TECHNOLOGIES FOR CLIMATE CHANGE ADAPTATION: EMERGING LESSONS FROM DEVELOPING COUNTRIES SUPPORTED BY UNDP

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In developing countries, resource-dependent communities are disproportionately affected, yet less equipped to cope with the adverse impacts of climate change. Though generally associated with institutional adjustments, technology transfer, absorption and diffusion provide outstanding opportunities to increase the resilience of vulnerable communities and the ecosystems on which they rely to the risks of climate variability and extremes. In spite of the potential for technology diffusion as it emerges from the international regime, scientific evidence suggests that global efforts to transfer climate-smart technologies needed for successful adaptation in developing countries have fallen short. This paper examines current challenges and opportunities related to technology transfer for climate change adaptation in developing countries, as well as the contribution of the United Nations Development Programme - Climate Change Adaptation Team (UNDP-CCA) in promoting technology absorption and diffusion at the country level.

These days, climate change is one of the most prominent challenges facing humanity. Recent data released by the National Oceanic and Atmospheric Administration (NOAA) of the United States suggest that June 2010 was the hottest month of June on record.[1] Resource-dependent communities in developing countries are disproportionately affected, yet less equipped to cope with the adverse impacts of climate change. As extreme weather reaches its peak, the need to adapt becomes an urgent priority. The transfer of technology—which in the broadest sense includes not only materials and equipment, but also the technical and commercial information and human skills needed to properly understand and use it—is presented as one of the main pillars to increase the resilience of vulnerable communities and their ecosystems to climate risks. Yet today, global efforts

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to transfer and diffuse climate-smart technologies have fallen short of what is required for significant adaptation in the coming decades.[2] The experience of the UNDP Environment and Energy Group in promoting the absorption and diffusion of technology in developing countries can help pave the way for successful transfer of technology to developing countries.

We begin by elaborating on the opportunities and constraints associated with the transfer of technology in developing countries, then go on to present the portfolio of UNDP's projects addressing the absorption and diffusion of technology in climate change adaptation in developing countries. Our final section explores the prospects for scaling up efforts to transfer technology for climate change adaptation in developing countries.

Opportunities and Constraints to Technology Transfer in Developing Countries

From the United Nations Framework Convention on Climate Change (UNFCCC) in 1992 to the Kyoto Protocol in 1997 to the Bali Action Plan ten years later, several multilateral environmental agreements have been developed to assist developing countries in adapting to climate change; namely, by facilitating innovation and diffusion of technology that can bolster the resilience of vulnerable communities to climate change, variability and extremes. For example, Article 4.5 of the UNFCCC urges developed countries who are party to the Convention (Annex I countries) to promote, finance and facilitate the transfer of environmentally sound technologies and know-how to developing countries. Yet despite their commitments, the difficulty of fulfilling this critical need has highlighted the importance of moving toward concrete actions. Today, the World Trade Organization's (WTO) agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) provides potential opportunities to speed up the transfer of technology for adaptation. While addressing some concerns, significant challenges still need to be overcome in developing countries in order for adaptation technologies to deliver their full promises.

Technology Transfer Opportunities for Climate Change Adaptation in Developing Countries

TRIPS constitutes the most comprehensive multilateral agreement in the area of intellectual property rights. The agreement is replete with technology transfer opportunities for developing countries. In addition to establishing minimum standards for intellectual property rights, a central aspect of TRIPS is that it allows countries to position intellectual property rights in the context of their public policy.[3] In this respect, several provisions known as TRIPS flexibilities allow devel-

oping countries to overcome the constraints pertaining to the protection of intellectual property rights, and provide them with critical policy space, especially for climate change adaptation.[4] These provisions include exceptions to patent rights and compulsory licensing. As stated in Article 30 on the "Exceptions to Rights Conferred," TRIPS does grant exceptions to the exclusive rights conferred by a patent, assuming that these exceptions do not conflict with normal exploitation of the patent and do not prejudice interests of the patent owner, taking into account the interests of third parties.[5] Such exemptions are particularly pertinent within the context of climate change adaptation, given the need to adapt foreign technology to local environment. These exemptions allow companies in developing countries to invent around patent claims to gain access to environmentally sound technologies. This has proved important within the context of the implementation of other multilateral environmental agreements.[6] In the case of compulsory licensing, TRIPS allows the use of a patented product or process without the consent of the patent owner, assuming that the proposed user has previously attempted to obtain authorization from the patent holder. This requirement is further waived in the case of national emergency and other circumstances of extreme urgency, or in cases of public non-commercial use (Article 31.b).[7] Compulsory licensing can, therefore, be seized to ensure rapid transfer and access to climate-related technologies for adaptation in developing countries.

TRIPS has the potential to facilitate the transfer of technology for climate change adaptation in developing countries.

In addition to the patent provisions, it is important to mention the provisions of Section 8 on the "Control of anti-competitive practices in contractual licenses."[8] As stated in Article 40, WTO members can adopt appropriate measures to prevent or control licensing practices or conditions within intellectual property rights that impede the transfer and the dissemination of technology. Further, Article 66, specifically designed for least developed countries (LDCs), recognizes the special needs and requirements of these countries and provides them with a transition period of ten years, during which they are only required to apply Articles 3, 4 and 5 of the agreement. During this period—which has now been extended from 2013 to 2016—LDCs can access a variety of channels for the transfer of technologies, including imitation and reverse engineering.

From this perspective, it is clear that TRIPS has the potential to facilitate the transfer of technology for climate change adaptation in developing countries. However, given the significant challenges pertaining to the institutional reform

and regulatory incentives needed both in the countries adopting the technology and in the country owning it, the process is far from being a cure.

Constraints to Technology Transfer in Developing Countries

In addition to lack of political will from developed countries, the failure to transfer technology to developing countries stems from several other factors, including the concerns surrounding intellectual property rights, the market-driven technology transfer and the weak capacity of absorption from inadequate institutions and policies. As stated above, intellectual property rights have been established to promote the innovation and diffusion of technologies and knowledge. However, there are circumstances under which intellectual property rights constitute an obstacle to the transfer of technology.[9] In fact, patents too broad in scope or level of protection of intellectual property might prompt owners to limit the availability, use or development of a process or product, thus hindering the transfer of technology. In the same vein, weak enforcement of intellectual property rights can discourage foreign firms from licensing their technologies in developing countries or from investing in promising domestic enterprises for fear that competitors will use it. For example, as a result of weak intellectual property rights regimes in Brazil, China, India and Turkey, foreign subsidiaries of global wind equipment companies registered very few patents in these countries, despite their investments in local manufacturing, research and development.[10] Another concern over the transfer of the technology is the market-driven approach governing this process. While developing countries expect significant access to technologies on concessional or grant terms, developed countries have primarily focused on markets. Unfortunately, developing and low-income countries are not attractive markets for entrepreneurs wishing to introduce new technologies. Moreover, assuming that technologies are effectively transferred, there is a need for complementary domestic policies and institutions ensuring that these technologies are effectively adapted and absorbed. Efficient use of technology requires prior technical knowledge, skills and resources.

However, developing countries still lag behind the critical mass of scientists required to efficiently use the technologies acquired.[11] In the case of climate change, the number of engineers needed to implement context-specific adaptation technologies is particularly low in low-income countries. As per the need to design domestic policies mobilizing technology and fostering innovation, few developing countries have the technical capacity to handle such an endeavor. In addition, national research institutes are generally underfunded and research is not demand driven. For example, investments in agricultural research and development in developing countries only account for about 27 percent of global investments,

though this figure has been on the rise since 1981.[12] Furthermore, provided that adaptation technologies are devised or adapted to local conditions, communities still do not have access to credits nor do they have the inclination to invest in new technologies.[13]

As a result, beyond the opportunities offered by TRIPS flexibilities, the transfer of technology to developing countries is limited by significant constraints related to domestic and external barriers. Multilateral institutions are currently being considered as an option to support the global effort for the development and diffusion of climate-smart technologies for adaptation. As a leading multilateral institution in the area of development, UNDP is committed to scaling up the diffusion and absorption of technologies in developing countries through a large portfolio of projects specifically addressing the issue of technology transfer.

UNDP's Projects in Technology Diffusion and Absorption for Climate Change Adaptation in Developing Countries

The strong commitment of the UNDP Climate Change Adaptation (UNDP-CCA) group to the technology transfer issue is reflected in its robust portfolio of twenty-nine projects specifically geared toward the absorption and diffusion of technology for climate change adaptation in developing countries. These projects are now being implemented in twenty-nine countries in Africa, Asia, Europe, the Pacific and Latin America. The Global Environment Facility (GEF) is the largest funder of these initiatives, with nearly $66 million in grant contributions.

Adaptation programs and projects being implemented with UNDP's technical assistance and financing using resources managed by the GEF aim to achieve the following key results: (a) develop technical capacities at the national and sector levels to undertake prospective exercises in order to identify climate change risks and opportunities and prepare long-term strategies for risk management; (b) internalize climate change risks into planning, budgeting, management and decisionmaking of key economic sectors; (c) revise and formulate national and sectoral policies and establish appropriate institutional support mechanisms; (d) test approaches and technologies for climate change risk management in key sectors at the national and sub-national levels; (e) codify and disseminate knowledge and best practices.[14]

In this respect, a project approach is used to promote a combination of so-called hard and soft technologies for effective and efficient impacts.[15] Technologies are chosen by countries based on their cost-effectiveness, environmental sustainability, cultural compatibility and social acceptability. The sustainability of each project stems from the establishment of institutions to monitor and evaluate technologies for potential adjustments, course corrections and feedback. The scope of

intervention includes both the human and the natural systems, with the principal goal of increasing their resilience to climate change risks.[16] Below is a description of the use of these technologies in these different systems.

Technology Used for Climate Change Adaptation in the Human System

The transfer of technology in the human system aims to protect human life by increasing resilience to adverse climate change variability and extremes. Technologies are primarily used in the context of adaptation in the following thematic areas: agriculture and food security, water resources management and disaster risk management.

Agriculture and food security. Fourteen UNDP-supported country projects promote the adoption and diffusion of technology in the domain of agriculture and food security. Eight projects take place in Africa, while four are in Asia and two in the Pacific. Most of these projects equip and build the technical capacity of key stakeholders and institutions, specifically technical staff, local farmers, community-based organizations and NGOs. They also promote agricultural- and pastoral-resilient techniques and practices, such as dissemination of stress-resistant crops and rangeland seedlings, promotion of crop diversification and introduction of pest management techniques. A typical example is the Community Based Adaptation to Climate Change through Coastal Afforestation Project in Bangladesh. This project partners with the Bangladesh Rice Research Institute (BARI) to demonstrate adaptive technologies in high-salinity areas. Additionally, it partners with BARI to train staff and farmers in adopting suitable vegetable and orchard cultivation technologies. These technologies have already been tested in coastal areas. Other interventions include crop diversification and the creation of freshwater reservoirs to facilitate dry season agriculture.

Water resources management. Thirteen projects under implementation focus on the adoption and diffusion of technologies in the area of water resources management. As in the previous intervention area, the majority of these projects take place in Africa (in this instance seven) with four in Asia, one in Latin America and one in the Pacific. These projects aim to enhance the capacity of communities and relevant institutions to integrate climate change into water resource management. In this respect, they introduce, demonstrate and promote integrated water resources management practices, such as changing crop patterns, selection of drought-tolerant crops, drip and borehole irrigation, and water conservation techniques such as rainwater harvesting. A key example of this is the Adaptation to Climate Change through Effective Water Governance project being implemented in Ecuador. The project supports the incorporation of water-saving technologies

for irrigation, such as drip irrigation and adjusting timing and volumes of water application in irrigated land. It also supports agricultural practices leading to efficient use and conservation of water, such as change in crop patterns, selection of drought-tolerant crops and improved land management techniques.

Infrastructure/Disaster risk management (human system). Nine projects promote the diffusion and absorption of technologies with regard to risk management. These projects are more evenly distributed geographically with four in Asia, three in Africa and two in the Pacific. The projects build the technical capacity of communities and institutions to design and develop infrastructure systems that help withstand increasing variability and intensity of climate hazards. An illustrative case is the Promoting Climate-Resilient Water Management and Agriculture Practices project in rural Cambodia. The project conducts measures to reduce vulnerability of infrastructure to the impacts of climate change by constructing irrigation canals and dykes, as well as security hills to help prevent flooding.

Technologies Used for Climate Change Adaptation in the Natural System

Technologies used in the natural system aim to protect the biological and physical environments from the adverse impacts of climate change. In the case of UNDP-CCA projects financed by the GEF-managed funds, these technologies are used in the areas of biodiversity and ecosystem management, sustainable land management and disaster risk management.

Climate-resilient ecosystem management. Four projects specifically address technology absorption and diffusion of biodiversity and ecosystem management. Asia holds two projects; Europe and Latin America, one each. The majority of these projects build the capacity of key stakeholders, while identifying and disseminating suitable technologies for the protection and conservation of biodiversity and diverse ecosystems. The principal ecosystems discussed here are forest, wetland and coastal ecosystems. A typical example is the Adaptation to Climate Change Impacts in Mountain Forest Ecosystems projects in the South-Eastern region of Armenia. This project trains foresters to conduct early identification and localization of pest invasion and to use environmentally sound aerial pest control techniques, with a focus on the use of a biological treatment that acts on leaf-eating insects without damaging biodiversity.

Sustainable land management (SLM). Six projects address the diffusion and absorption of technologies for sustainable land management. Four of these projects occur in Africa and two in Asia. These projects enhance the technical capacity of key

stakeholders, specifically farmers and pastoralists, to identify, disseminate and implement sustainable land management techniques to restore degraded soils, stabilize land and improve agriculture productivity. A key example is the Adapting to Climate Change through the Improvement of Traditional Crops and Livestock Farming project in Namibia. The project identifies and disseminates cost-effective, innovative and appropriate SLM techniques, which integrate environmental and economic benefits. Moreover, the project strengthens the technical capacity of service organizations and improves livestock rearing through integrated pasture and animal bio-capacity management techniques.

The successful transfer of technologies for adaptation to climate change will require significant institutional change.

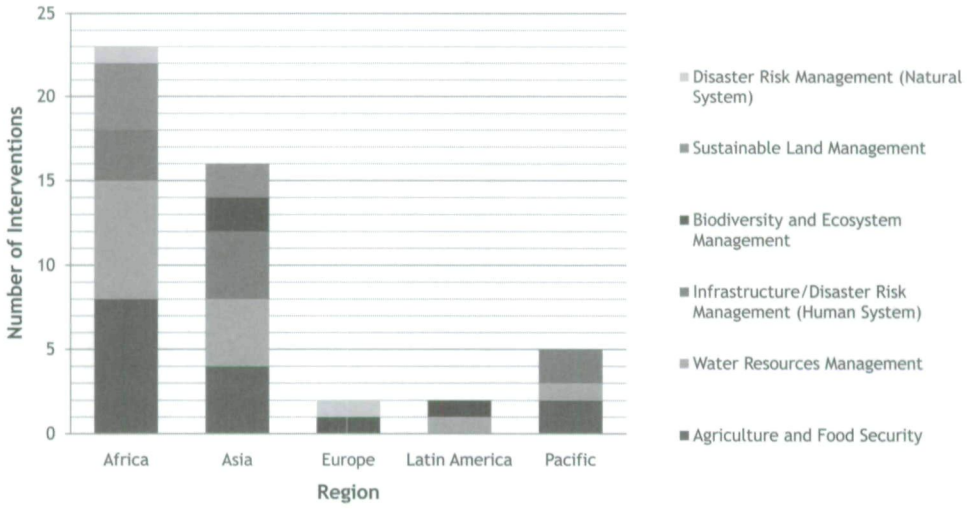
Disaster risk management (natural system). Two projects, based in Egypt and in Albania, specifically deal with the absorption and diffusion of disaster management techniques as they pertain to the natural system. In Egypt, the Adaptation to Climate Change in the Nile Delta through the Integrated Coastal Zone Management project assists the government in implementing the national Integrated Coastal Zone Management (ICZM) plan by installing a set of innovative shoreline protections. This project is implemented following the so-called living shorelines approach, which focuses on an innovative set of bank stabilization and habitat restoration techniques to reinforce the coastline, minimize coastal erosion and maintain coastal processes. The project in Albania promotes the use of efficient technologies to assess vulnerability to environmental changes. This involves training key stakeholders in the use and application of models such as DIVA, an interactive tool that enables users to simulate socioeconomic change and adaptation on natural and human coastal systems.

Assessment of Technology Transfer Within the UNDP's Portfolio of Projects and Lessons Learned

The UNDP-CCA is currently assisting sixty non-Annex I countries to adapt to climate change. As mentioned, twenty-nine non-Annex I countries have at least one project incorporating the issue of technology transfer. Africa, with twenty-three interventions, is the mainstay of technology transfer interventions, followed by Asia with sixteen interventions, and the Pacific Region with five (Figure 1). Asia can be considered the only region with all kinds of interventions. The absence of technology transfer interventions in the area of natural resources management is remarkable in Africa. The agriculture sector receives the most interventions.

Notwithstanding, such interventions are absent in Europe and Latin America. Interventions in technology transfer for water resources management occur in all regions with the exception of Europe.

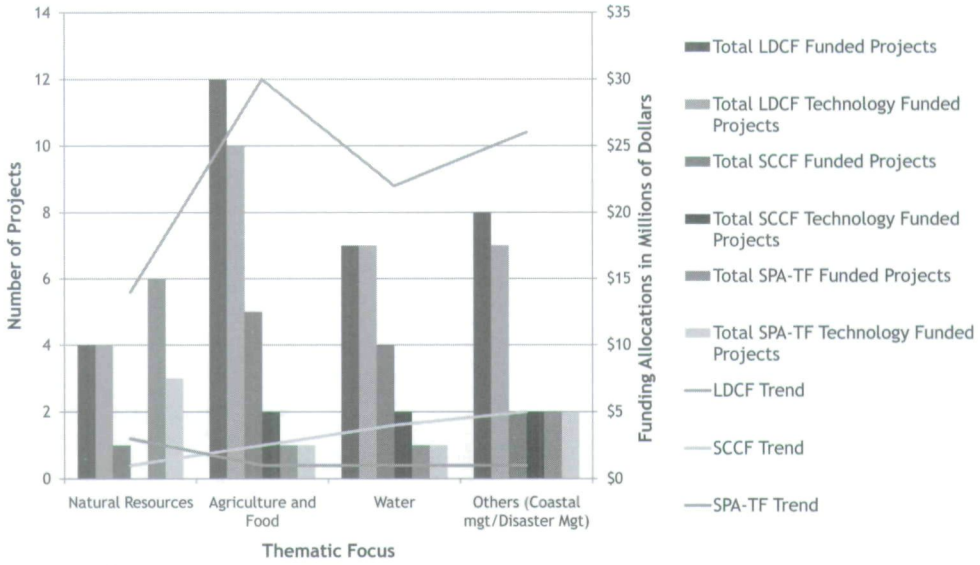
Figure 1: Distribution of Technology Transfer Interventions per Region and per Thematic Area



Source: UNDP.

Three GEF-managed United Nations Framework Convention on Climate Change (UNFCCC) funds are used to channel on-the-ground funding: the Least Developed Countries Fund (LDCF), the Special Climate Change Fund (SCCF), and the GEF-Strategic Priority on Adaptation Trust Fund (SPA-TF). As a whole, technology transfer is given a high priority within the UNDP-CCA financing portfolio. Almost every funding mechanism—LDCF, SCCF, SPA-TF—allocates funding to each technology transfer intervention area, as shown in Figure 2. LDCF is the most important provider of funding with the highest contribution in the areas of agriculture and food security, and to a lesser degree in the areas of disaster risk management/infrastructure and water. We can also notice that in the areas of natural resources management and water, the totality of the LDCF envelope is allocated to technology transfer. This holds true for the SPA-TF in the areas of agriculture and food security, water and disaster risks management/infrastructure, and for the SCCF in the area of disaster risk management/infrastructure.

Figure 2: Allocation of Funding for Technology to Support Adaptation per Thematic Areas

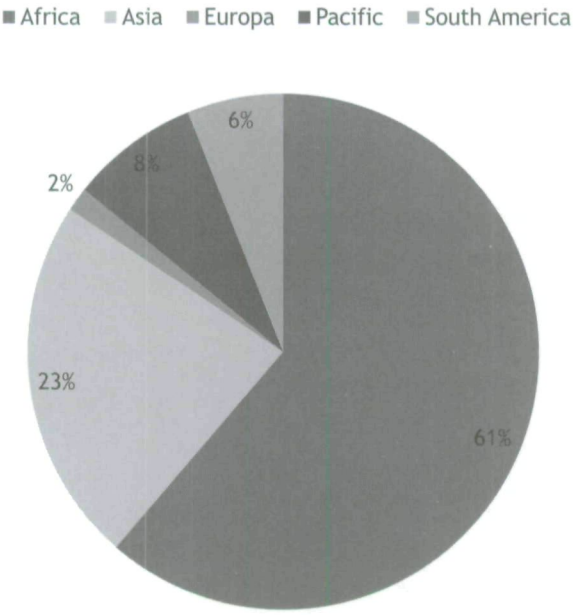


Source: UNDP.

Africa receives the highest level of funding, representing approximately 61 percent of the total budget allocated to technology transfer, followed by Asia, which receives 23 percent—as highlighted in Figure 3. The least funded region in this respect is Europe, with only 2 percent.

As a whole, the UNDP-CCA gives special consideration to the transfer of technology within its portfolio of projects. Almost every funding mechanism addresses the transfer of technology in a specific intervention area, and the majority of funding mechanisms allocates the totality of its funding to projects incorporating technology transfer interventions. The most important provider of funding is the LDCF, and the best-served area is agriculture and food security. Africa and Asia are the most well- provided regions in terms of number of interventions and allocation of funding. The reason for this is not that they are more vulnerable than other regions, but rather that their need for technology diffusion and absorption for climate change adaptation is greatest. In the perspective of the GEF-5 (2010–2014), the UNDP-CCA deserves some adjustments, especially in the regional distribution of specific technology transfer interventions. We find striking that some regions with a large number of biodiversity hotspots, such as Africa and the Pacific, receive no technology transfer interventions in this area that are financed by earmarked resources for adaptation. Furthermore, funding mechanisms such as SCCF and SPA-TF will need additional allocation and attention in order to feed into every technology transfer intervention area.

Figure 3: Distribution of Funding for Technology Transfer per Region



Source: Advancing Climate Change Adaptation in Developing Countries: An Overview of the UNDP-GEF Adaptation Portfolio 2010.

Recommendations for Scaling Up Technology Transfer and Diffusion in Developing Countries

The successful transfer of technologies for adaptation to climate change will require significant institutional change, with supportive policies to address the constraints over their integration into developing countries. In this respect, international measures can aid national efforts in creating both institutions as well as the proper environment for successful technology diffusion and absorption in developing countries.

Policy Recommendations for Multilateral Institutions and Developed Countries

The role of the international community is essential to ensuring the transfer of technology to developing countries. The desired contributions of the international community can be summarized as follows:

Increase voluntary contributions to the various adaptation funds. Substantial funding is required in order to stimulate technology transfer in developing countries. Funding is necessary to build human and institutional capacities, to conduct research and to create incentives for innovation that are relevant to adaptation in developing

countries, including technology transfer. The planned resource allocation efforts of US$500 million over the next four years sought by major multilateral funding institutions such as the GEF are significantly short of seriously addressing the urgent challenge of adapting to climate change.[17] The donor community must come together to make the necessary funding available for developing countries to adapt. Failing to do so is likely to impose costs—including opportunity costs—that are several orders of magnitude larger than the costs of adaptation.

Transfer climate-smart intellectual property rights to the public good domain. The transfer of climate-smart intellectual property rights to the public domain is considered to be a critical measure for inclusion in TRIPS. It constitutes an efficient solution to address the laxity and inertia in the compliance to international binding agreements.

Formulate appropriate policy instruments. Developed countries need to formulate national policies that, on the one hand, do not reduce incentives to license technology in developing countries and, on the other hand, do not prevent foreign firms from licensing publicly funded adaptation technologies.

Recommendations for Developing Countries

Complementary domestic policies in developing countries are essential to promoting technology transfer and ensuring that it is effectively adapted and absorbed. In this respect, the role of the state, private sector and other institutions is fundamental. Their actions need to target the following realm:

Strengthen skills and knowledge. Skills and knowledge constitute the backbone of any technology absorption process. They can be acquired by investing in institutions and programs using knowledge infrastructure such as universities, schools, extension services, research and development institutions and laboratories. These investments will enable both the public and private sectors to efficiently use climate-smart technologies and to make scientific-based decisions.

Increase funding amount and efficiency. Funding from multilateral institutions alone will not ensure efficient transfer and absorption of technology for climate change adaptation. Funding from both the public and private sector will be necessary in order to finance research, development, demonstration and dissemination, absorption in firms, technical consulting and training. In the same vein, shifting from guaranteed to competitive funding will increase their efficiency, and with it the efficiency of institutions.

Increase cooperation between research institutions, the public and the private sectors. A

united effort can guarantee effective technology transfer and absorption. Bridging institutional divides will be fundamental to fostering knowledge exchange and experience-sharing. Institutional cooperation was one of the keystones of the Asian Green Revolution and is today regarded as a keystone of China's breakthrough.

Improve the business environment. A suitable business environment provides the ingredients necessary for climate-smart technology transfer and diffusion. This entails eliminating barriers to technology transfer, namely tariffs and other trade barriers that increase the domestic price of climate-smart technology or render them cost-ineffective. Regulatory incentives and public support programs need to ensure that the market functions properly and that firms do not face unnecessary risks. Moreover, a well-functioning financial sector, coupled with macroeconomic stability, can guarantee access to credits by vulnerable communities, while simultaneously providing additional foreign development investments (FDIs) to accelerate technology transfer and absorption.

Business-as-usual development is clearly not sustainable in the context of the reality of climate change.

Conclusion

The United Nations Development Programme and other multilateral development organizations are working intensively to promote pro-poor and pro-growth adaptation that encourages climate-resilient economic development and sustainable livelihoods. In the case of UNDP, this is done by supporting the integration of climate-related risks and opportunities into national planning and poverty reduction, especially to address the needs of poor and vulnerable populations. Technology transfer plays a pivotal role in adaptation, particularly at the community level. It is evident from UNDP's experiences to date in assisting countries to adapt that technology transfer cannot be promoted or sustained in a policy vacuum. It is equally important to enhance the policy and regulatory environment in order to facilitate and sustain technology transfer and demonstrate technologies, which, in turn, increases uptake and absorption.

Business-as-usual development is clearly not sustainable in the context of the reality of climate change. In order for it to be successful, development must be pursued with programs resilient to anticipated long-term climate change. This new reality has implications for the way we think about and rely on technology to support resilience. There is not only a need for technological solutions, but there is also a need for strengthening the absorptive capacity of the public and private

sectors so that they can properly absorb, employ and improve the most appropriate technologies. In this respect, multilateral institutions can help, but not without complementary actions from the public and the private sectors in both developed and developing countries. This entails a fundamental change in the way technology is produced and disseminated, with the public sector providing the appropriate regulatory framework and creating the necessary business environment, and the private sector providing matching funding. As pointed out by the UNFCCC expert group on technology transfer, technology for adaptation to climate change is not a panacea, but it constitutes a pillar of a broader framework of integrated solutions.[18]

NOTES

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