Indigenous, Traditional and Local Knowledge for Bottom-up Adaptation Innovation

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Abstract

Adaptation technologies are location- and sector-specific. The process of their development, transfer, and adoption are complex and are not usually guided by established market mechanism. At the local level, uses of adaptation technology are usually guided by coping or autonomous response to climate impacts. Adoption of appropriate adaptation technologies requires fulfillment of a number of conditions not only at the point of application but also in the broader market and policy spectrum. Given impending risks of climate change beyond 1.5ºC global warming, additional adaptation consideration will be necessary to design and apply a suit of adaptation technologies considering multi- and systemic risk scenario. This paper proposes a bottom-up approach for adaptation technology development, transfer and adoption stressing the importance of indigenous, traditional and local knowledge (ITLK) systems, local innovations, efforts, and initiatives. The paper explains how communities, government, scientific community, and private sector could be a part for creating local markets of appropriate adaptation technology and related services.

Introduction

Adaptation is the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities (IPCC, 2014). Adaptation technologies in the form of hardware, techniques, knowledge, or skill sets are critical in facilitating adjustment to expected climate changes and impacts in incremental manner or to achieve transformative adaptation before confronting adaptation limits. Transformative adaptation allows changes in the fundamental attributes of a socio-ecological system and creates a new setting capable of withstanding adverse climate impacts. Adaptation technology innovation and deployment therefore should not only target short-term "quick-fixes" but they should be also geared towards creating market-oriented solutions allowing rapid up-scaling and diffusion and subsequently integrated as a part of systemic change. The systems transition consistent with adapting to and limiting global warming to 1.5°C requires the widespread adoption of new and possibly disruptive technologies and practices and enhanced climate-driven innovation in the areas of innovation capabilities, industry, and finance (IPCC, 2018).

Technology transfer is one of the core elements of climate change discourse. The Paris Agreement recognizes strengthening cooperation on development and transfer of adaptation and mitigation technologies and facilitation of the process through Technology Mechanism (UNFCCC, 2015). The Technology Mechanism consists of policy body (i.e., Technology Executive Committee) and implementation body (i.e., Climate Technology Centre and Network, CTCN) (UNFCCC/TEC, 2021b). CTCN supports accelerated development and transfer of technologies through technical assistant, creating accessible climate information and technologies, and fostering collaboration. Further, under Poznan Strategic Program (UNFCCC COP14), the Global Environment Facility (GEF) provides funding to climate technology development and transfer activities through Technology Needs Assessments (TNAs), piloting priority technologies identified under TNAs and dissemination of lessons and good practices. Capitalizing such mechanisms and processes, including other initiatives within or outside UNFCCC, requires addressing key barriers of technology innovation and transfer at the local level where adaptation technologies are needed.

Methodological and operational aspects of adaptation technologies are relatively underdeveloped. Challenges exist in defining and operationalizing the concept of adaptation technologies, develop methodologies to assess and prioritize adaptation technologies and ensuring full use and integration of available information and knowledge (Trærup and Bakkegaard, 2015). So far, the development and deployment of new technologies are skewed towards supporting climate change mitigation, while development and transfer of adaptation technologies are lagged behind woefully in the absence of policy focus and finances. There are relatively few funding covering research and development (R&D) initiatives on adaptation technologies (UNFCCC/TEC, 2021a). For instance, there was stagnation of R&D efforts towards adaptation between 1995 and 2015 and only limited to select countries (e.g., China, Germany, Japan, United States, or the Republic of Korea), while during the same period R&D doubled in the case of climate change mitigation technologies (Dechezleprêtre et al., 2020). Unlike mitigation which relies on single metrics, i.e., greenhouse gas (GHG), adaptation involves multi-dimensional metrices comprised of both qualitative and quantitative indicators, which are inherently difficult to measure, assess, and aggregate thereby limiting establishment of direct connection with the final outcomes (UNEP, 2017). Moreover, adaptation is ubiquitous, diverse, location-specific, dispersed across all socio-economic sectors and usually involving specific challenges, myriad stakeholders, and overlapping interest groups (UNFCCC, 2006b). The outcomes of adaptation could be overlapping with other kinds of interventions and requiring a longitudinal evaluation extending to years. These complexities limits transfer of technologies increasing the risk of adoption due to mismatch in adaptation needs and technology absorption capacity in countries or areas other than the point of innovation (Dechezleprêtre et al., 2020). Meanwhile market demands and incentives for developing and transferring are either underdeveloped or nonexistent, especially, at the local level where such technologies are needed. The available climate finances are not suited for small-scale and distributed direct investments to local levels (Soanes et al., 2017). There is a need for paradigm shift in the way adaptation technologies are mainstreamed into policies, financial support mechanisms, and actions, inclusive of both state and nonstate actors. Innovation policies need to combine public support for research and development with policy mixes that provide incentives for technology diffusion (IPCC, 2018).

Given this general background, this paper presents a bottom-up approach for accelerating adaptation innovations and their transfer. The essence of the approach is that major innovative disruptions should happen at the point of their application while the external technology transfer should be need-based to supplement key deficiencies at the local level. The paper advocates for a growing need to recognize indigenous, traditional and local knowledge (ITLK) system as a key foundation for progressing appropriate technological innovations. The paper starts by clarifying the scope of adaptation technologies followed by the importance of a bottom-up approach. It then presents a bottom-up approach of technology innovation targeting systemic transformation needed to adapt and build resilience against worsening climate change impacts.

Adaptation technologies and their typologies

Adaptation measures and strategies are diverse in scope (Figure 1). As a process, adaptation actions are characterized by many uncertainties and extended project cycles. Technology can play an important role in the effective adoption of particular measure or strategy in a given situation. As technology is more about implementation of solutions, it can bring tangible benefits. For instance, information and communication technologies (ICT) could be deployed in almost all adaptation measures listed in the Figure 1. Similarly, a particular technology, such as drip irrigation, could be used as no-regret adaptation strategy against seasonal water scarcity as well as to maximize water use efficiency purely out of economic consideration. Such no-regret adaptation strategies are cost-effective at present (including, without significant climate impacts) as well as under climate change scenarios. Technology could be distinguished into hardware, software (process and know-how involved in uses), and orgware (organizational or institutional processes involved in adoption and diffusion) (Haselip et al., 2019).

Identifying, assessing, and evaluating technologies for climate change adaptation is a complex, dynamic process that cuts across scales, sectors, and levels of intervention (Trærup and Bakkegaard, 2015). Broadly, technologies for adaptation can comprise "hard" technologies, such as seawalls and water storage dams, and "soft" technologies, such as crop

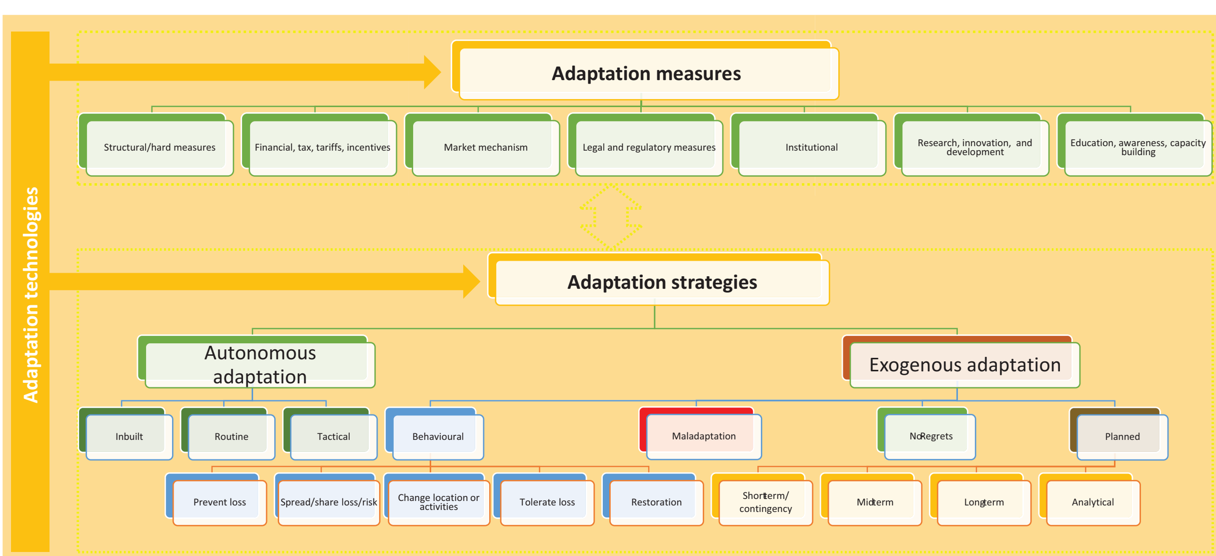

Figure 1: Contribution of technology to various adaptation measures and strategies (developed based on IPCC, 1994)

rotation, climate information falling under traditional, modern, high technology, and future technology (UNFCCC, 2006a). While an exhaustive list of adaptation technology is hard to comprehend, both CTCN and TNA process suggest broad classes of technology based on the experiences working in different countries and stakeholders. CTCN webpage lists seven broad technology classes (agriculture and forestry, coastal area, early warning and environmental assessment, human health, infrastructure and urban planning, marine and fisheries, and water) for adaptation. Meanwhile, TNA adaptation taxonomy reorganizes the technology into six broad classes (agriculture and livestock, water, forest and land, marine, fisheries, and coastal zones, health, climate change forecast and monitoring) (Woo et al., 2021). These broad classes could be further subclassified into specific technologies. For instance, agriculture and livestock class could include technologies related to new crop varieties, farming system, irrigation, conservation, soil management, etc.

Besides sectoral focus, there could be several alternatives or considerations for technology classification to reflect local circumstances. It could done based on regional specificity (such as technologies for coastal and low-lying islands, for mountains, for arid and semi-arid region, temperate regions), scale of application (local scale, subnational, national, regional, or international), risk and impacts (help understand climate risks, help to reduce risks or impacts, help to communicate risks), cross-cutting impacts (disaster risk reduction, ecosystem conservation, adaptation-mitigation synergistic), or targeting vulnerable group (gender, differently abled, old and children, indigenous people, those under poverty).

The main goal of classifying adaptation technologies is to assist identification of appropriate technological options as well as to avoid selecting those contributing maladaptation. For instance, existing guideline from TNA suggests three components to do that in a systematic manner: identify or prioritization of technologies, barrier analysis, and development of technology action plan (Haselip et al., 2019). While TNA under UN are usually done at the national level, there is a need for further consideration to trigger action and create an environment of adaptation innovations at the local level. While technology plays a pivotal role to enable adaptation actions, its ease of access, affordability, acceptability, and capacity to implement at the local level are even more critical. In particular, the technological options developed and introduced from outside face the risk of rejection or abandonment when one or more of operational conditions are not fulfilled or when the learning curve is steep. To overcome such situation, technological choices should be guided by adaptation needs and priorities considering the future risks at the local level. There is a strong need of 180 degrees reversal of technology innovation and development from existing largely top-down to the bottom-up in future. Local areas should be viewed as the locus of technological innovations to trigger locally led adaptation. Such a shift in direction could guide effective channeling of technology transfer along with needed supports (i.e., finance, capacity building) directly to the local level. Within the scope, adaptation technology should be viewed as an integral part of transformative adaptation process and hence properly aligned with the local adaptation planning and implementation framework.

ITLK as a foundation of bottom-up adaptation innovation

Communities employ various measures and strategies to cope with and adapt to climate change impacts based on ITLK systems. ITLK systems also refer to the understanding, skills and philosophies developed by societies with long histories of interaction with their natural surroundings (UNESCO, 2020). ITLK is often the only means available in the absence of planned adaptation interventions (Shivakoti et al., 2021). For many, ITLK informs decision-making about fundamental aspects of day-to-day life, including responses to climate change impacts. ITLK stems from generations of on-the-ground climate observations and interactions with the environment; it enables better understanding of the impacts at finer spatial scale and a greater temporal depth.

The learning curve is minimal and the risk of nonadoption is lower because ITLK forms an integral part of livelihood strategies. What is lacking, however, is their proper recognition as a valid technological choice for adaption since assessments are limited regarding the robustness to withstand future climate impacts. It is hampering further promotion and development of ITLK to adjust according to changing socio-economic and climate change condition. As future climate impacts can also increase the vulnerability of ITLK, proper reinforcement of ITLK through scientific validation and integration of modern technologies will be still relevant. It is important to modernize the ITLK through innovations while maintaining the core cultural and value system intact.

In recent times there is widespread recognition and appreciation including in the major assessment reports (such as IPCC, IPBES) and agreements (such as the Paris Agreement) to utilize and promote ITLK for climate adaptation (Shivakoti et al., 2021). TNA as well as climate finance (such as GCF) also emphasize proper acknowledgements of ITLK and safeguarding rights of indigenous people holding ITLK (GCF, 2018; Trærup and Minjauw, 2021). What is necessary is the proper identification, documentation, and incorporation of potential ITLK into local adaptation plans and actions. Adaptation should build on existing practices and approaches, including ITLK, so that introduced technological choices could act as reinforcement and at the same time easily adoptable. ITLK can be viewed as an obvious entry point for planning adaptation intervention as well as for developing appropriate technological solutions. The developed technology, due to their grounding to local reality and needs, fares a good chance of success triggering needful investments from local as well as other sources.

Realizing bottom-up innovations

Adaptation is a continuous process involving various elements of socio-ecological system that interact with worsening climate change in a complex manner. The existing mechanism of technology innovation, transfer, and adoption in the upstream are found less effective to bring meaningful and enduring changes at the local level, the ultimate point of implementation, due to various financial and non-financial barriers. The blanket approach of technology transfer risk rejection or discontinuity, especially, after the termination of external supports. Usually the main limitation of external support, such as through projects or programs, is that necessary capacity and mechanism needed to produce, supply, use, maintain, and manage introduced technologies could not be established in a few years (Khan et al., 2018).

Given climate uncertainty, people and communities as end-users cannot expect scientists and external supports to solve the problem, instead they have to change the way of decision-making and preparing themselves accordingly (Hallegatte, 2009). A systemic approach of locally led adaptation is necessary involving public, civil society, and private institutions (Soanes et al., 2021). The approach demands a technology prioritization based on multi- and systemic risk assessment (Figure 2).

Instead of selecting standalone technological choices, a packaged solution such as climate smart agriculture (CSA), addresses multiple risks by combining mutually reinforcing technological options. CSA aims to tackle three main objectives: sustainably increasing agricultural productivity and incomes; adapting and building resilience to climate change; and reducing and/or removing greenhouse gas emissions, where possible (FAO, 2021). Packaging of the technological options can consider addressing three adaptation concerns. First, technological option needs to address gaps in climate information to understand as well as for decision support regarding the level of expected impacts (in future or real-time) and resultant vulnerability. Indigenous practices such as observation of wind speed and deep seas wave size, dense cloud formation, behavior of animals (crabs climbing walls) are used to forecast cyclones in Bangladesh (PROSHAR, 2014). Similar cases such as flood forecasting in the Gandaki River Basin relying on clouds in upstream, changes in noise and/or color of river water, ants leaving the river banks or climbing trees (Acharya and Poddar, 2016). Integration of such ITLK with modern forecasting or early warning could greatly assist reduce the level of uncertainty and hence minimize potential losses from the impacts. Second, technological option will act to reduce the exposure and impacts such as building dikes to prevent floods or enhance water storage for drought mitigation. Number of ITLKs are employed in the Asia-Pacific regions such as stilt houses, floating garden, water harvesting, flood mitigation, indigenous food/farming systems (Shaw, Uy, and Baumwoll, 2008; SAARC, 2008; Song et al., 2016; Trærup and Minjauw, 2021; FAO, Alliance of Bioversity International, and CIAT, 2021). There is a potential to infuse technological innovation with ITLK in such cases too. In Guangxi, China, scientist worked with communities under participatory plant breeding to develop drought and pest resistant hybrid maize by combining traits of traditional varieties and high-yielding hybrids (Song et al., 2016). Final, technological option helps reducing vulnerability and building resilience such as diversifying livelihood and income generation options. For instance, it could involve promotion of adaptation through ecotourism by integrating tradition, culture, and indigenous tools or crafts.

Local technological innovations demand creation of proper delivery mechanism that is inclusive of gender, youth, indigenous group and vulnerable groups, and key sectors. For instance, women usually play major role in selecting and saving seeds of indigenous varieties (Song et al., 2016). Their know-how will be crucial not only designing solutions but also transferring to future generation. Local innovations are critical for building technological solution that builds on existing practices such as ITLK. Local innovation does not have to be technically advanced (such as genetic engineering or climate downscaling) but appropriate and effective. However, technical experts, scientists, or researchers are important partners to co-develop solution to apply latest technological advances such as uses ICT, accessing information from satellites, or designing nature-based solutions related to ITLK.

The evolution of local solutions can trigger built-up of institutional capacity, local expertise, and entrepreneurship such as training or extension facilities, repair shops such as for sprinklers or solar irrigation, local manufacturing of spare parts, seed bank, etc. The role of private finance as well as public funds for local development could be mobilized to finance technological options based on their merits or performance such as likelihood on the return of investment. Promotion of innovative, flexible and devolved financing scheme can result in built-up of local capacity to mobilize funds for climate change adaptation and resilience building. It could serve as an effective channel for administrating supports from external sources (both national and international).

The final requirement for bottom-up adaptation technological innovation is the communication of adaptation progress, gaps, and needs for support. Locally appropriate benchmarks or indicators could be developed to keep track of issues, results, and outcomes which are important for demonstrating performances, transparency, recognition of local efforts and capacity, and trust building. Local institutions, local government, NGOs, or CBOs can play an important role in this regard.

A multilevel governance inclusive of state and nonstate actors, such as industry, civil society, and scientific institutions, cross-sectoral coordination at various governance levels needs to be established to ensure participation, transparency, capacity building, and learning among different players enhancing access to finance and technology and enhancing capacities. Government bodies at the national level, development partners, INGOs, UNFCCC bodies, climate finances can respond to remove barriers by establishing fast-track for technical, financial, and capacity supports to the local level.

Conclusion

Innovation and technology have a major role in driving adaptation interventions

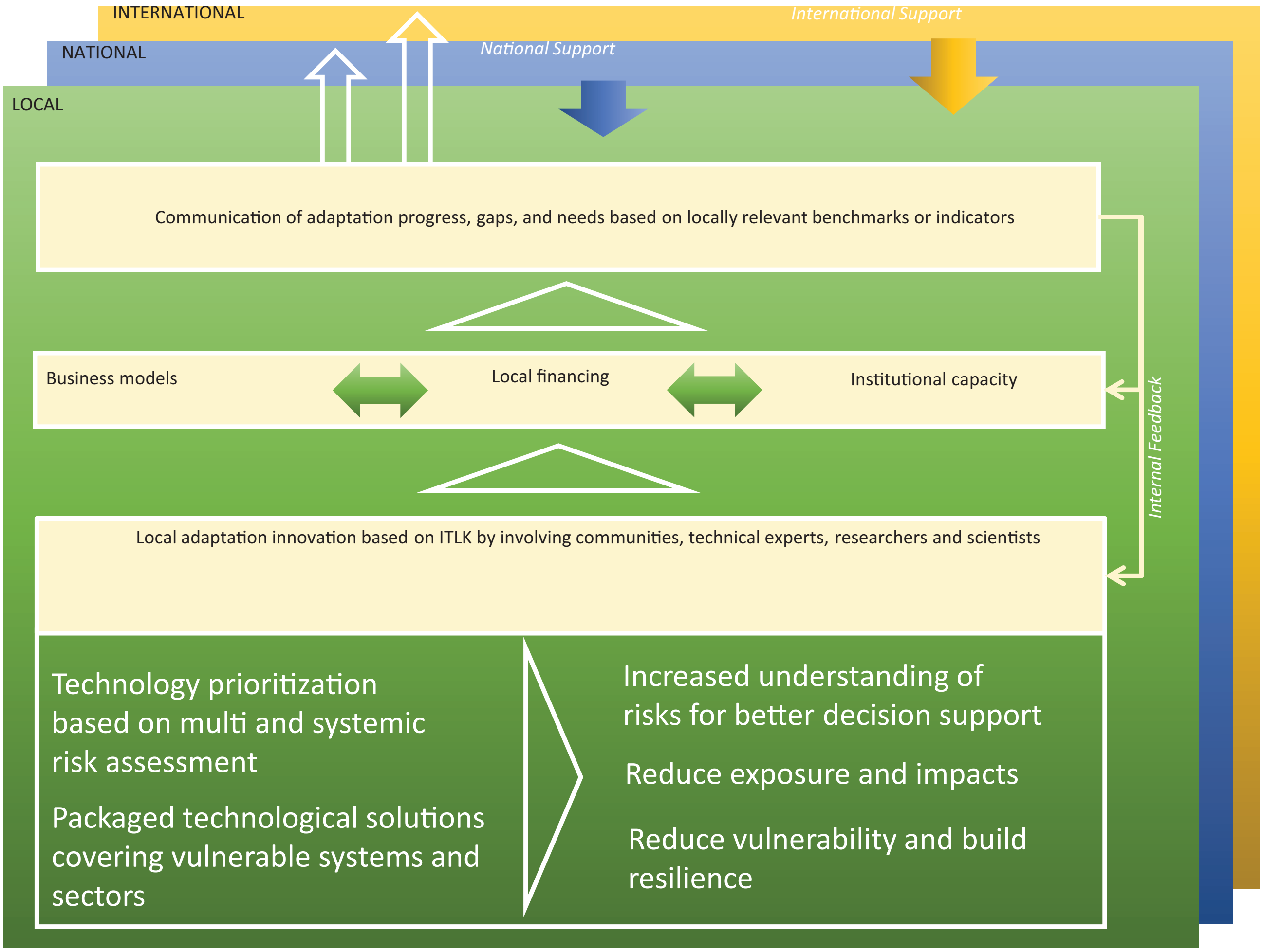

Figure 2: A generalized conceptual framework of bottom-up adaptation innovation

(Source: Author)

in the Asia-Pacific. Since adaptation decisions are often based on imperfect knowledge, the role of appropriate technology can be instrumental in reducing uncertainty as their outcomes are immediate and tangible. Despite a major recognition and call for development, transfer, and wider adoption of adaptation technologies, rate of technology diffusion is lagging behind due to institutional, financial, and market barriers. International climate finance is less flexible towards smaller scale interventions specific to particular local areas adaptation needs and circumstances. Meanwhile a blanket approach of technology transfer to a larger scale are prone to risk of nonadoption such as due to steep learning curve involved or mismatch in priorities. While the external finances and technology transfer are critical to support on-the-ground adaptation needs, a proper setup capable of attracting and absorbing such supports is urgently needed. The paper suggests substantial reorientation of focus on bottom-up approach of adaptation innovation such that developed adaptation technologies are appropriate, grounded to the local needs and that builds on ITLK. Further, bottom-up adaptation innovation can attract local investments for the creation markets solutions, build-up of local expertise, and institutional capacity. To enable bottom-up adaptation, involvement of relevant stakeholders such as technical experts and researchers, local government, financial institutions, NGOs, CBOs, local media are critical. It is hoped that promoting bottom-up approach eventually encourage creation of flexible national and international channels for the transfer of technology, finance, and capacity building supports as envisioned in the Paris Agreement.

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