it and operationalize it for impacts.

6.5 Lack of investor and institutional interests

If potential investors of CDM-focused financial products (e.g., bonds, shares) find it inconvenient to invest in low-return CDM focused financial products, then it will not be possible to divert adequate funding through them. It could also happen due to significantly discouraging return opportunities associated with CDM products. Furthermore, CDM financing procedures will requires highly qualified trained employees to perform such activities with great care. Financial sector may not commit enough investments required financial and human capital in such projects if they earn less than required rates of return.

6.6 Problems of information asymmetry, moral hazard, and adverse selection

It may be a big challenge for financial institutions or development agencies to collect reliable information regarding the direct victims and the ones who actually deserve the support against their specific losses due to a climate induced disaster. There could be moral hazard and adverse section problems associated while identifying people with real needs and developing and implementing appropriate financial products by relevant stakeholders such as financial institutions, development agencies, or social enterprises concerned.

Overcoming the challenges could be a really daunting task. It will need a serious commitment and coordinated effort from financial sector and development sector participants and the concerned national level regulatory and policy organizations. CDM relevant stakeholders in a country could form a joint and collaborative umbrella body which would facilitate formal long-term collaborations between development sector and financial sector players. The platform could work actively to introduce and adapt to necessary financial innovation, design required financial products and processes, and formulate effective and favourable regulatory and policy environment in an economy. The concern is that such collaborations and joint efforts seem really difficult to begin with, however, the good part is that they are not impossible. In order to make this happen, a serious and positive effort is essential from all parties concerned.

6.0 Conclusion

Engaging the formal financial sector to CDM activities will require financial innovation and redesign of financial system architecture. A combination of return and social welfare needs to be achieved is this entire process, which requires a solid and long-term multilateral collaboration and commitment of the relevant stakeholders. While this paper provides a general idea and some examples of how formal financial institutions can engage with CDM activities, it would require substantial research in order to develop appropriate and practically functional models. Such solutions, if developed, could be more useful for developing countries that are heavily reliant on ODAs and public sources for financing natural disaster management. In particular, while meeting a large financing need, developing countries could reduce foreign dependence and maintain sovereign financial freedom.

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