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Seeing Water Through the Trees: Maasai Activists in Kenya Among Indigenous Leaders Worldwide Calling for Upstream Forest Conservation as Nature-Based Solution for Downstream Water Security Amidst Climate Crisis

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Abstract: Maasai Indigenous activists' call to save the Mau Forest Complex, the largest, but most heavily deforested water tower in Kenya, for its role in protecting downstream water security has emerged as a global environmental-policy microcosm. Both western-emanating Scientific Ecological Knowledge (SEK) and Indigenous and Traditional Ecological Knowledge (ITEK) affirm that upstream forests provide landscape-scale natural infrastructure that protects downstream water quality and flow regulation. However, global water policy hegemony has traditionally been focused primarily—and, at times, solely—on SEK-based built grey infrastructure investments, such as dams and water treatment plants. Amidst climate crisis, the global water policy stage has experienced a recent surge of interest in Nature-Based Solutions (NBS), including forest-based water protection, that are rooted in long-standing ITEK and harness the power of intact natural ecosystems as a form of natural infrastructure to achieve societal goals. Indigenous Peoples, including the Maasai, are disproportionately marginalized by water insecurity and frequently related land-rights struggles. However, many Indigenous leaders globally have emerged as change agents, calling for a water policy paradigm shift that prioritizes implementation of such NBS for water. Through a detailed exploration Maasai Indigenous leaders' efforts to protect the Mau Forest in Kenya, as well as an analysis of United Nations Development Programme Equator Initiative case studies spanning multiple continents, this paper explores how Indigenous leaders are increasingly advocating—both in their own communities and more globally—for the protection of upstream forests to support downstream water security. Further, this paper explores the surging visibility of such NBS for water—and climate—at global sustainable development policy events, including September 2019's United Nations General Assembly and Climate Change Summit in New York; December 2019's UN Climate Change Conference (COP 25) in Madrid; and January 2020's World Economic Forum Annual Meeting in Davos, Switzerland. From a sustainability education perspective, this paper proposes that, partially in response to climate-related realities, a new global water policy paradigm appears poised to take a more pluralistic approach that includes increasing implementation of ITEK-informed NBS for water into a policy landscape that has been historically dominated by western-emanating SEK-based grey infrastructure preferences. The potential of this paradigm shift is illustrated by the North American Indigenous Mi'kmaq concept of Two-Eyed Seeing, which encourages the synthesis of solutions from both SEK and ITEK on a path toward positive social-ecological outcomes.

Keywords: Water security; Kenya; Maasai; Indigenous Peoples (IPs); Indigenous Peoples and Local Communities (IPLCs); Nature-Based Solution (NBS); Africa; forest conservation; climate change; Indigenous and Traditional Ecological Knowledge (ITEK); Scientific Ecological Knowledge (SEK); United Nations; water tower; green infrastructure; natural infrastructure; source water protection; Human Right to Water; Greta Thunberg

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"Upstream forests are important to be protected because . . .
they are a source of water for those living downstream,
so they need to be conserved."
—George Risa Kosen, Maasai Indigenous Water & Forest Activist, 2019

In drought-prone East Africa, Maasai and other Indigenous environmental activists are demanding the restoration and preservation of the Mau Forest water tower, Kenya's largest upstream forest, now reported to be 75% deforested (United Nations Environment Programme [UNEP], 2016). The movement aims to regain the upstream forest's ability to serve as natural infrastructure to protect source water for downstream dryland communities and wildlife. The effort has emerged as a microcosm of an emerging global environmental policy paradigm, which, amid climate crisis, is increasingly focused on implementing Nature-Based Solutions (NBS).

Worldwide, a growing chorus of Indigenous Peoples and Local Communities (IPLCs) is calling for the conservation of upstream forests as a downstream water-security policy strategy (United Nations Development Programme [UNDP] 2012a; UNDP, 2012b; UNDP, 2012c; UNDP, 2016). This forest-based NBS is informed by long-held Indigenous and Traditional Ecological Knowledge (ITEK), which frequently recognizes upstream-downstream water dynamics at landscape scale. While NBS focus on harnessing the power of intact natural ecosystems as a form of natural infrastructure to achieve societal goals, global water-policy discourse, which is frequently driven by western-emanating Scientific Ecological Knowledge (SEK), continues to be dominated by technology-based built grey infrastructure, such as dams and water treatment plants. It is currently estimated that less than 1% of water infrastructure investments come in the form of NBS (as cited in United Nations World Water Assessment Programme [UN WWAP], 2018).

However, as climate change exacerbates risks to water security (United Nations [UN] & World Bank, 2018; UN WWAP, 2018; World Health Organization [WHO], 2013) and demand mounts for carbon sequestration co-benefits, NBS such as the conservation of upstream source water-protecting forests are increasingly mainstreamed into global policy dialogue (UN WWAP, 2018). NBS-focused policy played a considerably more visible role, for instance, during September 2019's United Nations (UN) General Assembly and Climate Change Summit in New York; December 2019's UN Climate Change Conference (COP 25) in Madrid; and January 2020's World Economic Forum (WEF) Annual Meeting in Davos, Switzerland. Further, a variety of IPLCs have been recognized by UNDP's Equator Prize for their successful implementation of such forest-based NBS for water security (UNDP, 2012a; UNDP, 2012b; UNDP, 2012c; UNDP, 2016). For instance, IPLCs in the vicinity of the Manambolo Valley of Madagascar, the Bosawás Biosphere Reserve in Nicaragua, the Chananaw Ullikong Protected Area in the Philippines, and the Annapurna Conservation Area of Nepal have collectively preserved tens of thousands of hectares of upstream water-protecting forests by sustainably managing forest protected areas and biological corridors, reintroducing Indigenous forest-management techniques, protecting against slash-and-burn deforestation, and leading tree replanting campaigns—all with an eye toward downstream water benefits (UNDP, 2012a; UNDP, 2012b; UNDP, 2012c; UNDP, 2016).

Tension often exists between the paradigms of ITEK, as implemented by the Maasai community and the Equator Prize recipients mentioned above, and SEK. While ITEK is based upon detailed ecological knowledge of local lands passed down through generations, embraces holistic landscape-scale approaches working in harmony with nature, and frequently supports NBS concepts; SEK is based upon a reductionist view of nature, and frequently supports western, technology-based grey infrastructure solutions driven by capitalism-based cost-benefit analyses. In this paper, I argue that the global water-policy stage, with hegemonic influences often emanating from the western Academy, SEK, and global nongovernmental organizations (NGOs), may be experiencing an inflection point. This proposed policy pivot is marked both by greater recognition of the scientific legitimacy of water-related ITEK as well as increasing mainstreaming of upstream forest preservation as an NBS policy option for longer-term water security downstream, an idea firmly rooted in ITEK (UN WWAP, 2018). While "NBS are not a panacea" (UN WWAP, 2018, p. 8), fueled by the urgency of climate change, policymakers seem poised to increasingly embrace pluralistic policy choices—combining both technology-based SEK and nature-based ITEK solutions. This increased inclusion of ITEK-informed NBS is supported by environmental economics-based cost-benefit analysis approaches, including Payment-for Ecosystem Services (PES) schemes, that seek to quantify the value of ecosystem services—such as the dollar value of water protection provided by upstream forests—in increasingly sophisticated ways.

This concept is illustrated by the North American Indigenous Mi'kmaq concept of Two-Eyed Seeing, which prioritizes the synthesis and harmonization of *both* Indigenous *and* western ecological paradigms—ITEK and SEK—to influence positive social-ecological change on both local and global scales (Marshall, et al., 2015; Peltier, 2018). By embracing such a Two-Eyed Seeing approach, forests, including the Mau Forest Water Tower in Kenya, may play a role *more significant than ever before* in a newly emerging water-security policy paradigm.

Maasai Indigenous Activists' Fight to Save Kenya's Mau Forest Water Tower

On a February 2019 day, thousands of activists packed the streets of Narok Town, Kenya, calling for the restoration and long-term conservation of the Mau Forest (G. Risa Kosen, personal communication, August 12, 2019). The Mau Forest is Kenya's largest water tower, a term frequently used in East Africa to describe higher-elevation forests that are central to regulating the regional water cycle. The now-heavily destructed Mau Forest Water Tower forms critical upstream natural (green) infrastructure (Bird Life International, 2013; G. Risa Kosen, personal communication, August 12, 2019; UNEP, 2016), historically providing water protection for downstream East African communities, including Maasai Indigenous pastoralists and wildlife (Dapash & Poole, 2019; G. Risa Kosen, personal communication, August 12, 2019).

Figure 1 (left). Maasai environmental and land-rights activist George Risa Kosen leads a protest in Narok, Kenya, calling on the county and national governments to stop deforestation in the Mau Forest Water Tower. From: Kosen, 2019. *Figure 2* (right). Smoke rises from the Mau Forest during ongoing clearing activities. August 2019 near Ololulunga, Kenya. From: Bielawski, 2019.

George Risa Kosen, a Maasai Indigenous environmental and land-rights activist who has become increasingly visible on the issue since 2013, led the march, as illustrated above in Figure 1. Kosen and others called for a peaceful protest that would eventually contribute to forest policy change with significant potential water security implications for his downstream Maasai community. In an August 2019 interview with Kosen, he underscored the critical role the current generation of Maasai leaders play in influencing how future generations, both Maasai and beyond, will continue to fight for source water-protecting forests based upon ITEK:

> We need to conserve the forest. . . so that the water tower upstream can flourish to make rivers to flow as they have been flowing in the past . . . from a hundred years ago. We have to come out as activists to show the world that we as Maasai want the Mau Forest to be conserved. As a group of young people, we were yearning to have good water for our people. When the forest was cut down, we started seeing rivers shrinking and the water becoming dirty . . . It was a disaster . . . And that's why I decided to be on the front line . . . to defend the forest, the source of all rivers. (G. Risa Kosen, personal communication, August 12, 2019)

As Kosen spoke, just a few kilometers away from Narok at the edges of the Mau Forest just outside of Ololulunga, smoke could be seen still rising above a new plot of forest being cleared, as illustrated above in Figure 2. Such deforestation is particularly concerning given the Mau Forest's direct impact on water security throughout East Africa and beyond.

Critical Water Importance of the Upstream Mau Forest

The Mau Forest is called a *water tower*—as many higher-elevation forests in East Africa are—because of its critical role in protecting water supplies for downstream communities (Center for International Forestry Research [CIFOR], 2019; Pearce, 2015). Due to water tower forests' elevation in Kenya, "they intercept clouds blowing off the Indian Ocean, capturing most of the

country's rains" and "are the sources of all but one of Kenya's major rivers" (Pearce, 2015). The Mau Forest, specifically, is regarded as the most critical water tower for all of East Africa (Chrisphine, et al., 2016) and "a water tower of international importance that needs attention at both the local and international level" (UNEP, 2016, p. 35). The water-related services it provides to downstream communities include "freshwater provisioning, river flow regulation, flood mitigation, recharge of ground water, erosion control, water purification, . . . [and] micro-climate regulation" (Bird Life International, 2013).

Located in Kenya's great Rift Valley, the forest spans approximately 400,000 hectares in 22 forest blocks (Albertazzi, et al., 2018; Bird Life International, 2013). As "the largest water catchment area in Kenya" (Mutugi & Kiiru, 2015, p. 683), the Mau Forest serves as the upper water catchment area for 12 major rivers and five major lakes (Albertazzi, et al., 2018; Bird Life International, 2013; Chrisphine, et al., 2016). Downstream, the forest is the source of water for more than 5 million people in Kenya (Sena, 2011), and also provides water critical to multiple wildlife conservation areas of global significance, including the Maasai Mara Game Reserve in Kenya (Albertazzi, et al., 2018; FAO, 2019*)* and the Serengeti game reserve in Tanzania (Sena, 2011).

One of the major river systems fed by the Mau Forest to its south is the transboundary Mara River Basin, which, as illustrated below in Figure 3, traverses Maasailand across both Kenya and Tanzania, ultimately contributing to the larger Nile River System (Global Water for Sustainability, 2012). The Mara River's headwaters include the Amala and Nyangores Rivers, which emanate from the north in the heart of the Mau Forest, as illustrated below in Figure 4. Within this specific basin, the Mau Forest provides 60% of the water flowing into transboundary Lake Victoria (UNEP, 2016). Notably, in the drought-prone drylands of sub-Saharan Africa (United Nations Department of Economic and Social Affairs [UNDESA], 2016), the Mara River itself at times "becomes the only permanent source of flowing water, providing a critical resource for the pastoralist Maasai community" (Global Water for Sustainability, 2012, p. 8).

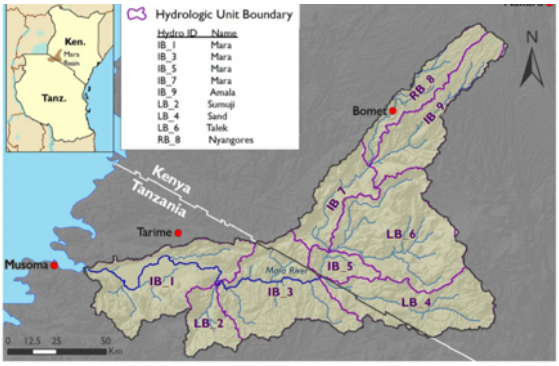

Figure 3 (left). The transboundary Mara River Basin spans Kenya and Tanzania, becoming part of the greater Nile River Basin via Lake Victoria. In this map, the Mau Forest Complex is located in the northern-most section of the Mara River Basin illustrated. Retrieved from: United States Agency for International Development [USAID] (2019). *Vulnerability and adaptation in the Mara River Basin* (p. 8). *Figure 4* (right). The headwaters source of the Mara River is a swamp in the Mau Forest. From: Kosen, 2019.

Mau Forest Deforestation under Colonialism, Neocolonialism

Despite its increasingly articulated water security-related significance, the Mau Forest "has been systematically destroyed . . . with the resultant upsetting of a delicate ecological equilibrium" (Mutugi & Kiiru, 2015, p. 683). It is estimated that the intact forest remaining in the Mau Forest Complex currently represents just *one quarter* of the tree cover it once provided (UNEP, 2016). One of the current visually jarring lines of deforestation encroachment is visualized below in Figure 5.

Figure 5. The line between intact Mau Forest and tracts that have been deforested is clear in this photograph, which depicts the boundary between Narok and Bomet Counties, Kenya. From: Kosen, 2019.

There are varying perspectives on how significantly deforestation occurred during colonial rule of Kenya, which spanned the years 1895 to 1963. Some Maasai elders state the most significant deforestation began after Kenyan independence in 1963 (M. Poole, personal communication, December 1, 2019). However, others state "by 1930, parts of the Mau complex were cleared for the establishment of forest plantations" (Klopp & Sang, 2011) and that vast swaths of forested lands were cleared during colonial rule to establish large-scale tea plantations (Sena, 2011). What is clear is that forest destruction occurred at an alarming pace during post-1963 Kenyan independence (Albertazzi, et al., 2018) under neocolonialism, which is underpinned by capitalism-driven land privatization in opposition to communal land-management approaches central to Maasai pastoralists' political economy (Dapash & Poole, 2019). Deforestation rates during recent decades have been particularly swift with an estimated quarter of the forest destroyed during the past 20 years alone (Albertazzi, et al., 2018; Bird Life International, 2013). Such contemporary deforestation has stemmed from illegal logging, unplanned settlement and encroachment, charcoal burning, and conversion to agricultural land (Bird Life International, 2013; Republic of Kenya, Ministry of Environment and Forestry, 2018; UNEP, 2016).

Many assessments underscore the role Kenyan politics has played in the deforestation process (Albertazzi, et al., 2018). It has been noted that "these forested hillsides were notoriously

the places that corrupt senior politicians annexed illegally to provide farmland for their allies, constituents, and tribal members" (Pearce, 2015), while some also suggest the forest "has been over-exploited due to a lack of institutional governance and a long-term strategic plan" (UNEP, 2016, p. 34).

Deforestation's Negative Impacts on Downstream Water Security

Anthropogenic destruction of the Mau Forest Complex has significantly threatened its ability to "stor[e] and distribut[e] water to outlying areas" (UNEP, 2016, p. 34), resulting in direct threats to downstream water supplies (FAO, 2019). Deforestation, from a general ecological-systems view, is linked to reducing upstream land's natural ability to absorb and store rainwater; the drying of downstream rivers and streams; downstream flooding, including flash flooding; and soil erosion (Republic of Kenya, Ministry of Environment and Forestry, 2018). These landscape-scale ecological realities—long recognized by ITEK and increasingly both recognized by SEK and quantified by ecosystem-services valuation models—are specifically illustrated in the Mara River Basin downstream of the Mau Forest. For instance, a recent study of land-use change in the Nyangores watershed of the upper Mara River Basin (Mwangi et al., 2016) concluded that "deforestation is majorly responsible for changes in . . . hydrology" (p. 257) and underscored that land-use change may continue to be more impactful to streamflow than climate change moving into the future. Notably, climate change is broadly recognized as exacerbating impacts to water security in the Mara River Basin. Recent research found "temperatures have risen by 1°C–1.5°C and rainfall is becoming more erratic" (United States Agency for International Development [USAID], 2019, p. 1). Such climate-related changes are projected to continue with increasing temperatures; longer, more intense heat waves; more frequent and intense drought; and changing, less reliable seasonal rainfall patterns (USAID, 2019). Projecting into the climate-era future, some suggest that any continuing Mau Forest deforestation "will cause an environmental disaster in Kenya [by] significantly reduc[ing] river flows" (Bird Life International, 2013).

Water Impacts on Downstream Maasai Indigenous Pastoralists

The urgency with which Maasai activists like Kosen approach the deforestation issue is largely driven by the negative ethnoecological impacts to Maasai communities, as well as wildlife, downstream in Kenya and further downstream in Tanzania. Maasai pastoralists in the rural drylands have faced historical long-term water insecurity foundationally resulting from the naturally arid and semi-arid climate in low-lying sub-Saharan Africa, where "drought is the dominant climate risk" (UNDESA, 2015). These concerns have only been exacerbated through the destruction of the water-protecting Mau Forest and the water-cycle impacts of global climate change. Notably, in Kenya, approximately *half* of the Mara River Basin's residents "collect water directly from the Mara River or its tributaries" (USAID, 2019, p. 11), which means that changes to water flow and quality caused by upstream deforestation are experienced in personal and tangible ways by members of the Maasai community.

One example of the water insecurity facing many rural drylands Maasai villages comes from villages near Talek, Kenya, just north of the Maasai Mara Game Reserve. Here, according to multiple interviews conducted during July and August 2019, downstream water insecurity has significantly increased during the past two to three decades, negatively impacting the health of both humans and livestock (G. Risa Kosen, personal communication, August 12, 2019; S.O. Sairowua, personal communication, August 5, 2019; S.K. Emanuel, personal communication, August 5, 2019; O. Kerakor, personal communication, August 5, 2019). According to interviews, increasing water dilemmas stem from the drying of rivers, flash flooding, changes in seasonal surface water flows, and associated waterborne disease.

Figure 6. Nasuju Dukuny, a Maasai woman in her 70s, gathers her family's daily water into a jerry can from a water pan near her home. From: Bielawski, 2019.

The burden of water insecurity is felt particularly by Maasai women, who are traditionally responsible for fetching water for their families (Dapash & Poole, 2019). Nasuju Dukuny, a Maasai woman in her 70s pictured above in Figure 6, often gathers water daily from a shallow water pan shared by livestock. Dukuny noted, "We sometimes travel a very long distance to fetch water and stay the whole night. About five kilometers. It was very risky and dangerous for us . . . many people have lost their life" (N. Dukuny, personal communication, August 5, 2019).

Maasai Water-Related ITEK

While Maasai water-related ITEK, which clearly recognizes landscape-scale links between upstream forests and downstream water availability and quality, has been shared from generation to generation for centuries, its ability to provide the water security it once did has come under contemporary threats, including upstream deforestation and land-privatization schemes.

Maasai pastoralists' political economy traditionally relies upon the communal use and care for land, which recognizes upstream-downstream water dynamics through the long-term sustainable management of both upstream watered forests and highlands as well as downstream drylands (Dapash & Poole, 2019). This Maasai communal land approach supports the Maasai pastoralist political economy, which is centered on tending livestock, including goats, sheep, and cattle, as illustrated below in Figures 7 and 8. Such pastoralism requires a constant search for water and grazing sources; livelihood is rooted in the ability to move livestock and people across the landscape—from upstream forests and highlands to downstream drylands—to access watered

lands based on natural ecological cycles (Dapash and Poole, 2019). Specific Maasai ITEK has traditionally addressed landscape-scale water security in two key ways. Through the practice of deferred grazing, "the best-watered land [is left] untouched, sometimes for as long as a several years, to ensure that its health can support an entire community through droughts (Dapash & Poole, 2019, p. 4). Through this practice, Maasai pastoralists honor the landscape-scale concept of maintaining natural drought reserves, higher-elevation watered lands, such as those in the Mau Forest and in nearby highlands, that support water security when water is scarce in downstream drylands (Dapash & Poole, 2019).

Figure 7 (left). Maasai pastoralists near Talek, Kenya, move cattle in search of grazing and water sources. From: Bielawski, 2019. *Figure 8 (right).* Maasai pastoralists near Talek, Kenya, move goats across a seasonal riverbed from the Maasai Mara Game Reserve back to a group ranch. From: Bielawski, 2019.

In this way, Maasai land-management approaches run counter to capitalism-based land privatization schemes that emerged during colonization and continue today in Kenya under post-independence neocolonialism (Dapash & Poole, 2019). The upstream Mau Forest has historically been the ancestral home to both the Maasai and the Ogiek Indigenous Peoples (UNEP, 2016). However, starting during colonialism, significant portions of the Maasai community's best watered lands and drought reserves, including those within the Mau Forest Complex, were confiscated (Dapash & Poole, 2019). Colonial-era land grabs, which left Maasai pastoralists confined to the driest lands in southern reserves (Ntimama, 1994), have had significant negative consequences for water security, including hampering Maasai communities' ability to conserve drought reserves (Dapash & Poole, 2019; G. Risa Kosen, personal communication, August 12, 2019). This concern frequently underpins conversations with Maasai community members in traditional villages in the drylands of Kenya. In Kolong Village near Talek, Kenya, Chief Elder Shinana Ole Sairowua, as illustrated below in Figure 9, noted:

> When I first came to this area [more than 40 years ago], there was a lot of water coming to these seasonal rivers. But, as time went on, the water was beginning to deteriorate . . . I am very bitter to hear that people are destructing the Mau Forest. . . We rely on that forest for our water here. . . I am very surprised and disappointed because the Mara River used to be

> full every time of water, but just right now you can just step right across . . . The Mau Forest destruction is affecting the ecosystem down here. (S.O. Sairowua, personal communication, Aug. 5, 2019)

Figure 9. Chief Elder Shinana Ole Sairowua stands in Kolong Village. From: Bielawski, 2019.

In response, environmental and land-rights activists, including Kosen, continue their advocacy today to reclaim Indigenous ancestral lands—and to conserve the Mau Forest.

Future of the Mau Forest Water Tower

Looking forward, as Indigenous activists continue to push the issue of upstream forest conservation, the Kenyan government has led two phases of forest evictions in an effort to clear the Mau Forest Water Tower of unplanned settlements and eventually begin reforestation and longer-term conservation (Republic of Kenya, Ministry of Forest and Environment, 2018). As previously discussed, the Mau Forest has been inundated by settlers from a range of tribes who have engaged in a variety of deforestation activities, creating barriers to forest restoration. The second phase of forest evictions, which targeted 60,000 forest settlers (Sayagie, 2019, September 2) concluded in October 2019 (Kenya News Agency, 2019). While recent forest evictions are considered a critical piece of future forest conservation, they have been met by some claims that forcing individuals to abandon forest land may represent human-rights violations (Amnesty International, 2018; Cultural Survival, 2018; Human Rights Watch, 2019).

The evictions are part of a larger forest restoration plan, which includes "a new forest policy with a commitment to manage all indigenous forests (including the Mau Forest Complex) to conserve water, soil, and biodiversity" (UNEP, 2016, p. 34). Within days of the evictions' conclusion, leaders from the Kenyan national government and Narok County, in which the Mau Forest is located, announced a plan to plant 100,000 trees in a single day (Nov. 1, 2019) at the site of former settlements in the Maasai Mau Forest, one of the 22 forest blocks, with an eventual 10-million-tree replanting campaign to follow throughout the entire Mau Forest Complex (Kenya

News Agency, 2019). For Kosen, who led the march in Narok calling for such restoration, replanting cannot come soon enough: "For trees to help water storage it will take time. I think it will take five to seven years and then in 10 years the environment will come back to where it was before" (G. Risa Kosen, personal communication, August. 12, 2019).

Indigenous Peoples' Global Push for Forest-Based Water Protection

Maasai activists in Kenya and Tanzania are not alone in the movement. Indeed, they are among a growing chorus of IPLCs drawing broader global attention to the ability of upstream forests to protect downstream water, an NBS firmly rooted in water-related ITEK established in Indigenous communities around the globe. While water insecurity in drought-prone sub-Saharan Africa (UNDESA, 2016) presents specific challenges to Maasai communities, mounting water insecurity exacerbated by climate instability and coupled with rampant deforestation are faced by an increasing portion of the global population among both Indigenous and non-Indigenous communities in both developed and developing nations (UN & World Bank, 2018; UN WWAP, 2018). It is estimated that more than one-third of the world's population lives in a region of water scarcity (UN & World Bank, 2018), and "at least two thirds of [remaining forests] are in a degraded state" (UN WWAP, 2018, p. 3). This scenario presents specific challenges for the world's estimated 370 to 500 million Indigenous Peoples (IPs) (United Nations Educational, Scientific and Cultural Organization [UNESCO], 2019), who are frequently disproportionately impacted by lack of access to safe water (UN, 2011).

While IPs are noted for their disproportionate water risks, they also have increasingly become global agents of change by sharing ITEK related to water security with broader audiences on the international water policy stage (Ervin, 2019). Notably, IPs "care for an estimated 22% of the Earth's surfaces" (International Labour Organization, 2017, p. 13). Through the lens of sustainability education, such Indigenous leaders of change increasingly call upon policymakers to break down the tensions that have historically existed between ITEK, which frequently supports NBS for water, and western-emanating SEK, which is more frequently focused on built grey infrastructure solutions.

As noted by Nelson (2008), ITEK "is so foreign to the mindset of modern, western science and the Eurocentric paradigm, it is often difficult for non-native outsiders to understand these realities and teachings" (p. 14). This concept is echoed by Hunn (1999), who, in highlighting the contrasts between ITEK and western science through the lens of ethnoecology, described ITEK as "fundamentally sound as science" (p. 23), but cautioned that it is "gravely threatened, in imminent danger of going to the grave with the present generation of elders" (p. 23). Nelson (2008) further pointed out that IPs are recognized for a belief in "cognitive and cultural pluralism" in which "diverse ways of thinking and being" are valued simultaneously (p. 4). Amid mounting global water-security risks only exacerbated by climate change, this call for pluralism-based policy decisions is further contemplated by the North American Indigenous Mi'kmaq concept of Two-Eyed Seeing, discussed in more detail below, which underscores the value of engaging the synergies between the two paradigms, SEK and ITEK.

Within this context, it is notable that an increasing array of international NGOs and intergovernmental organizations (IGOs), including UNDP's Global Programme on Nature for Development through its Equator Initiative, are driving visibility of NBS, including the use of natural infrastructure provided by upstream forests as a longer-term, landscape-scale policy solution for water security based on long-held Indigenous knowledge (UN WWAP, 2018; UNDP, 2012a; UNDP, 2012b; UNDP, 2012c; UNDP, 2016).

United Nations Development Programme's Equator Initiative Examples

UNDP's Equator Initiative Nature-Based Solution Database provides a global information-sharing platform to learn from a wide range of IPLCs successfully implementing NBS rooted in ITEK to achieve progress on reaching the UN's Sustainable Development Goals (SDGs), including SDG 6, which is related most directly to water (UNDP, 2019b). Many recipients' solutions parallel Maasai activists' efforts to conserve Kenya's Mau Forest Water Tower. An analysis of 50 freshwater management-focused Equator Prize case studies (Bielawski, 2018) identified 15 specific examples of IPLCs conserving upstream forests for the purpose of downstream water security by establishing or maintaining protected areas, including Private Protected Areas (PPAs), Indigenous and Community Conserved Areas (ICCAs), or government protected forests (Bielawski, 2018). Some of these examples are explored below in brief.

Madagascar's Manambolo Valley

In Madagascar's Manambolo Valley, forests provide "critical ecosystem services . . . including water regulation and watershed protection" (UNDP, 2012a, p. 3) to an estimated 200,000 residents (UNDP, 2012a). However, "slash-and-burn agriculture, grazing, forest fires, and illegal timber and precious stone operations" (UNDP, 2012a, p. 6) threatened downstream water security. The Association of Manambolo Natives (Fikambanan'ny Terak'i Manambolo—FITEMA), recipient of the 2002 UNDP Equator Prize, worked to create a protected area of forest, as illustrated below in Figures 10 and 11. The group's efforts ultimately resulted in 1,000 hectares of forestland being transferred to the management of local residents (UNDP, 2012a). The group used a traditional land-management technique called the Dina, which involves "elders mak[ing] decisions after consulting their ancestors" (UNDP, 2012a, pp. 4-5). The group later reported that "the main environmental benefit which has been improved over time is the communities' access to water for irrigation and drinking" (UNDP, 2012a).

Figure 10 (left). The Farmers Association of Manambolo Natives in Madagascar has worked to reverse a trend of deforestation using a traditional land management method. From: UNDP, 2012a. *Figure 11* (right). The group has reclaimed 1,000 hectares of forestland in an effort to protect local water supplies. From: UNDP, 2012a.

Nicaragua's Bosawás Biosphere Reserve

In Nicaragua, responding to slash-and-burn deforestation that threatened water security near the Bosawás Biosphere Reserve, the Farmer-to-Farmer Program (Programa de Campesino a Campesino - PCaC) worked to protect 20,000 acres of forestland to protect source water and prevent erosion (UNDP, 2012b). The group received the UNDP Equator Prize in 2002.

The Philippines' Chananaw Ullikong Protected Area

In the Kalinga Province of the Philippines, the Chananaw Indigenous People, as illustrated below in Figure 12, advocated to protect the Chananaw Ullikong Protected Area, as illustrated below in Figure 13, as an ICCA (UNDP, 2012c). This strategy underpinned the group's efforts to reverse ecologically destructive slash-and-burn practices and to protect downstream water (UNDP, 2012c). The Farmers' Association for Rural Upliftment, recipient of the 2010 Equator Prize, noted that conserving the 9 sq.km. area of upstream forest "increased the supply of water for human consumption and irrigation" (UNDP, 2012c, p. 7).

Figure 12 (left). The Chananaw Indigenous community of the Philippines is working to restore forests. From: UNDP, 2012c. *Figure 13* (right). Through the preservation of forests in the Chananaw Ullikong protected area, water supplies have improved. From: UNDP, 2012c.

Nepal's Annapurna Conservation Area

In the high-elevation Himalayas of Nepal, as illustrated below in Figure 14, where surrounding landscapes were significantly deforested, residents of the Kaski District faced multiple water security concerns, including climate-related flash flooding and lack of access to personal and irrigation water. In response, the Conservation Area Management Committee, Parche, has invested in local forests as a landscape-scale water-security strategy by participating in the sustainable management of the Annapurna Conservation Area, a Community Conserved Area (CCA) (UNDP, 2016). This CCA extends more than 7,000 sq. km., forming critical natural infrastructure for protecting water supplies for downstream communities (UNDP, 2016). After planting more than 200,000 trees through reforestation and afforestation, as illustrated below in Figure 15, the community noted improved "health and functioning of ecosystems," including improvement in freshwater access, which has "dramatically improved community well-being" (UNDP, 2016, p. 11).

Figure 14 (left). The Annapurna Conservation Area in the Himalayas. From: UNDP, 2016. *Figure 15* (right). More than 200,000 trees were planted through reforestation and afforestation efforts. From: UNDP, 2016.

These IPLCs from around the globe—calling to protect upstream forests for the benefit of downstream water—are not isolated voices. Indeed, the global call to increase the implementation of such NBS in water policy alongside now-dominant SEK-based built grey infrastructure is reaching an unprecedented tenor. Some argue, in the midst of climate change, a tipping point of policy action has arrived.

Tipping Point for Nature-Based Solutions' Inclusion in Global Water Policy

The North American Indigenous Mi'kmaq concept of Two-Eyed Seeing encourages the exploration of potential shared harmonies and synergies between both Indigenous and western

ecological paradigms, namely ITEK and SEK, in support of "a better and more healthy world" (Marshall, et al., 2015, p. 17). Through this ITEK- and SEK-informed Two-Eyed Seeing approach, protecting upstream forests may become an increasingly implemented strategy for protecting downstream water supplies. While ITEK and SEK terminology and nature-valuation lenses may differ—such as forests' description as a *water tower* by some traditional-economies' ITEK versus *natural capital* or *natural/green infrastructure* by capitalism-linked SEK—both paradigms uphold the concept of upstream forest conservation as an ecologically valid water-security solution of increasing importance in the context of climate crisis (UNEP, 2016; FAO, 2019; Republic of Kenya, Ministry of Environment and Forestry, 2018; Kosen, 2019; Kerakor, 2019, Dapash & Poole, 2019; UNDP, 2012a; UNDP, 2012b; UNDP, 2012c; UNDP, 2016).

Hegemonic global water policy discourse, which is traditionally rooted in SEK-based grey infrastructure approaches, has potentially reached a tipping point, marking increasing recognition of NBS. I suggest that, as illustrated below in Figure 16, global water policy of the future, driven partially by the urgency of climate change and related demands for forest-based carbon sequestration, will include an increasing ratio of ITEK-informed NBS. Notably, this model does not suggest that a universal approach to water policy—one that includes, for instance, more SEK than ITEK—should be implemented on Indigenous lands, such as in Maasailand. Rather, it suggests a generally increasing ratio of ITEK to SEK in a global average sense.

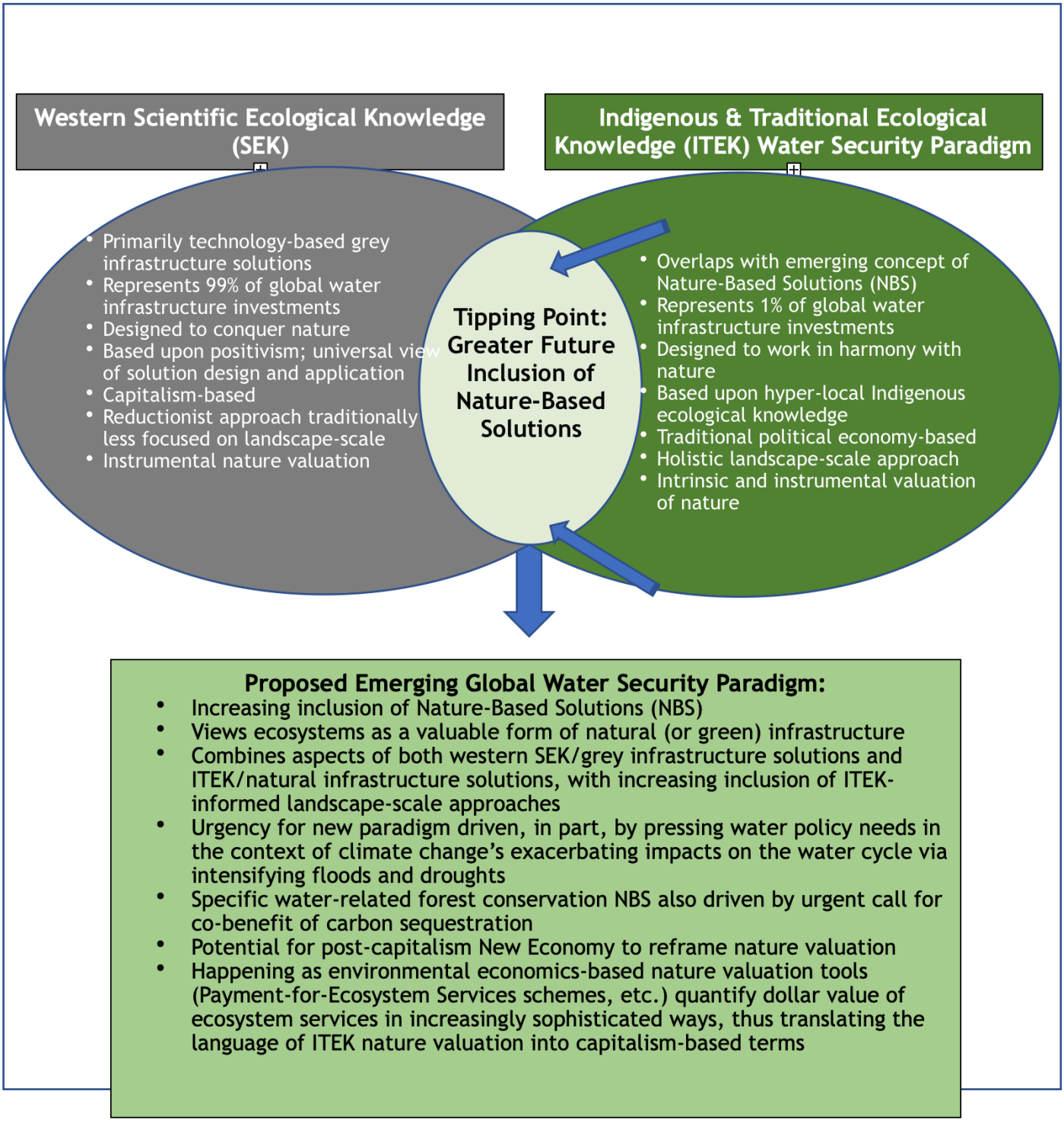

Figure 16. Proposed emerging global water security policy paradigm combines an increasing amount of ITEK and NBS with western hegemonic grey-infrastructure-based views. From: Bielawski, 2020.

On the world's water policy stage, there has, indeed, been a recent upswell in support for such ITEK-informed NBS, including the landscape-scale protection of upstream forests, such as the Mau Forest Complex, as natural water infrastructure supporting downstream water security (UN WWAP, 2018). NBS for water security globally currently represent less than 1% of water infrastructure investments (as cited in UN WWAP, 2018, p. 3). However, an expanding cadre of NGOs, members of the western Academy, and IGOs—such as UNDP, The Nature Conservancy (TNC) and the International Union for the Conservation of Nature (IUCN)—are pushing the idea of using natural ecosystems such as forests to naturally protect water. As stated in the 2018 UN World Water Development Report (UN WWDR):

> Attention to NBS has significantly increased in recent years. This is evidenced through the mainstreaming of NBS into a wide range of policy advances, including in water resources, food security and agriculture, biodiversity, environment, disaster risk reduction, urban settlements, and climate change. This welcome trend illustrates a growing convergence of interests around the recognition of the need for common objectives and the identification of mutually supporting actions—as illustrated best in the 2030 Agenda for Sustainable Development through its acknowledgment of the interdependency of its various Goals and targets. Upscaling NBS will be central to achieving the 2030 Agenda for Sustainable Development. Sustainable water security will not be achieved through business-as-usual approaches. NBS work with nature instead of against it, and thereby provide an essential means to move beyond business-as-usual to escalate social, economic and hydrological efficiency gains in water resources management. (UN WWAP, 2018, p. 2)

Driven by Climate Change Pressures

This potential NBS water-policy inflection point comes amid mounting climate change-related water concerns (Cooley, 2012; Intergovernmental Panel on Climate Change [IPCC], 2018). Specifically, climate change is projected to further threaten water supplies (IPCC, 2018) and intensify regionally specific floods and droughts (Cooley, 2012; IPCC, 2018). NBS are increasingly central to climate change discourse. Indeed, the 2018 UN WWDR described NBS both as "already recognized in the climate change agenda" and, further, as "central to addressing climate change" (UN WWAP, 2018, p. 35). Recognized global water policy frameworks now stress that "ecosystem-based management should be the primary means of climate change adaptation—and this largely involves using NBS for water" (UN WWAP, 2018, p. 35). Nonetheless, technology-based solutions continue to dominate mainstream media discourse.

Increasing demands to conserve upstream forests for their water-security benefits coincide with mounting climate-related policy demands to increase the co-benefit of carbon sequestration offered by the world's forests. This trend is illustrated by the UN's Reducing Emissions from Deforestation and Forest Degradation (REDD+) program, which acknowledges that, "as up to 11 per cent of carbon emissions are caused by deforestation and forest degradation, it is important that the reduction of these emissions is part of the global plan to fight climate change" (UN-REDD Programme, 2016). Specifically, REDD+ provides developing nations with financial

incentives to conserve forests for their carbon sequestration benefits, while acknowledging the co-benefit of water regulation provided by forest conservation (UN-REDD Programme, 2016).

Increasing Visibility of Payment-for-Ecosystem-Services (PES) Schemes

The field of environmental economics has provided increasingly sophisticated cost-benefit analysis tools to quantify the dollar value of Ecosystem Services (ES) provided by intact ecosystems such as the value of water storage and filtration provided by upstream forests (Earth Economics, 2017). Relatedly, an increasing number of PES financial schemes, which are based upon such ES valuation models, are in place between upstream and downstream communities in both rural and urban areas.

New York City's water system is one of the most prominent and celebrated water-related PES examples in a developed nation to date. More than 20 years ago, in 1997, the New York City Watershed Program invested in the conservation of three upstream watersheds—the Catskill, Delaware, and Croton—through a PES scheme, as illustrated below in Figure 17 (Abell et al., 2017; New York State Department of Environmental Conservation, n.d.).

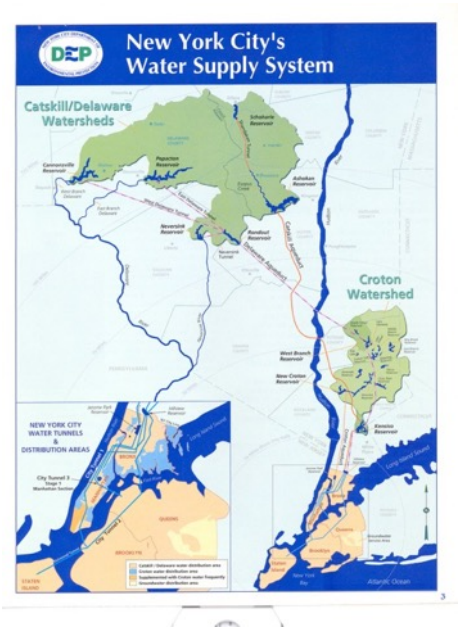

Figure 17. New York State Department of Environmental Conservation's "New York City's Water Supply System" Map. The Catskill, Delaware, and Croton watersheds serve as natural infrastructure to naturally filter water for more than 8 million New York City residents. From: New York State Department of Environmental Conservation. Retrieved from: https://www.dec.ny.gov/lands/25599.html.

New York's PES program protects and naturally filters source water that ultimately flows downstream to New York City's 8 million residents (Abell et al., 2017; New York State Department of Environmental Conservation, n.d.). This landscape-scale NBS for water security strategy was an alternative to investing US $8-10 billion in a new grey-infrastructure water treatment plant (Abell et al., 2017). Ultimately, this PES scheme both conserved upstream forests and "sav[ed] the city more than US$300 million a year on water treatment operation and maintenance (O&M) costs" (Abell et al., 2017, p. 56). In doing so, it became an often-cited example of how PES schemes can support the implementation of NBS for water security.

NBS Gain Momentum at UN Week, COP 25, and Davos' WEF

The upswelling interest in such NBS is illustrated by the rising prominence of NBS highlighted—by both Indigenous and non-Indigenous voices—during recent global sustainable development and economic policy events at the UN, WEF, and beyond.

At January 2020's economic-focused WEF Annual Meeting in Davos, Switzerland, natural ecosystems' impacts on future global economic performance were discussed more than during any previous annual meeting, as the WEF Global Risks Report 2020 "ranked biodiversity loss as one of the top five risks in terms of impact and likelihood over the coming decade" (WEF, 2020). Noting that one-third of forest cover globally has been destroyed, the WEF declared that the "19th and 20th century model of economic growth has come at a significant cost to nature," while underscoring "the opportunity [to] embrace nature based solutions" as part of the future call to "reset humanity's relationship with nature" (WEF, 2020).

Meanwhile, at the UN Climate Change Conference (COP 25) in Madrid in November 2019, the Stockholm International Water Institute (SIWI) issued a policy briefing entitled "Managing the Forest Water Nexus," which underscored that "forests and water are inextricably linked" in their relationship with climate regulation (SIWI, 2019). The brief further noted:

> [Forests' functions include the] regulation of basin flow, reduction of flooding and droughts, or impact on water yield or quality, as well as climate regulation through carbon sequestration and securing of carbon sinks. The complexity of the highly contextual forest-water relationships requires management decisions that are based on science and an understanding of these relationships at different temporal and spatial scales, as well as changing climate and land-use contexts. (SIWI, 2019)

Two months earlier in New York, NBS were highlighted as one of six dedicated action areas during the UN General Assembly (UNGA) and UN Climate Action Summit (UNDP, 2019, September 19). Notably, during UN Week, Nature4Climate, an NBS-focused communications initiative led by UNDP, UN-REDD, IUCN, Conservation International (CI), TNC, and a range of other NGOs and IGOs, worked to concurrently amplify the NBS message:

> Is nature the forgotten climate solution? We think so. Especially when you can look at the science and see the lack of action. . . . Despite the fundamental science being very well understood, action on land use lacks the funding and attention. (Nature4Climate, 2019)

Formed in 2018, Nature4Climate's articulated goal is to "catalyze partnerships between governments, civil society, business and investors based on the urgency to protect, restore and fund nature-based solutions" (Nature4Climate, 2019).

Additionally during UN Week, the UN Global Compact (UNGC), which engages CEOs to make corporate sustainability commitments, issued a "Nature-Based Solutions for Climate Manifesto" to drive visibility of NBS during the UN Climate Action Summit (UNGC, 2019). The manifesto read, in part:

> Nature-Based Solutions (NBS) are an essential component of the overall global effort to achieve the goals of the Paris Agreement on Climate Change. . . . They are effective, long-term, cost-efficient and globally scalable. NBS are already being delivered, are visible and credible, and can be exponentially scaled-up if they are fully valued and receive proper investment. Action is needed now to ensure that they achieve their full potential. At present NBS only receive a small share of climate finance. Success depends on maximizing nature's contribution to climate action, with intensified NBS from now onwards. . . . World leaders should do all within their power to ensure that nature's transformative potential is fully valued and realized in decision-making especially in relation to climate action. This includes governance processes that are designed to stop the destruction of nature and the damage caused by investments or incentives that contribute to environmental harm. (UNGC, 2019)

While this manifesto engaged corporate audiences during the UN Climate Summit, other messages issued during UN Week targeted a wider range of policy makers and the public.

Youth Climate Activist Greta Thunberg Addresses NBS

In a video segment presented during UN Week and produced by *The Guardian,* Swedish youth climate activist Greta Thunberg and journalist George Monbiot underscored the role NBS, including the conservation of natural forests, can—and should—have combatting climate change (*The Guardian*, 2019, September 19). Thunberg's opening provides a grim overview of climate-related destruction on Earth, including the activist stating that "we are living in the beginning of a mass extinction" (*The Guardian,* 2019, September 19). Monbiot then announces—with ironic amazement in his voice—the discovery of "a magic machine that sucks carbon out of the air, costs very little, and builds itself" (*The Guardian*, 2019, September 19). He continues, with a hint of sarcasm: "It's called a tree." The video seems to attempt to cleverly persuade audiences who may be engrained in western hegemonic technology- and SEK-focused frameworks into considering what forest preservation and other NBS, frequently rooted in ITEK, could achieve for climate mitigation among other goals. In this way, the video message takes its own Two-Eyed Seeing approach by bridging western-emanating SEK and technology-based policy frameworks with ITEK-rooted NBS. The segment ends with Thunberg's call to action to "protect, restore, fund." The video, which was partially funded by CI, quickly generated a viral online response.

Such efforts are not alone in their attempts to present NBS in a manner more approachable to audiences steeped in technology- and SEK-based paradigms. In a similar move that positions ITEK-supported NBS for water security in a western technology-driven frame, UNDP recently launched a site, "The Answer is in Nature," which proclaims: "Our planet has an artfully designed solution to the global water crisis: Trees," before describing trees as "nature's technology" (UNDP, 2019a). The site frequently combines the words *nature* and t*echnology*:

> Human innovations . . . are critical to addressing big environmental challenges. But the key to planetary health is in nature's own technology. Nature provides the forests that are our best allies when it comes to safeguarding our freshwater supply. It's up to us to preserve them. (UNDP, 2019a)

Conclusion

Increasing the role of ITEK-informed NBS, such as conserving upstream forests to increase downstream water security, in global water policy embraces a Two-Eyed Seeing approach. It also parallels the call for a newly forged *soft path* for water policy proposed by Pacific Institute water scholars. Christian-Smith and Gleick (2012) describe the current U.S. water policy *hard path* as one reliant on "centralized infrastructure and decision making using technology and institutions developed in the 19th and 20th centuries" (p. xvii), while describing the proposed future water policy soft path as being more decentralized, employing a range of both grey and natural, ecosystem-based infrastructure options, and "striv[ing] to improve the overall productivity of water use rather than seek endless sources of new supply" (p. xvii). While Christian-Smith and Gleick (2012) specifically recommended the soft path for U.S. water policy, it is possible to consider the concept more globally as well. Relatedly, in a background paper published by both IUCN and TNC, Krchnak et al. (2011) further underscored the large schism historically situated between these two policy approaches:

> Past failures in policy have created a divide between conventional infrastructure development and biodiversity conservation. This has led black-and-white, either-or thinking to predominate and to the widespread exclusion of ecosystems from planning and investment in infrastructure. On the one hand, this has resulted in devastation of biodiversity and on the other hand to inefficient infrastructure development. In many river basins, water, food and energy security is demonstrably weakened as a result. (Krchnak, et al., 2011, p. 7)

Christian-Smith and Gleick's (2012) proposed future soft path acknowledges policymakers need not make an either-or choice between traditional grey infrastructure and NBS. Rather, they argue, the soft path can support the needs of both human water needs and natural ecosystems by utilizing a range of both grey and green solutions (Christian-Smith & Gleick, 2012). This view parallels the Indigenous-based concept discussed earlier by Nelson (2008) of "cognitive and cultural pluralism" (p. 4) in which "diverse ways of thinking and being" (p. 4) can be valued

simultaneously. This pluralistic view is further embraced by the UN WWDR, which, in 2018, for the first time, focused entirely on the future role of NBS for water policy:

> As humankind charts its course through the Anthropocene, and tries to avoid the tragedies of the past, adopting [NBS] is not only necessary for improving water management outcomes and achieving water security, it is also critical for ensuring the delivery of co-benefits that are essential to all aspects of sustainable development. Although NBS are not a panacea, they will play an essential role in building a better, brighter, safer and more equitable future for all. (UN WWAP, 2018, p. 8)

Seeing Water Through the Trees in Kenya's Mau Forest Water Tower and Beyond

While global water and climate policy campaigns seek to increase investment in NBS, back in East Africa, Kosen and his activist colleagues continue their fight to restore the upstream Mau Forest Water Tower, a critical piece of natural infrastructure to support downstream water security throughout Maasailand:

> We need to change the world. We need change for our people to get clean water. UN Laws of Human Rights indicate that everybody is supposed to have clean and safe water . . . I came to know that the truth was trees. Trees are very valuable to water. (G. Risa Kosen, personal communication, August 12, 2019)

Taking a pluralistic Mi'kmaq Two-Eyed Seeing approach to water policy, the future conservation of the Mau Forest may be poised to become a leading example of how Indigenous communities and western technology-based policymakers—collectively—come to *see water through the trees*.

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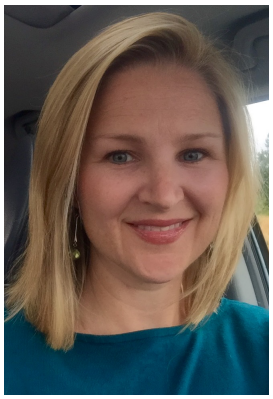

Author thumbnail: Amanda Bielawski

Icon image: Maasai environmental and land-rights activist George Risa Kosen leads a protest in Narok, Kenya, calling on the county and national governments to stop deforestation in the Mau Forest Water Tower.

Alternative icon image: The headwaters source of the Mara River is a swamp in the Mau Forest.