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Perspective

Evaluating migration as successful adaptation to climate change: Trade-offs in well-being, equity, and sustainability

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SUMMARY

The role of migration as one potential adaptation to climate change is increasingly recognized, but little is known about whether migration constitutes successful adaptation, under what conditions, and for whom. Based on a review of emerging migration science, we propose that migration is a successful adaptation to climate change if it increases well-being, reduces inequality, and promotes sustainability. Well-being, equity, and sustainability represent entry points for identifying trade-offs within and across different social and temporal scales that could potentially undermine the success of migration as adaptation. We show that assessment of success at various scales requires the incorporation of consequences such as loss of population in migration source areas, climate risk in migration destination, and material and non-material flows and economic synergies between source and destination. These dynamics and evaluation criteria can help make migration visible and tractable to policy as an effective adaptation option.

INTRODUCTION

A key emerging insight into the challenge of adapting to climate change impacts is that many interventions fail to produce positive outcomes, either in terms of being ineffective at reducing risk or creating unforeseen consequences for others.[1] This is a worrying development in the search for climate-resilient pathways and for the emerging practice of adaptation to climate change. Most often, those facing the consequences of current or future risks are, in effect, on their own, needing to make the most of their circumstances. There are, therefore, risks of both ineffective interventions and risks of ineffective individual strategies for dealing with long-term climate changes. Increasingly, climate risks may be part of other long-term shifts in population and in short-term displacement. Migration is therefore increasingly recognized as a potentially effective means of shifting, avoiding, and spreading risks from climate change impacts.[2–4]

Much research has already established success criteria for adaptation. Holistic conceptualizations recognize the need for increasing whole-system resilience and reducing the risks of and vulnerability to climate change impacts without compromising sustainability.[5,6] Most existing appraisals of adaptation success focus on planned adaptation interventions, such as projects, programs, or policies, that seek to enhance adaptive capacity or reduce risk.[1,7] In-depth reviews of experience, by the IPCC and others, show that very often, adaptation action or interventions reproduce or redistribute pre-existing vulnerability, or create new vulnerability, especially for already marginalized groups[1,8] Less work has been done on evaluating the success of autonomous adaptation strategies that are deployed by households and individuals in response to climate change impacts. This calls for a system-wide assessment of migration as adaptation.

Migration here means moving place of residence—it encompasses what are judged to be voluntary moves by individuals and households, either temporarily (e.g., seasonal or circular migration) or long term, as well as involuntary and often temporary displacement as a result of unforeseen circumstances including extreme weather events.[9] It includes movement within the same country, as well as to neighboring countries or other international destinations. Importantly, migration in the context of climate change takes place on a voluntary-forced continuum, encompassing categories that are fluid and non-exclusive.[10] The explicit recognition of migration as a legitimate and potentially effective response to climate change has been consolidated in the past decade. Black et al.,[2] for example, argue that migration is part of the landscape of risk but needs to be evaluated as part of common movement motivated by economic and other opportunities.

Table 1. Evaluation criteria for migration as successful adaptation as entry points for identifying trade-offs and metrics of success

Dimensions of success	Trade-offs	Metrics of success
Well-being	between different well-being dimensions (objective, subjective, relational), of different individuals (men/women/children), of households and individuals (migrant/household)	● housing and living conditions for migrants in destination ● healthcare and social protection coverage in destination ● change in income ● school attendance ● proportion of remittances invested in productive assets (e.g., land, agricultural inputs) versus consumption ● food security and nutrition ● social capital
Equity	between different individuals in terms of distribution of risks and hazards and recognition in policies and programs	● political representation of migrants in destination and participation in policy processes ● women's participation in community decision-making forums ● access to early warning and meteorological information ● access to housing, services, and infrastructure in destination ● reduced mortality and morbidity associated with disaster risk
Sustainability	between social and ecological systems and between different social units (individual/household), including at different spatial scales (origin/destination).	● access to knowledge and training ● access to agricultural extension advice ● integration of traditional and scientific knowledge for resource management ● access to social protection

Metrics of success should be based on disaggregated data to capture intersectional differences, including across different timescales.

For example, population movements through migration have the potential to reduce overall inequality through promoting sustainable economic development.[11] Such recognition of migration as an adaptation strategy, however, inevitably places the responsibility on individuals themselves for predicting and responding to future risks and could encourage policy inaction.[12] Intensifying calls for recognizing loss and damage from the adverse impacts of climate change also bear relevance for evaluations of migration as successful adaptation, as migration in the context of climate change is increasingly recognized as both a source and symptom of loss and damage.[13–15]

Here, we assess under what circumstances migration constitutes a successful adaptation to climate change by examining the entire social phenomenon and system of migration. As with all adaptation actions, their effectiveness depends on outcomes that make them sustainable for all,[1,7] thus avoiding maladaptive responses.[16] Sustainable adaptation in the context of migration, therefore, would require simultaneous promotion of social equity and environmental integrity.[17] We examine the inter-temporal and social implications of migration through a representative selection of three scenarios spanning different social and temporal aspects of the migration system: intra-household dynamics in places of origin, experiences in places of destination, and links between destination and origin vis-à-vis remittances. We identify three evaluation criteria—well-being, equity, and sustainability—that can in turn help identify trade-offs that could potentially undermine the success of migration as adaptation (Table 1). We show that for migration to be successful adaptation, well-being, equity, and sustainability outcomes need to be positive for individuals moving, for communities and places that are hosting them, and for origin regions, including across different temporal scales.

INTRA-HOUSEHOLD DYNAMICS IN MIGRATION SOURCE

Migration from rural agrarian economies in search of opportunities elsewhere, increasingly driven by climate change impacts on livelihoods, shapes the demographic composition of rural societies. On the one hand, migration can bolster rural economies vis-à-vis remittances; on the other hand, it represents a loss of human resources for rural areas.[18] How the benefits and costs of migration are distributed in places of origin, and thus how successful migration as an adaptation is and for whom, needs to be understood with reference to inter-sectional differences.[19] The conditions under which men and women use migration as an adaptation to environmental risk are socially differentiated and contextually contingent. Socially constructed identities shape the gendered nature of migration, mediate the distribution of productive and reproductive roles, and govern control over resources and assets within communities as well as within households.[20] The social implications of migration in places of origin are not homogeneous, and factors such as household structure (nuclear or extended), migration type (short or long term), position in the family life cycle, and social class or caste shape individuals' roles and intra-household bargaining.[21–24] And households are not static units; they are constantly evolving, being shaped by the mobility of different members, which requires the constant negotiation and renegotiation of roles and intra-household power dynamics.[25,26] For example, younger women in extended households usually enjoy less decision-making power following their husband's migration compared with women in nuclear households. This is because male, as well as older female, members of the extended family assume the decision-making role, including regarding the use of remittances sent by the migrant husband.[21,24,27] Migration can thus result in the unequal distribution of well-being between different social and temporal scales, with important ramifications for the

Box 1. Gendered agricultural practices in migration origin: Trade-offs in equity and sustainability

Labor migration as a form of livelihood diversification is mostly practiced by rural men in Bangladesh. While such voluntary migration has overall positive economic outcomes in places of origin, enhancing the status of left-behind women and affording them improved access to healthcare,[38] it also increases women's domestic and agricultural work burden. This so-called feminization of agricultural labor, however, rarely leads to real changes in women's autonomy and control over resources, as their absent husbands or other male household members often continue to control their actions.[39,40] Women's unequal access to male-dominated networks, value chains, knowledge, and resources, in turn, results in less successful and potentially unsustainable agricultural adaptation to climate risks.[34] In Kenya, the uneven distribution of tasks leads to reduced incentives to engage in conservation measures, as left-behind women have less time to invest in labor-intensive soil and water conservation practices.[41] In western Kenya, the constrained agency of women leaves them ill equipped to effectively manage their farms, with negative environmental consequences. Women continue to plant maize on degraded land to maintain tenure and avoid stigma, but this undermines soil fertility and food security. Rural family members are increasingly resorting to buying rather than producing their food and laboring on other people's land instead of cultivating their own.[42] Migration may in some circumstnances, therefore, reinforce, rather than reduce, vulnerability to climate and environmental change. Promoting gender equity in migration source areas, in terms of distribution of power and recognition of intersectional needs in policies and programs, is key to the success of migration as adaptation.

sustainability of adaptation. Households' material well-being may improve thanks to remittances, but the physical and subjective well-being of rural women decreases due to their growing work burden, constrained decision-making, and limited access to resources.[22,24,28] In men's absence, women experience increased stress, anxiety, and loneliness.[28] The children of migrants might benefit from improved material well-being and access to education but lose out on the emotional bond with their parents, as well as on the transfer of knowledge and skills from one generation to the other.[28,29]

Women's unequal standing in many rural societies has a bearing on their capacity to implement positive adaptation and to leverage the benefits of migration (Box 1). Despite becoming *de facto* household heads in men's absence after migration,[27,30–32] women's agency is strongly mediated by structural mechanisms and institutional norms. Commonly in agrocultural comunities with patrilineal land ownership, women's decision-making is limited to the household: strategic decisions about investing remittances and selling or buying land or other assets that are central to adaptation and risk management often continue to be made by men even in absentia.[23,33] Even when women gain some bargaining leverage at the household level, they frequently remain excluded from decisions about the use and management of communal resources.[24,30] For example, in northern Pakistan, water scarcity has led to increasing competition for water including from external users, and while women are responsible for irrigation tasks in men's absence, their decision-making and conflict resolution capacity in water governance disputes is limited.[30] Women's adaptive capacity is further constrained by the inequitable design and delivery of state and non-state programs and interventions. They remain regularly overlooked when it comes to extension advice, early warning, and skill training because these either explicitly target men (e.g., in places where women are not recognized as farmers) or implicitly reinforce existing structural barriers by failing to consider women and their cultural needs (e.g., women's need to observe their *purdah* and protect their reputation) or by failing to take into account unequal relations of power between men and women.[34–37]

Women's marginalized position results in a range of coping strategies, some of which contribute to improved well-being, but others may prove unsustainable in the long term. Positive coping examples demonstrate women's resourcefulness and include risk and work sharing; forming self-help groups, food banks, and women's associations; and sharing access to goods or resources to alleviate the vulnerability of poorer women who would otherwise have limited options to cope.[30,37,42–45] Women also leverage their home-based skills such as crafts and food production to generate income and build savings.[44] But, while acting as a source of short-term relief, some coping strategies might lead to trade-offs and potentially constitute maladaptation on longer time horizons. For example, women in rural Bangladesh who took up commuting for paid work when their migrant husbands failed to support them experienced relational vulnerability manifest in fractured social capital for being branded non-compliant with dominant religious and social norms.[12] Similarly, to compensate for labor shortage or to assist with reproductive tasks, it is not uncommon for children in migrant-sending families to drop out of school, jeopardizing the well-being and adaptive capacity of future generations.[24,27,44] Due to the complex links between social and ecological systems, some coping strategies may turn out adaptive for one part of the system but maladaptive for the other. For instance, in rural Pakistan, climate change, ongoing agrarian change, and male outmigration have, in combination, led to a reduction in livestock numbers and planting of trees on earlier grazing lands. This, in turn, resulted in the disappearance of *patti* (traditional wool) weaving, customarily practiced by women. Women used to sell *patti* in the nearby market, gaining economic independence, and thus losing *patti* could undermine the long-term social and material well-being of women and, with that, their future adaptive capacity.[30]

MIGRATION OUTCOMES IN PLACES OF DESTINATION

The success of migration as adaptation is intimately linked to the outcomes for migrants at destination, whether they move within the same country or internationally. Climate and environmental hazards and structural conditions reinforce or even exacerbate the social vulnerability of migrants in destinations. Migrants often replace one type of precarity at origin for another at their destination,[46] thus creating precarity chains for themselves and their families that serve to sustain rather than eliminate sources of vulnerability.[19,47] Migrants are disproportionately exposed to

Box 2. The experience of low-income rural-urban migrants in Chattogram, Bangladesh: Trade-offs in well-being and equity

Chattogram is the second largest city in Bangladesh, a rapidly industrializing hub, and a popular destination for domestic labor migrants moving from climate-affected rural and coastal areas. Focusing on exposure to environmental hazards as a source of insecurity,[52] a driver of subjective well-being,[53] and a source of urban precarity among migrant populations,[54] existing studies provide an insight into a range of outcomes that have implications for the success of migration as adaptation. Rural-urban migrants are confronted with exclusionary, incomplete, and insufficient urban infrastructures that mediate almost all aspects of their everyday lives in cities.[54] They occupy informal settlements on marginal land and are exposed to environmental hazards, which, combined with socio-economic factors, shape their perceived experience of human security.[52] These conditions are the result of entrenched power inequalities that permeate urban systems of planning and governance, including adaptation planning and disaster risk reduction, and reinforce migrants' disproportionate exposure to climate and environmental risks and hazards at their urban destination.[54] Understanding what shapes the well-being of migrants, including subjective well-being outcomes,[53] and ensuring recognition in urban planning as well as national ambitions on climate action is key to supporting migration as successful adaptation.[54] Positive initiatives at the national level are emerging, such as the development and adoption of the National Strategy on the Management of Disaster and Climate Induced Internal Displacement (NSMDCIID), which also contains provisions for climate-related mobility to urban areas.[55] Participatory urban planning and deliberative approaches can support the implementation of national policy ambitions in urban centers and can promote the inclusion of diverse perspectives on building safe, sustainable, and resilient cities for people to live in.[54]

risks and hazards and usually have limited adaptive capacity.[48–51] They find themselves living on the periphery of urban societies (Box 2) or face legal precarity at international destinations, leaving them particularly vulnerable to exploitation. They get by on insecure and irregular incomes, which has a knock-on effect on their ability to remit to their families. Migrants deploy various strategies to cope with insecurity and precarity in order to continue sending remittances, some of which may turn out to be unsustainable and even maladaptive in the long term, thus undermining the adaptive capacity of both migrants and their families.

Migrants compensate for the absence of social networks in their destination by offering support to each other, including providing emotional support and free tuition to migrant children who are excluded from formal education systems.[56–58] Women exploit their gender-specific roles and skills to create their own livelihoods and have been shown to succeed at building bridging social capital with their wealthy employers, granting them access to in-kind support and borrowing.[12,59] To absorb income losses, migrants also employ a range of erosive coping strategies such as restricting or reducing food intake, moving to poorer-quality accommodations to save money, deferring mortgage payments, taking loans, selling some assets, using up savings, and even declaring bankruptcy.[19,60–62] These may offer short-term relief but can be detrimental for the future well-being and adaptive capacity of migrants.

Social and environmental risks and hazards in destination negatively impact the physical and mental health of migrants. Poor physical and mental health outcomes, in turn, have important implications for the adaptive capacity of both migrants and their families.[15,46,49,54,63] There has been an observed rise in infectious diseases (e.g., HIV, malaria, dengue fever) and non-communicable diseases (e.g., diabetes) in migrant populations due to a change in lifestyle, exposure to environmental hazards, and social practices.[50,64,65] Migrants working in dirty, dangerous, difficult jobs are also at increased risk of occupational hazards and accidents. In addition to physical health problems, migrants often suffer from stress and anxiety as a result of their precarious existence and the weight of obligation toward their left behind families.[66,67] Despite poor health outcomes, migrants have limited access to healthcare due to a mixture of structural and psychosocial barriers.[46,65] Left-behind family members play a key role in supporting migrants' well-being by providing informal and emotional support.[14,58,67,68] Women leave children in the care of relatives, and migrants receive monetary and in-kind support from family during crises or gain access to loans through family members in origin.[69–72] As much as support from left-behind family can be a source of relief, it can also be a source of distress and anxiety when migrants are unable to fulfill their obligation to remit.[14,58,66–68]

Experiences of migration at destination are, however, not homogenous but are shaped by intersecting socially constructed identities such as gender, class, caste, race, and age, which mediate differentiated access to opportunities and support. Gendered notions surrounding the use of space—men's economic participation in public spaces versus women's confinement to reproductive roles in the private sphere—lead to the inequitable distribution of opportunities and benefits attainable through migration.[12,73] For example, research with migrant women in Bangladesh showed that following their move, they struggled to access psychological support and information about healthcare or job opportunities, faced stigma and social penalties for breaching social and religious norms, and even became trapped at their destination as a result.[12,14,74] Age, marital status, caring obligations, and whether women moved alone or with a male family member were additional factors that intersected with gender in shaping migrant women's experiences at their destination. Interrogating migration as successful adaptation through an intersectional climate justice lens[75] reveals that structures of subordination and power asymmetries are simply replicated when people move, or indeed new forms of oppression and subjugation are experienced by migrants as a result of intersectional marginalization. They give rise to inequity in the realm of migration outcomes and have implications for the success of adaptation within the wider system of migration.

Successful adaptation through migration may be further hampered by the general invisibility and lack of recognition of migrants in policies pertaining to the governance of labor migration, social protection, urban planning, and climate change

adaptation that not only replicate existing patterns of inequality and vulnerability but also create new forms of precarity in destination. Much adaptation planning fails to consider the specific needs of migrants.[50,54,57] The COVID-19 pandemic exposed the lack of consideration of migrants in many governmental support initiatives.[62,76,77] Other policies consciously exclude migrants in order to make migration an unattractive prospect, such as the household registration systems in cities of Vietnam, China, India, or Bangladesh.[71,72,78,79] The design of many formal employment schemes (e.g., temporary agricultural workers, domestic workers) creates conditions for coercive and abusive working arrangements. For example, migrants' visas are often tied to a specific employer, and in the Middle East, the *kafala* (sponsorship) system limits migrants' ability to change employers.[47,56,57,80] As migrants often lack citizenship rights, political representation, and linguistic skills as well as face discrimination based on ethnic or religious affiliation at their destination,[50,54,78] their agency to challenge wrongdoing or raise grievances is diminished. Instead, migrants adopt a culture of endurance and avoidance, which, over time, can erode their physical and mental health and well-being.[56]

COMPLEX LINKS BETWEEN SOURCE AND DESTINATION

Flows of remittances between migrants and their places of origin are diverse and consist of financial, social, and in-kind transfers. While remittances have the potential to promote development and adaptation to climate change for rural migrant-sending households and communities,[81,82] it is important to interpret their role in supporting adaptation vis-à-vis migrants' condition at their destination, the socio-economic circumstances of households prior to migration, and the availability of information and technology for adaptation.[83] Financial remittances sent by migrants who are themselves vulnerable are often irregular and unreliable.[66,84] Migrants go to great lengths to sustain the flow of remittances, but when these strategies fail, they may have to return home with little or no resources or become trapped at their destination.[15] Beyond the loss of remittances, the families of failed migrants also face social backlash and may lose vital social capital, while migrants suffer from poor mental health.[85,86] The return of migrants during COVID-19 highlighted the vulnerable situation of both migrants and their families, who had little savings to draw on and resorted to maladaptive practices, including reducing food intake or selling assets such as grains or vegetables that were intended for their own consumption.[86–88] These strategies have repercussions for food security, and the loss of food reserves will likely undermine future adaptive capacity. The potential of social remittances (i.e., ideas, skills, knowledge) to improve adaptive capacity is contingent on the skills and knowledge gained elsewhere being compatible with and transferable to the origin context and the households' access to other assets, as well as the life stage of returning migrants and their motivation to engage in innovation. In order to capitalize on social remittances, households also need financial assets; thus, social and economic remittances often go hand in hand.[26]

The positive or negative impacts of remittances for adaptation might not be immediately apparent because they unfold over time, and long-term implications across interlinked social and temporal scales may be masked by short-term outcomes. In addition to meeting basic needs, remittances sent to rural areas are, for the most part, invested in human and physical capital, in effect, the education of children and productive resources such as land, equipment, or agricultural inputs. Better-educated youth should have access to jobs that are less susceptible to climate change impacts and may transition to improved social status.[19,26] Using remittances to enable girls' education can facilitate improved empowerment for future generations of women, affording them a stronger standing in intra-household and community-level bargaining, thus improving their adaptive capacity.[31,89] However, when the educated youth and women migrate, it can have adverse impact on agricultural production and family-based care systems for elders.[90,91]

Under some circumstances, remittances can also reproduce vulnerability or only alleviate hardships in the short term.[51,92,93] In drought-prone parts of India, migrant remittances are invested in borewells, which lead to a departure from collective resource use and management.[51] Over time, the individualization of resources will not only negatively impact the local ecology (i.e., if village ponds are not maintained), but moving from collectivist risk sharing to individualistic lifestyles will likely have negative repercussions for social resilience. Studies in Nepal have documented how poorer families without access to credit have invested remittances into livestock. But increased livestock comes at the expense of children's education, as they are pulled out of school to tend to the animals. While purchasing livestock may seem like a positive adaptation strategy that insures households against future shocks, it can have negative implications for the adaptive capacity of future generations.[93]

Remittances can also be subject to temporary or permanent disruption due to shocks and crises with potential implications for the adaptive capacity of recipient households and families. For example, in the context of intensifying climate change impacts, remittance flows may be disrupted between closely linked rural and urban economies.[94] Remittance flows appear to be largely resilient to crises and, indeed, often operate in a counter-cyclical fashion: remittances tend to grow during economic downturns or following disasters, when private capital flows are reduced[95,96] (see Table 2). This is down to a number of factors. Geographically dispersed destinations and diverse economic sectors of employment mean that not all migrants are affected by crises. Remittances are sent by the migrant stock, not only recent migrants, who absorb income shocks through coping strategies. Return migration does not take place to a large extent, and those who return bring their savings with them, which also count toward remittances. Fiscal policies incentivize the sending of remittances, including via formal channels, which are easier to track. Finally, due to the exchange rate impact and devaluation of local currencies, investment-oriented remittances may increase.[60,72,86,95,97–99] It is important to keep in mind, however, that data are only systematically collected on international remittances, which are easier to monitor, and we know less about how internal remittances behave in response to shocks. These data are also reported at an aggregate level and thus hide the differentiated experiences of households. Not all households benefit from rising remittances during

Table 2. Examples of how remittances respond to shocks and crises and possible implications for climate change adaptation

Remittance trends	Adaptation implication	Examples
Remittances increase following shocks and disasters	support post-disaster recovery and pre-disaster preparedness	following climate-related disasters, remittances to rural parts of Bangladesh tend to increase; migrants remit around 50% more per month, which is a significant increase relative to their incomes[104]
Remittances slow down but do not stop	remittances continue to origin; migrants absorb income losses through coping strategies at a cost to their own well-being	following the global economic crisis in 2008, remittances sent by migrants from Spain to Ecuador slowed down but did not stop; migrants used different strategies to keep sending remittances: taking on extra work or working longer hours, looking for work in other cities or rural parts of Spain[70]
Involuntary return to origin with little to no savings	migrants are not able to adapt to the shock; involuntary return; remittances are interrupted or completely stop	following economic crises in Argentina and Spain, many Bolivian migrants experienced a sharp fall in incomes and a reduction in working hours; some returned to Bolivia, resulting in a loss of remittances; returnees often had very little savings and thus exacerbated hardships for their families[105]
Voluntary return to origin with savings	voluntary return to origin to support recovery; women are more likely to return; savings are invested into recovery and rebuilding	following the 2004 tsunami, many international migrants returned home to Sri Lanka, bringing their savings and helping family members to rebuild or move to safer locations; their households were relying on this money because they did not have sufficient resources to recover from the disaster[100]
Reverse remittances	families support migrants to help them cope in destination where they are often not covered by social protection	when the livelihoods of rural migrants in Nicaragua are affected by rainfall deficit in the destination, they receive so-called reverse remittances from their families; reverse remittances help migrants cope with rainfall variability and can resume remitting to their families once their livelihoods have recovered[101]
Increase in the flow of information	migrants and diaspora remit information to help households cope with and prepare for crises	following floods in rural Punjab in Pakistan, there was an increase in the flow of information from migrants, especially about weather forecasts and about when dams will be released; households who had a link with the city had better access to this type of information[106]
New patterns of remitting	new remitters who did not remit before; existing remitters sending to extended family who they did not send to before; new patterns can be short term while the crisis lasts	following the 2009 cyclone in Samoa, some migrants started to remit to family members who they did not send money to prior to the disaster; new remitters also emerged, who did not remit at all before; some of these new remittance patterns were only temporary in the aftermath of the cyclone[61]
Collective remittances	money, goods and resources sent by diaspora organizations and targeted at entire communities	following the Ebola outbreak in Sierra Leone, diaspora members and organizations in the UK mobilized to support their families and communities; they raised funds in the UK and sent material help such as protective equipment and chlorine to under-equipped hospitals, strengthening their capacity to respond to the epidemic[107]

crises, and in fact, remittance patterns might reproduce pre-disaster vulnerabilities.[87,100–103]

EVALUATING MIGRATION AS SUCCESSFUL ADAPTATION

Migration has been recognized and conceptualized as a potential adaptation strategy in response to changing climate and environmental conditions following the influential Foresight report on the topic in 2011[3,4,108] and an in-depth assessment of evidence by the IPCC.[8,109] The evidence base has variously shown that migration is highly differentiated in cause and consequence. Outcomes are wide, on a continuum ranging from maladaptation through coping mechanisms to sustainable adaptation responses.[110] While research on migration as adaptation tends to center on who migrates and why, in order to make a comprehensive assessment of success, there are three further areas, we suggest, that need to be incorporated. Based on insights from a review of evidence, we identify three criteria for evaluating the success of migration as adaptation: well-being, equity, and sustainability. They constitute more than normative outcomes and act as entry points for identifying trade-offs within and across different social and temporal scales that could potentially undermine the success of migration as adaptation (Figure 1).

Well-being is conceptualized as multidimensional, consisting of the objective outcomes and subjective and relational experiences of migrants, their families, and communities in origin and host societies. While success in the context of development and adaptation is often evaluated using objective indicators, which are easier to quantify and compare, they only provide a partial understanding of experiences and could overlook potential trade-offs that can hamper long-term success. A focus on measurable outcome indicators is increasingly challenged by calls for recognizing non-economic forms of loss and damage, including those that result from planned or autonomous adaptations, such as migration or relocation.[13,15] Emerging research on migrants' well-being indeed highlights the social and relational costs of migration and warns against linear accounts that equate migrants' access to better incomes with successful adaptation and improved

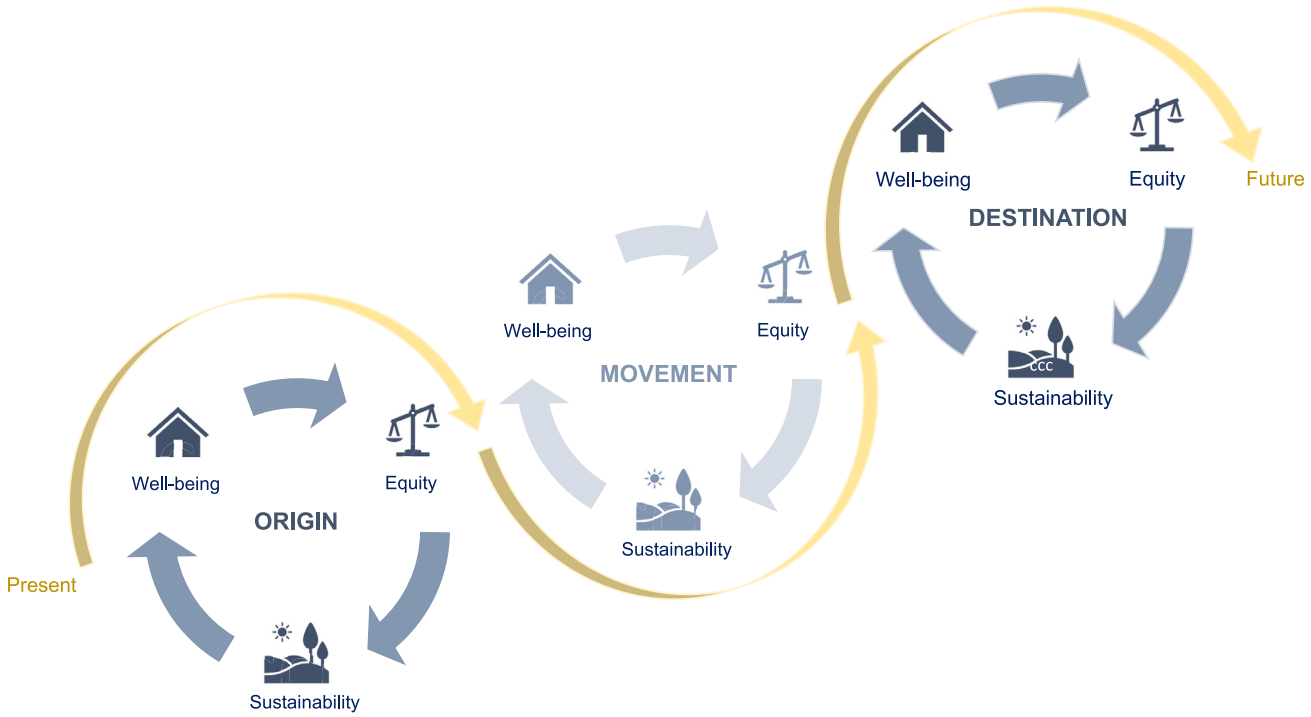

Figure 1. Evaluating migration as successful adaptation

The success of migration as adaptation evaluated through three criteria: well-being, equity, and sustainability. They can be used to identify trade-offs across different social scales (e.g., individual versus household), spatial scales (origin versus destination), and temporal scales (present versus future) that could potentially undermine the success of migration as adaptation.

resilience.[14,15,111] Mobility that takes place as an adaptive response in the context of changing climate and environmental conditions often results in trade-offs between different well-being dimensions, including at different social scales (i.e., within and between individuals, as well as between individuals, households, and communities). Moving, whether voluntarily or by force, entails a fracturing of social ties with one's community and of one's physical bond with the environment. While impossible to quantify, such losses may lead to a loss of sense of place and identity, with repercussions for multiple dimensions of well-being among affected populations.[12,14,112,113] Perceptions of well-being in turn have important implications for people's future agency to respond to climate-related risks and hazards at both migration sources and destinations.[15,112] Yet, adaptation planning and policy often overlook vulnerable groups in migration source and destination, thus undermining their well-being, perpetuating vulnerability, and leading to the uneven distribution of costs and benefits that can hamper the overall success of migration as adaptation.

Migration as adaptation to climate change is inherently spatial, with implications across different social and temporal scales, such as different individuals, communities, and present and future generations.[114] Autonomous responses to risks and hazards, such as migration as well as *in situ* adaptation vis-à-vis resource use and management, thus have implications for equity and justice. While migration has the potential to augment the welfare of rural households, it can also entrench structural causes of vulnerability and marginality and thus undermine, rather than promote, successful adaptation. Often, migration as adaptation leads to the social and spatial redistribution of risks, especially when autonomous adaptation efforts are not met with adequate policy support.[50,54] Policies that fail to recognize the needs and circumstances of migrants and their rural families result in the unequal distribution of risks and hazards coupled with low adaptive capacity. As demonstrated by reviewed evidence, migrants often replace one set of hazards with another at their destination when exclusionary policies render them to occupy marginal land prone to environmental hazards and to work in unregulated and precarious industries that offer little in the way of safety and security.[52,54] At the same time, rural family members, especially women and youth, face constraints in leveraging remittances for adaptation due to their unequal standing within the household and the wider community. In light of the distributional, procedural, and recognition aspects of migration as adaptation, it is therefore essential to evaluate its success through a climate justice lens that heeds to intersectional differences, the historic root causes of vulnerability, and the political economy of the multispatial and multitemporal system of migration.

Sustainability is already recognized in existing approaches for evaluating adaptation, which posit that adaptation is successful when it contributes to sustainable social and economic development while at the same time achieving social justice and preserving environmental integrity.[115] The concept of sustainability thus highlights the interlinkages between social and ecological systems within which migration as adaptation takes place. As well as being a symptom of changing climate and environmental conditions, migration also shapes environmental sustainability. But if migration as adaptation succeeds in enhancing net

Table 3. Examples of gendered well-being, equity, and sustainability trade-offs in time and space as a result of migration as adaptation

Trade-off	Scale		Well-being	Equity	Sustainability
	Social	Temporal			
Overall household material well-being increases but women's physical and subjective well-being decreases at origin due to increased work burden	social: household versus individual				–
Women's unequal position (low/no access to early warning and weather forecast and training) at origin leaves them vulnerable to climate change impacts	social: intra-household				–
Women's unequal position (constrained decision-making, access to information, knowledge, resources, and extension advice) at origin has negative implications for resource use and management and leads to maladaptation	social: intra-household;	temporal	–		
Women's choices about production can improve women's well-being (by mitigating work burden) but undermine long-term household food security	social: household versus individual;	temporal		–	
Women's coping strategies in origin during men's absence can result in gains for ecosystem integrity but losses in women's material and social well-being		temporal		–	

well-being, reducing overall inequality without placing added burden on the environment, it has the potential for transformative and sustainable adaptation.[11] Evidence on migration as adaptation attests to the intricate links between social and ecological systems, which often unfold over extended temporal scales or may implicate different socio-spatial units (e.g., families in migration origin and migrants in destination). It points to trade-offs that arise within and between social and ecological systems across time and space, potentially undermining successful adaptation and risking maladaptation.[16,115] Thus, evaluations of migration as successful and sustainable adaptation should entail a cross-scale and comprehensive assessment of the entire system of migration.

HOW TO MAKE MIGRATION AN INTEGRAL ADAPTATION STRATEGY

The discussion here has shown that for migration to be a successful adaptation, it needs to enhance well-being, be equitable in its outcomes, and contribute to wider sustainable development goals. It needs to be successful for migrants themselves and for wider society. Evaluations of success need to consider how such migration is disrupted by compounding climate risks.[116,117] This seems self-evident but is challenging to reach.

As all decisions, decisions about adaptation—such as to migrate or to adopt certain resource management practices—involve value judgements. As such, they are made with reference to the wider socio-political context, which mediates what is desired and what is feasible, inevitably leading to trade-offs. Thus, the impact of migration for adaptation is not homogeneous, and migration is not a successful adaptation for all social actors within the migration system due to asymmetries of power and other structural and institutional factors that reinforce and reproduce vulnerabilities. Documented experiences of households and individuals, including of different individuals within households, demonstrate major trade-offs between current and future goals. These include trade-offs between the well-being and adaptive capacity of different individuals, including at different temporal scales, for example for future generations, as well as within material and subjective dimensions of well-being. They also involve trade-offs between the well-being and resilience of individuals themselves (Table 3).

Equity, well-being, and sustainability trade-offs within the system of migration as adaptation in turn have implications for distributional, recognition, and procedural elements of climate justice.[118] In terms of distributional dimensions, left-behind populations in source areas and individual migrants in destination may well be disproportionately exposed to climate change impacts and other hazards, yet their adaptive capacity is constrained by prevailing structures and institutions. Lack of access to secure housing, income, and services, for example, massively constrains well-being and opportunities for many low-income migrants in growing cities. In terms of identity and recognition dimension, the vulnerability of both migrants and left-behind populations is reinforced by systemic forms of exclusion. In the case of left-behind women, such mechanisms include limited access to agricultural extension, capacity building, early warning, and other programs and interventions. Such trade-offs can lead to loss and damage that reinforce root causes of vulnerability, thus potentially undermining the success of migration as adaptation.[15,119]

If future migration is to be implemented as successful adaptation that simultaneously fulfils the criteria of equity, well-being, and sustainability, then the evidence here suggests that it needs to account for distributional, procedural, and recognitional elements of climate justice.[50,111] The policy implications and gaps are in knowing where and when migration may occur, in making destinations safe, and in facilitating international movement. First, there is not a systematic understanding of how and where people move in the face of climate risks. Such understanding can be tackled through observed data well between decadal census periods, such as by monitoring where populations are growing or diminishing as revealed by night lights and other economic indicators,[120] and by volunteered data on short-term movements.[121] An evidence base of best practices for integrating enhanced

migration flows in destination cities and potential areas of depopulation could be used to inform migration policy, strategies for supporting settlement for migrants, and receiving communities.

The second area is ensuring that the urban destination of most migrants exposed to climate risks are themselves safe and secure spaces. As we show, climate risks are simply of a different nature and character in urban destinations for many migration flows. The situation in cities in Bangladesh (as highlighted in Box 2) shows that migrant populations are largely invisible in processes of urban planning, but there are many practical steps for action on the infrastructure of the neighborhoods where migrants live, where they work, and how the city works for them. Linked to this is the need to document loss and damage that result from migration as adaptation, especially non-economic forms of loss and damage, to demonstrate the limits of migration as an autonomous form of adaptation and the need for complimentary policy support and action.[10,122]

The third and potentially most contentious area is seeking coordination and cooperation between states on cross-border migration. This is acute for smaller states where a larger proportion of migration is international in nature. The Global Compact on Migration, an international agreement to promote regular and safe migration, recognizes climate change as an adverse driver of migration—in other words, it skews existing migration flows, makes it less safe and secure, and creates new vulnerabilities. But the compact has yet to propose specific plans to deal with cross-border migration from climate change, even while recognizing it is a problem.[123] One arena for government action is coordination between countries with their neighbors and places with long-established migration flows. These are the most likely routes to safety through international movement when climate change makes the desirability for movement all the greater. This means that the destinations of people moving across borders in the context of climate change are likely to be neighboring countries, and evidence from countries in the Pacific shows this to be true. Both source and destination countries can, however, benefit from predicting future flows with certainty. These types of arrangements reduce irregular migration and trafficking and the ability to match skill needs in both countries. These types of coordination are becoming the norm, for example in Pacific countries with regional agreements on visas and return migration.[124]

We argue here for a comprehensive and systematic evaluation of migration as an effective adaptation, recognizing the well-being, equity, and sustainability dimensions of such action. Systematic understanding of migration as response to climate risks brings with it a further benefit—it brings knowledge and reality to bear on one of the most contentious of adaptation options. The prospect of large-scale migration is frequently referred to as an entirely negative prospect and a consequence of climate change impacts, often to encourage climate action. But this portrayal does not consider agency and the realities of migration as an effective and potentially sustainable and equitable adaptation to imposed climate harms.

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DECLARATION OF INTERESTS

The authors declare no competing interests.

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