Asemaa, Ma'iingan, and the Seventh Fire's instructions for assessing sustainability

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Abstract

From environmental impact statements to regulatory impact assessments, there are a variety of analyses in the United States that measure sustainability to inform federal, state, and/or local decision-making. Without procedures to ensure meaningful inclusion of Indigenous Knowledge and respect for Indigenous sovereignty, we find that many assessments currently jeopardize the discovery and development of truly sustainable solutions. Specifically, we evaluate how 17 different kinds of assessments (mis)align with Anishinaabe Gikendaasowin (Knowledge) on Asemaa, Ma'iingan, and the Seventh Fire prophecy – teachings that guide sustainable relationships between Physical, Plant, Animal, and Human Worlds. Our analysis is rooted in Anishinology and Two-Eyed Seeing, practices that together guide our approach to bridging Anishinaabe Gikendaasowin and Western scientific Knowledge and elucidate a more robust understanding of sustainability. "Sustainability" stands at a crossroads; ultimately, this analysis provides guidance for improving assessment protocols to ensure that current sustainability efforts do not repeat injustices of the past.

The Seventh Fire Prophecy

The Seventh Fire marks a time when the Anishinaabeg and the other Peoples around them will face a choice between two paths. One path is barren and charred, yet appears fast and easy; a path burned in the fire, paved over, and left lifeless. It is a path where the current momentum goes unchecked and causes rapid, irreparable destruction. The other path is unpaved – it is not fast or easy, but it is lush and rewarding. A path where fire leads to new life that requires those who walk it to be careful and considerate. It requires the Anishinaabeg and other Peoples to work together, to restore their relationships with each other and with the Physical, Plant, and Animal Worlds around them. The Physical, Plant, and Animal Worlds are the older, wiser relatives of the Human World. While these older-than-human relatives do not rely on humans for survival, humans by contrast are entirely dependent on their Physical, Plant, and Animal relatives. Healing humanity's relationships with the Physical, Plant, and Animal Worlds requires healing the relationships between Peoples as well. Only by walking this path together can life prevail.

- *As shared by Kathleen Smith, member of Gakiiwe'onaning (the Keweenaw Bay Indian Community of the Lake Superior Band of Chippewa Indians).*[1] *Many versions of this ancestral teaching exist and are stewarded by Anishinaabe Gikendaasowin (Knowledge) holders across Turtle Island.*[2,3]

Indigenous Peoples stand to be disproportionately impacted by green energy projects.[4] Though motivated by current climatic and environmental crises, these projects often fail to grasp that, for many Indigenous Peoples, climate change and the imminent manmade, sixth mass extinction event are continuations of crises born from historical and ongoing colonial oppression.[5] The UN Permanent Forum on Indigenous Issues cites colonialism as a dominant force of environmental destruction,[6] warning that without proper regard for Indigenous free, prior, and informed consent, green energy projects aiming to mitigate the climate crisis could instead engender Green Colonialism.[7] With the majority of critical minerals necessary for electric vehicles located on or near Indigenous lands,[4] there is an urgent need to understand the role of Indigenous self-determination in decision-making.

In the United States, the 2022 Inflation Reduction Act sets bold targets for domestically-sourced critical minerals,[8] and the homelands of the Anishinaabeg (the Ojibwe/Chippewa, Potawatomi, Odawa, and other Tribes) throughout the northern Great Lakes region in the U.S. and

Canada are prime candidates for new and/or expanded mining activities.[9] The planning, design, implementation, and management processes of these operations will govern whether they move society towards climate solutions or repeat exploitative patterns of the past.[10] In turn, these processes are governed by a suite of assessment protocols broadly referred to here as "sustainability assessments." These assessments inform decision-making at federal, state, and/or local levels, and they measure one or more of the four pillars of sustainability: environmental, social, cultural, and economic sustainability.[11–13] Specifically, we examine (see Supplementary Information (SI) Section 1 for more detail):

Cultural Impact Assessment (CIA),

Cumulative Impact Assessment (CumulIA),

Ecological Risk Assessment (EcoRA),

Environmental Impact Assessment/Statement (EIA),

Environmental Life Cycle Analysis (ELCA),

Health Impact Assessment (HIA),

Heritage Impact Assessment (HeritageIA),

Human Health Risk Assessment (HealthRA),

Natural Resource Damage Assessment (NRDA),

Permitting (Permits),

Regulatory Impact Assessment (RIA),

Social Impact Assessment (SIA),

Social Life Cycle Analysis (SLCA),

Technoeconomic Analysis (TEA),

Threat and Hazard Identification and Risk Assessment (Local) (LocTHIRA),

Threat and Hazard Identification and Risk Assessment (National) (NatTHIRA), and

Tribal Cumulative Impact Assessment (TribalCumulIA).

President Biden's recent federal policy shift to prioritize mining in the United States places an increasing importance on assessment frameworks that enable just and sovereignty-affirming decision-making. The question is not will there or will there not be mining; critical minerals are required for a decarbonized future.[14] The question is who gets to decide where and how this mining happens; who gets to decide what is sustainable.

The International Panel on Climate Change (IPCC) recognizes that "Indigenous governance systems supported sustainable lifeways over thousands of years" and calls for Indigenous Knowledge (IK) to underpin sustainability measures ranging from conservation efforts to impact assessments.[15] Meanwhile, the Biden administration pushed federal agencies to "apply Indigenous Knowledge in decision making, research, and policies across the Federal Government."[16,17] Responding to these international and domestic directions for greater application of IK, we employ an approach that grounds Western-based analytical methods within Anishinaabe Gikendaasowin (Knowledge) on sustainability.

Many studies explore how to apply both IK and Western scientific Knowledge (SK),[18–22] with Anishinology and Two-Eyed Seeing exemplifying two distinct practices for the nearly universal task Indigenous Peoples undertake to braid IK and SK together (see Methods).[2,23–25] Anishinology is the basis for this work and the relationships that produced it, described by Ojibwe Elder Marvin DeFoe as a practice of blending science and humanity.[26,27] The first, and primary, aspect of this work involved the humanity aspect of Anishinology: attending talking circles, memorial events, and other gatherings to cultivate relationships from a place of humanity – to share emotions, build trust, and form connections of kinship that surpass conventional collaboration.[1,26,28] Knowledge diffused along these bridges of relationship, blending IK and Western SK into an understanding of sustainability based on science, humanity, culture, and Anishinaabe Gikendaasowin.

Two-Eyed Seeing – a process of applying the strengths of IK and SK in tandem, developed by Mi'kmaq Elders Albert Marshall and Murdena Marshall alongside Dr. Cheryl Bartlett – then outlined the structure for this analytical work.[18–21] The blended understanding from Anishinology is distilled here as three Anishinaabe teachings presented in parallel with the three primary conclusions from the Western-based analytical methods. One eye is on the Western science-driven findings; one eye evaluates these findings against Anishinaabe Gikendaasowin:

The teaching of Asemaa: There is no sustainability without **consent**.

Consent fosters sustainable relationships among Physical, Plant, Animal, and Human relatives. Consent honors Indigenous self-governance; this section examines how assessment protocols do or do not affirm Indigenous sovereignty.

The teaching of Ma'iinganag: There is no sustainability without **connection**.

Human well-being and the well-being of Physical, Plant, and Animal relatives ("older-than-human" relatives) are inherently connected. This section explores the entangled assessment space resulting from protocols that artificially disconnect different aspects of sustainability.

The teaching of the Seventh Fire: There is no sustainability without **kinship**.

Kinship emerges from healthy relationships built on consent and connection.[3] This section examines the changes needed for assessment protocols to support kinship-based practices that ensure "sustainability" does not sacrifice sovereignty.

Results

Consent

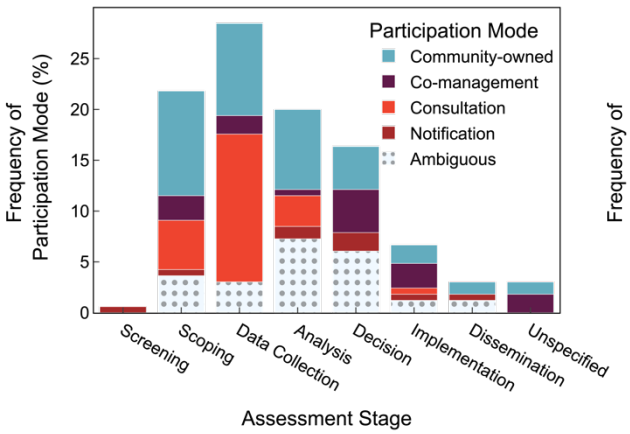
After creating the Physical, Plant, and Animal Orders, the Creator formed man and placed the first man on the Earth. When this first man beheld the world around him, he was awestruck. Awestruck by the beauty of the water, soil, grasses, trees, insects, and animals in such abundance. In his reverence, he stood completely still. For days he did not move, too afraid of the damage even a single step would cause. No matter how careful he might be, he knew there was no way he could take a step without injuring a relative, be it a patch of grass or even a small insect. But he also could not survive by staying still, and the other Orders of Creation knew this. The Spirit of Asemaa (tobacco) came to his aid. Appearing before him, Asemaa taught the first man how to move through Creation with humility and respect. Yes, Asemaa acknowledged, man is too dependent on the other Orders, too unequipped, and too new to the world to move without causing harm. But as long as man asks for permission and honors the response, he can minimize harm and ensure a strong, lasting, prosperous relationship with all Orders of Creation.

- *As shared by Mike Wiggins Jr., member of Mashkiiziibii (the Bad River Band of Lake Superior Chippewa).*[29]

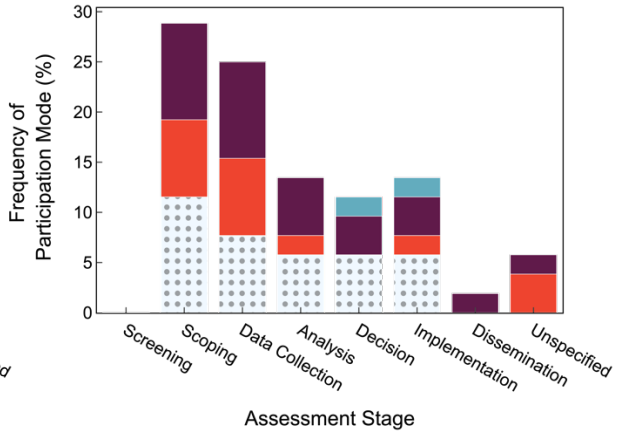
Consent separates relationships of care from relationships of violence. Asemaa teaches that sustainable relationships between and within the Four Orders of Creation (Physical, Plant, Animal, and Human) cannot exist without consent. The Human World is dependent on the older Orders of Creation,[27,30] and the lessons from Asemaa show the Anishinaabeg how to engage in consensual relations with these older-than-human relatives (SI Section 2). The United Nations Declaration on the Rights of Indigenous Peoples underscores the fundamental connection between free, prior, and informed consent and sovereignty.[31] Sovereignty is Indigenous Peoples' inherent right to self-determination and self-governance.[31,32] Assessments that fail to maintain sovereignty-affirming methods risk violating the self-determination and self-governance of Indigenous Peoples; accordingly, previous research explores how models, impact assessments, and regional/project planning support or violate Indigenous self-determination.[10,33–36] In particular, Larsen 2018 provides a foundation for evaluating how participation modes (community-owned, co-management, consultation, and notification) vary across assessment steps (scoping, evidence generation, significance determination, and follow-up) through his analysis of Indigenous participation in Canadian, Australian, New Zealand, Norwegian, and Swedish impact assessments.[35]

We expand on Larsen's work by including 17 different assessment methods, evaluating a more detailed set of assessment steps, and considering ambiguous modes of participation (SI Tables S.1-S.3). We define "community-owned" as denoting sovereignty-affirming participation procedures, co-management as sovereignty-supporting participation procedures, consultation as sovereignty-feigning, and notification as sovereignty-violating (SI Table S.3). Ambiguity arises when authority over the assessment and/or decision-making is uncertain, such as when Tribal authorities may or may not lead an assessment and situations where an unspecified or non-Tribal authority delineates the mode of participation for Tribes.

CIA (Y)



CumulIA (Y)



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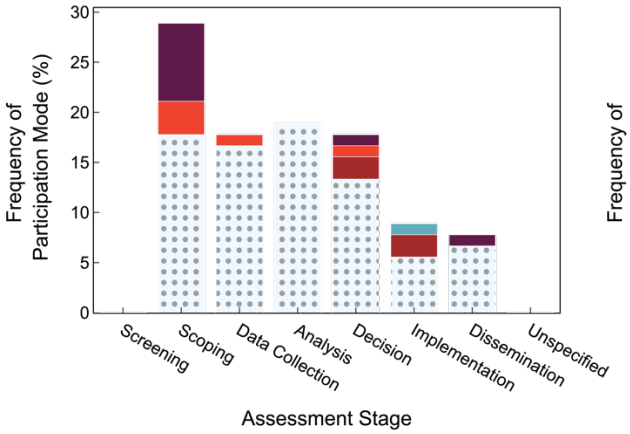
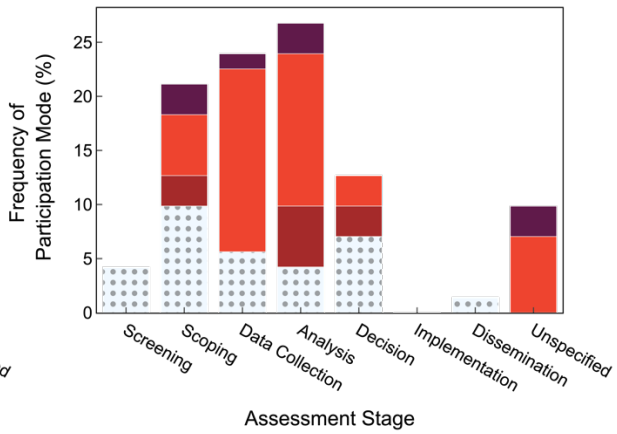
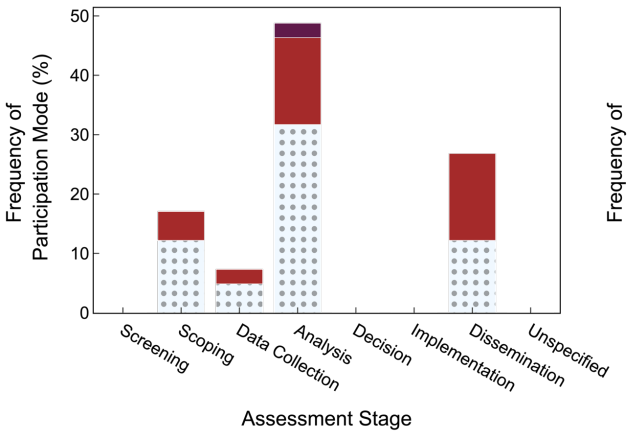


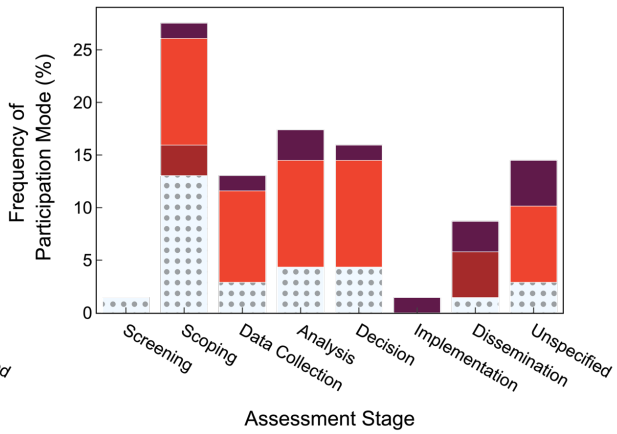
EIA



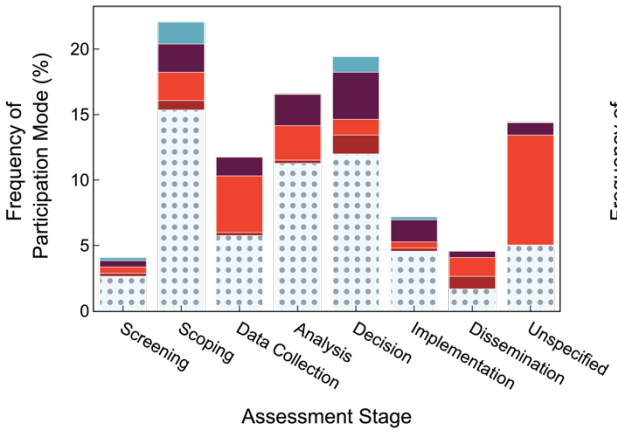
ELCA



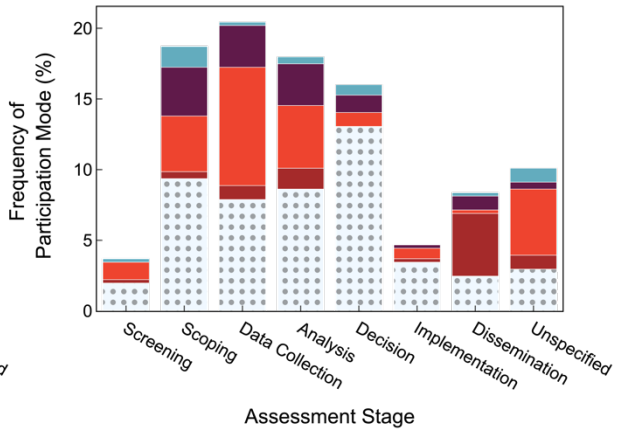
HealthRA



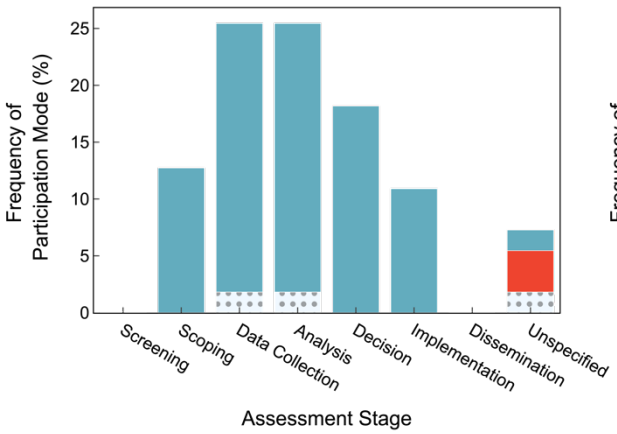
HeritageIA (Y)



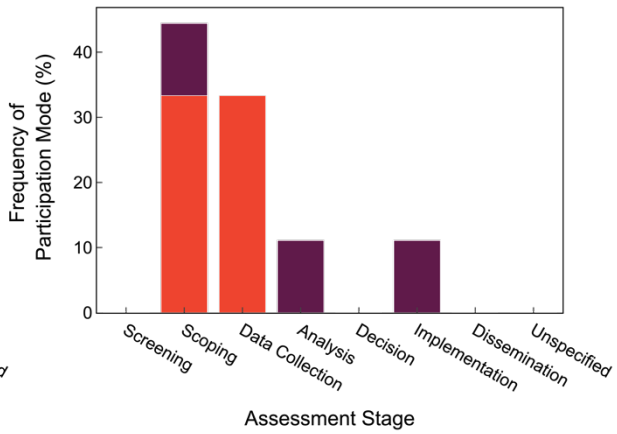
HIA (Y)



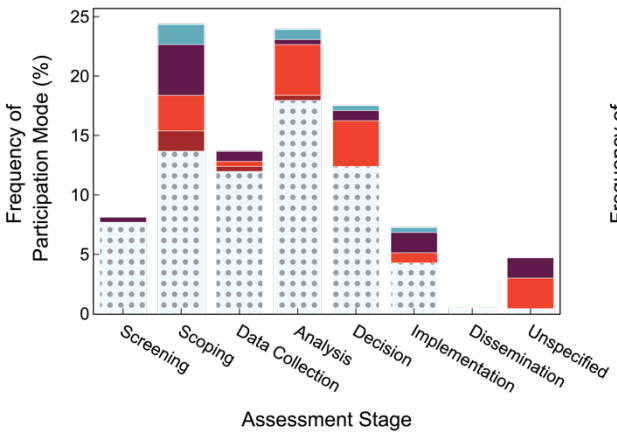
LocTHIRA



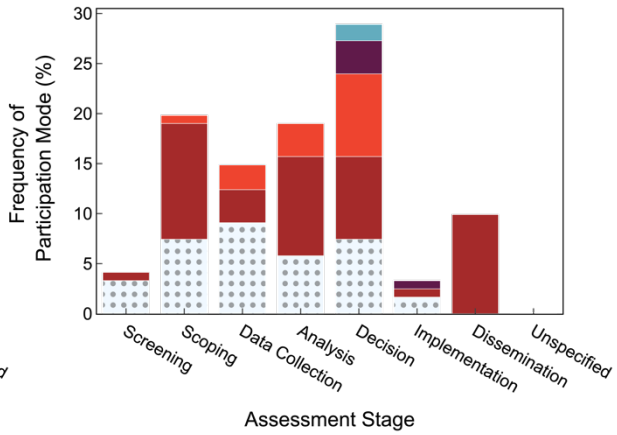
NatTHIRA



NRDA



Permits



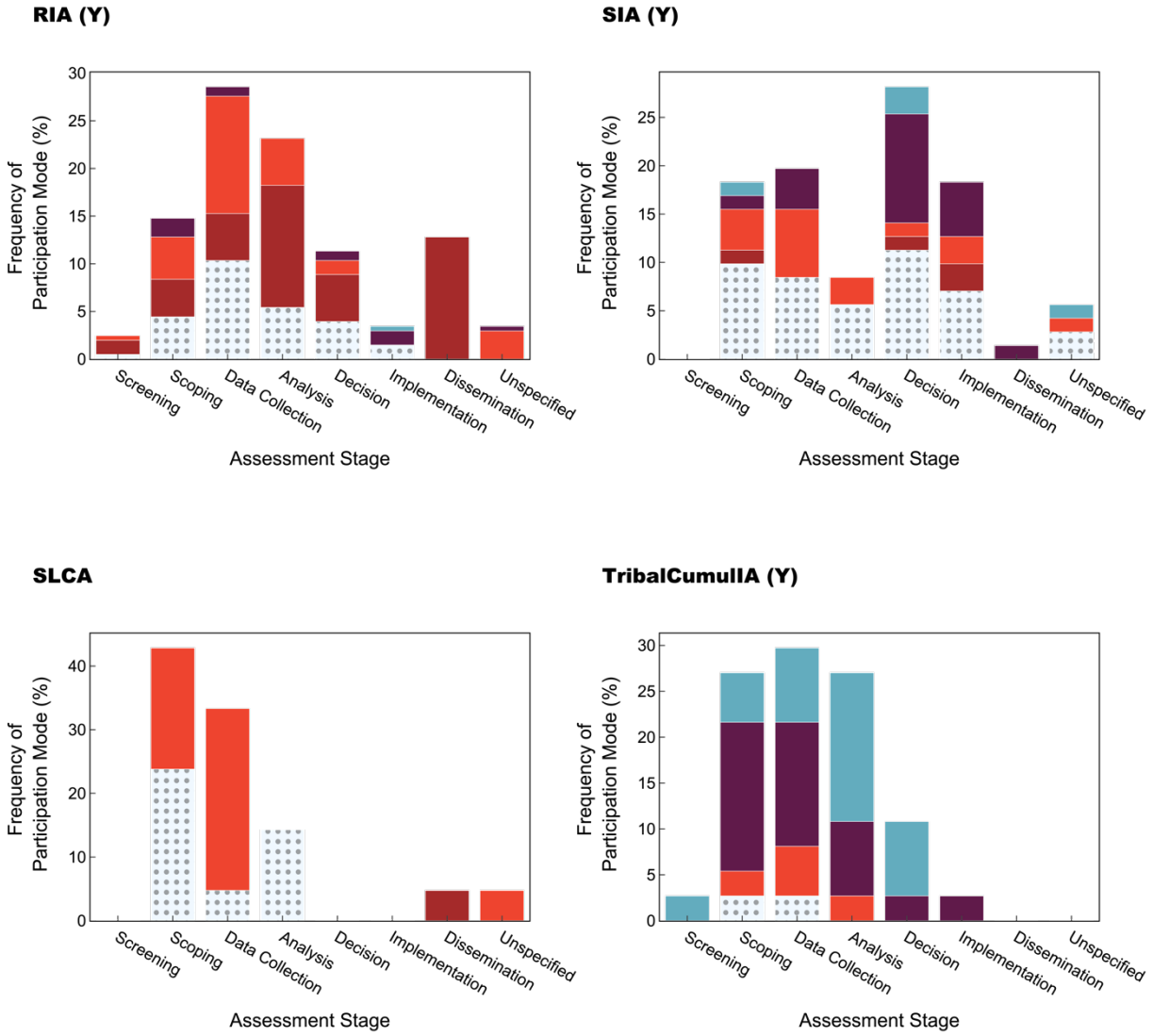


Figure 1: Modes of participation described at each assessment step for each assessment method. (Y) markings indicate that the protocols explicitly reference IK, Traditional Knowledge (TK), or Traditional Ecological Knowledge (TEK). There were no references to participation in TEA.

The mode of participation varies both within and between methodologies (Figure 1). Each assessment method displays a unique pattern of participation, but opportunities for participation are generally more frequent in earlier assessment steps like scoping, data collection, and analysis, a similar finding as in Larsen 2018.[35] Limited opportunities for participation in the earliest screening step (deciding whether and how to conduct the assessment) and in later decision-making

steps could mean Indigenous Peoples are exploited for their knowledge and/or resources but left out of final decisions.[37,38]

In particular, participation in the permitting process, EIA protocols, and RIA protocols occurs primarily via notification and consultation. Of the assessments we evaluated, permitting and EIA greatly influence decisions about large-scale projects requiring state and federal approvals. RIA meanwhile directly informs federal policy choices. These assessments have not adopted practices that affirm Indigenous sovereignty; notification violates sovereignty while consultation could simply pay it lip service. Despite the Tribal consultation guidelines of many government agencies, how consultation transpires in reality spans a variety of participation modes (see Methods). Quoting legal scholars, the Congressional Research Service notes that "'consultation remains vague and [practically] unenforceable.'"[39] References to consultation in assessment protocol language therefore fail to ensure Tribal sovereignty support, hence our label of "sovereignty-feigning." Other federally-influential assessments include HeritageIA, NRDA, and EcoRA, all of which are marked by high levels of ambiguity in terms of actual participation practices. ELCA and SLCA are incorporated in some policies such as the Renewable Fuel Standard[40] and are generally meant to provide a holistic measure of sustainability, yet these methods also limit participation to notification and consultation.

The Wehipeihana Model of Indigenous evaluation (Fig. 2) describes how evaluation can be done *to*, *for*, *with*, *by*, or *as* Indigenous Peoples,[41,42] and here we align it with Larsen 2018's framework. Notification indicates assessment processes that are done *to* Indigenous Peoples, consultation indicates processes done *for* Indigenous Peoples, co-management indicates processes done *by* Indigenous Peoples, and community-owned indicates processes done *as* Indigenous Peoples.[35,41,42] *For*, *with*, *by*, and *as* represent a continuum ranging from minimal Indigenous participation within exclusively Western-scientific approaches (*for*) to complete Indigenous control over the methods and values defining the assessment (*as*).[41,42] While lacking distinction by assessment step, visualizing where the assessments fall on the Wehipeihana Model allows for a high-level understanding of which assessments require the most adjustment to at minimum support and ideally affirm sovereignty.[41,42]

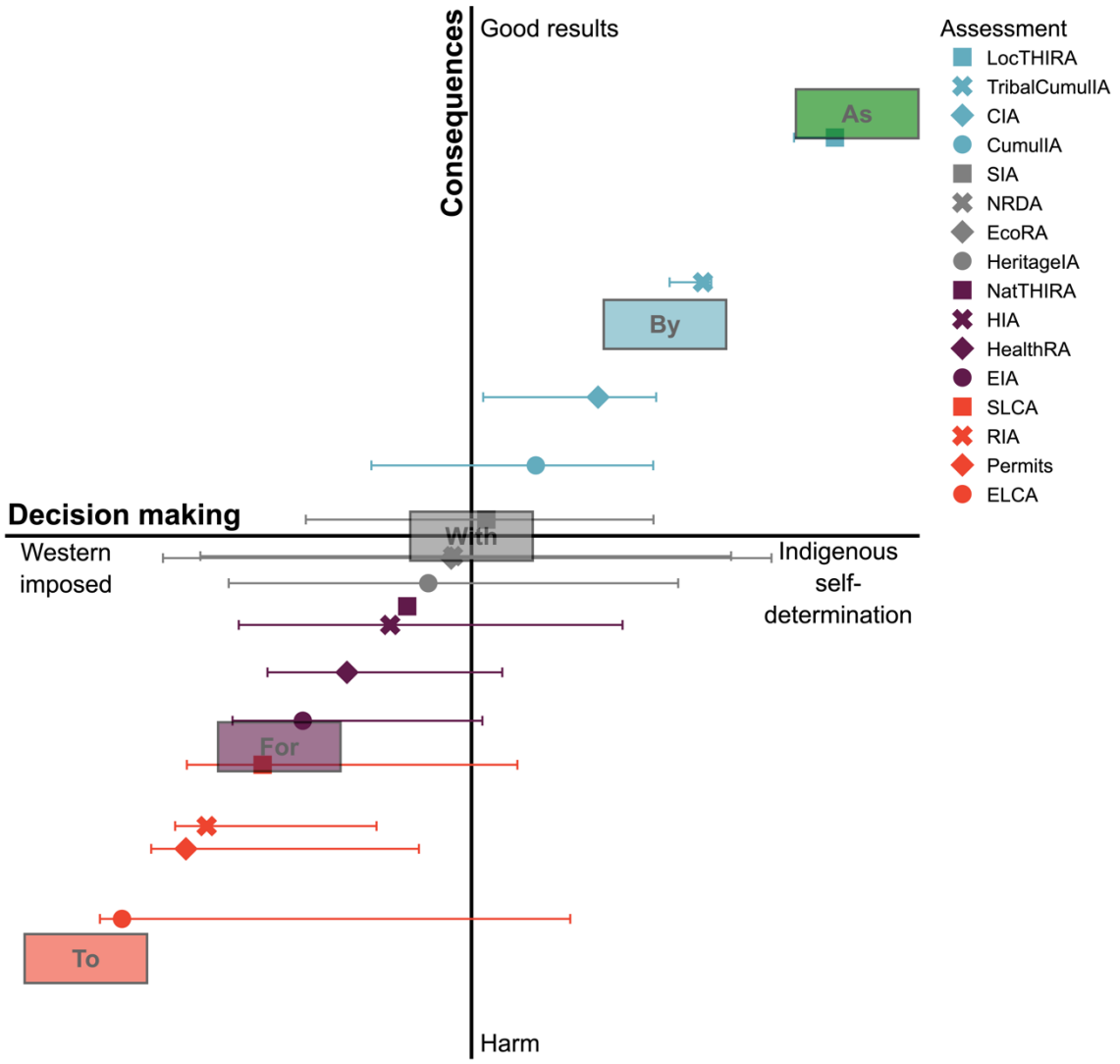


Figure 2: Mapping sustainability assessment procedures onto the Wehipeihana Model of Indigenous evaluation. Note that ambiguous language regarding participation generates high uncertainty for many assessment methods. Uncertainty bars represent how an assessment's location on the plot could shift if all ambiguous language is transformed to community-owned (bar towards the right) or notification (bar towards the left) language (see Methods).

Previous research generally does not mention the prevalence of ambiguous language in assessment protocols,[34,35] but the application of ambiguous language in practice likely governs the level of sovereignty-affirmation or violation (Fig. 2). Ambiguous language poses sovereignty

violation risks, but also leaves room for the procedures to adopt sovereignty-affirming methodologies. Such growth demands specific language requiring Indigenous co-management (at minimum) in any situation impacting Indigenous sovereignty. Procedures must specify that only Tribes themselves can waive participation by co-management.

Some assessment protocols could serve as guides for improving assessment methods. TribalCumulIA procedures co-written by several Tribal organizations and EPA Region 5 include many instances of co-management language,[43] while draft TribalCumulIA procedures written by Honor the Earth for the Minnesota Chippewa Tribe offer strong examples of community-owned processes.[44] Additionally, emphasis on community control of the assessment pushes LocTHIRA toward "*as*," but it should be noted that without explicit reference to IK there is still a risk that actual assessment implementation could exclude Indigenous methodologies and values. In fact, FEMA's THIRA guidelines require standardized language that could limit meaningful Indigenous participation (see Table 2), yet clarifications that communities can choose to incorporate their own language could still support IK inclusion.[45]

Studying protocol language is not the same as studying real-world assessment implementation, and this analysis does not assess any agency guidelines on Tribal consultation not outlined in assessment procedures. Still, our approach can guide future work in these areas. For now, protocol language indicates, at least qualitatively, whether the assessment methods that inform decision making will affirm or violate sovereignty. The majority of assessments analyzed here fall somewhere between assessments *for* and *by* Indigenous Peoples, in the "*with*" space where consultation often replaces consent. Asemaa did not teach the Human World to consult. Asemaa taught the Human World to ask permission; Asemaa spoke of consent. Consultation fails to ensure consent-based relationships among the Four Orders of Creation. Honoring these interconnected relationships is crucial for a sustainable future.

Connection

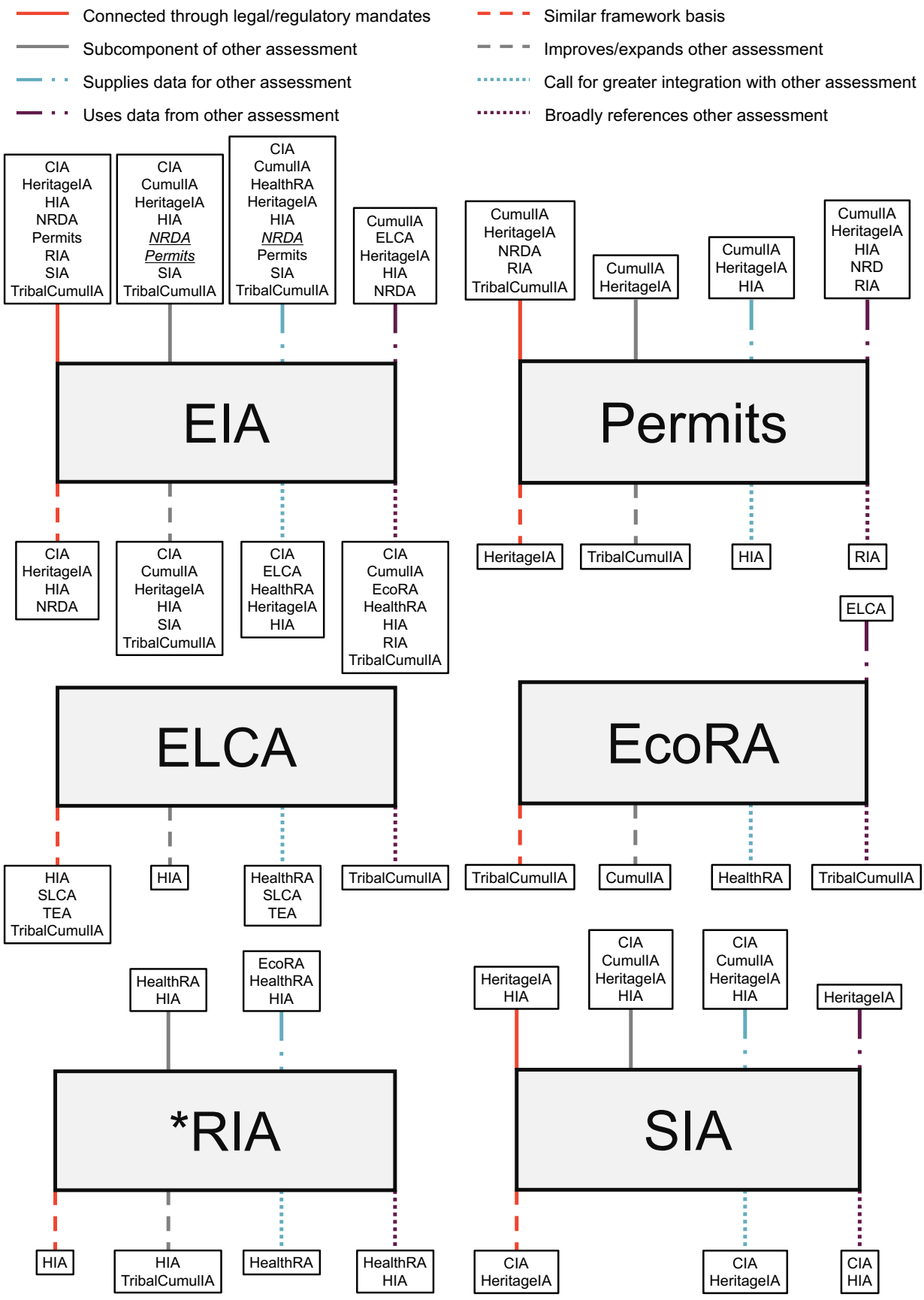
The Creator sent the Ma'iingan (wolf) and the Anishinaabe to travel the world together, naming the plants, animals, and other relatives they encountered. When their travels were complete, the Creator said they must be separated but would forever maintain a brotherhood. The Creator told

them that Ma'iinganag and Anishinaabeg would be forever connected, and whatever happens to one will happen to the other.

- *Based on teachings from many accounts, but especially from Marvin DeFoe Shingwe Bines, Neme (Sturgeon) Clan, member of Gaa-miskwaabikaang (the Red Cliff Band of Lake Superior Chippewa).*[26]

The Anishinaabeg teach that human well-being is intrinsically tied to broader ecological well-being.[2,46] Sustainability, and the assessments that measure it, must respect these connections between the Four Orders of Creation. Assessments may aspire to include multiple kinds of environmental, social, economic, and/or cultural effects; however, most specialize in only one or occasionally two of these pillars of sustainability (see SI Section 3). Many assessments defer to other assessments to fill the gaps outside their primary focus. The assessments are therefore highly intertwined. Mapping instances where one assessment references another in its protocols (Fig. 3), direct connections emerge between all 17 assessment methods. EIA and permits in particular are hubs that connect many assessments. The key role EIA and other permitting documents play in decision-making processes cement these assessments as valuable sources of data, recipients of other assessment data, and subjects of improvement efforts. Additional, indirect connections are outlined in SI Section 4.

With most individual assessments providing only a partial measure of sustainability, assessments accordingly work best collectively. Health effects not considered in EcoRA are considered in HealthRA; social effects not considered in ELCA are considered in SLCA. However, relying on connections between over a dozen assessment methods instead of focusing on fewer, more holistic methods generates a complex and burdensome assessment space. Tribes often contend with limited capacity to undertake multiple assessments, and evaluating environmental, social, economic, or cultural impacts in separate assessments is antithetical to many Indigenous teachings of interconnected human and older-than-human well-being. It is not enough, nor is it possible, to merely "include" IK; the assessment frameworks themselves need to be rebuilt by Indigenous Knowledge holders and Western scientists alike. Fewer assessments employing co-developed methods would generate a less burdensome yet more robust sustainability assessment space, reducing capacity demand and affirming Indigenous participation "*by*" or "*as*".



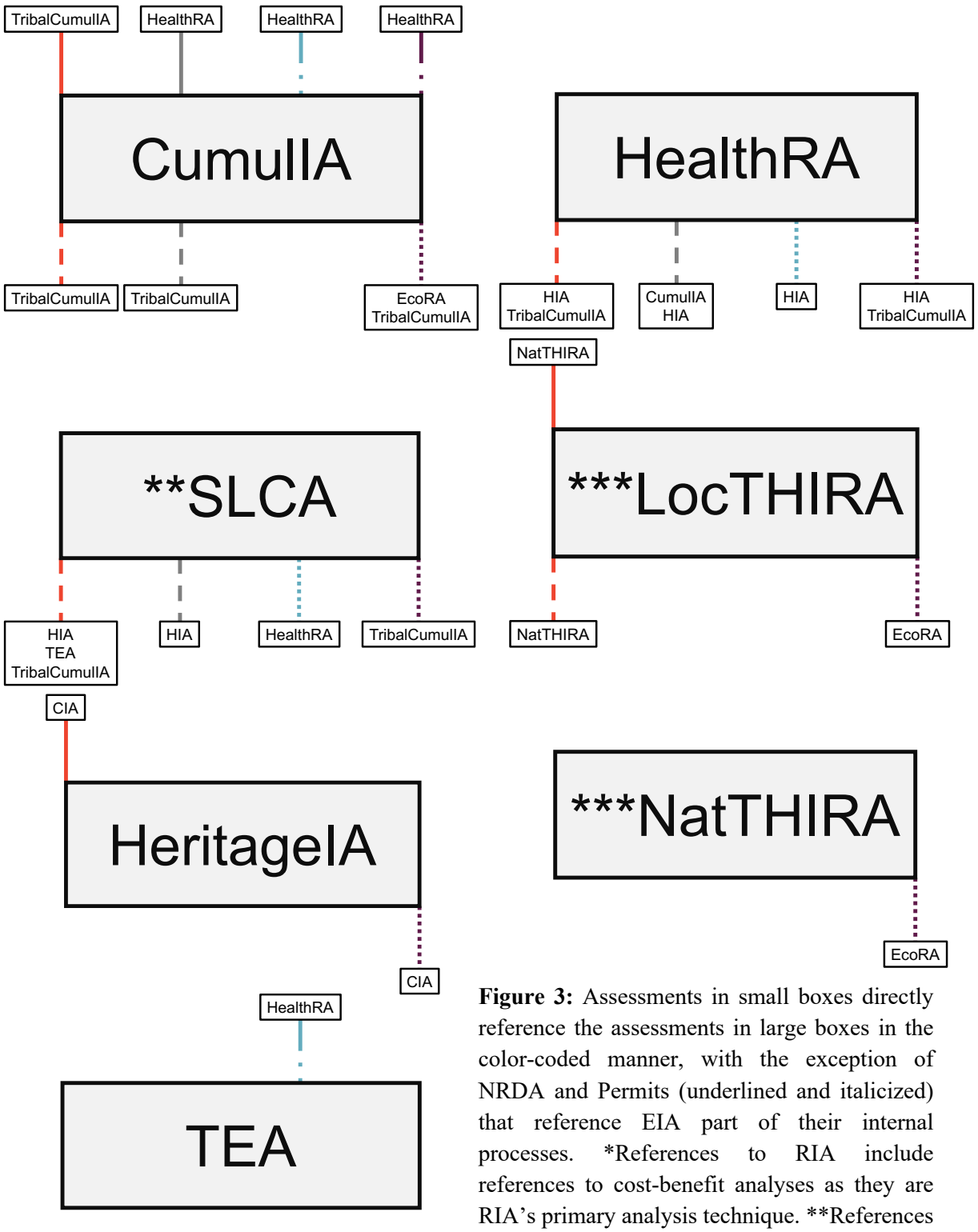


Figure 3: Assessments in small boxes directly reference the assessments in large boxes in the color-coded manner, with the exception of NRDA and Permits (underlined and italicized) that reference EIA part of their internal processes. *References to RIA include references to cost-benefit analyses as they are RIA's primary analysis technique. **References to life cycle analysis connect to both ELCA and SLCA. ***References to hazard assessment connect to both LocTHIRA and NatTHIRA.

What happens to Ma'iinganag happens to the Anishinaabeg,[47] and increasingly DeFoe expects what happens to Ma'iinganag will happen to all humankind.[26] The brotherhood between the Anishinaabeg and Ma'iinganag represents the overarching connection between the Human World and the older Orders of Creation.[26] As human actions violate these connections, the fate of Ma'iinganag ultimately foreshadows the fate of all people.[26] Assessments that fail to holistically evaluate sustainability jeopardize these connections between the Four Orders of Creation. Alternatively, assessments that are co-built with Indigenous Knowledge systems would inherently encompass these connections. Co-developing such assessments cannot happen unless the procedures that underpin assessments all respect sovereignty.

Discussion

Kinship – Returning to The Seventh Fire Prophecy

The Seventh Fire warns of the consequences that arise when relationships deteriorate. Methodologies centering reciprocity, respect, care, and justice are necessary for the relationship restoration and kinship essential to any genuine sustainability efforts.[46,48–53] For sustainability assessments, kinship forms when procedures embrace diverse knowledge systems. Weaving knowledge systems together forms a more robust understanding of sustainability than any single knowledge system could glean on its own.[2,18–21,54] Here, Anishinaabe Gikendaasowin gives meaning to and examples of sustainable, sovereignty-affirming practices, while the analysis results point to the changes required for assessments to guide sustainable decision-making according to this Knowledge (Fig. 4).

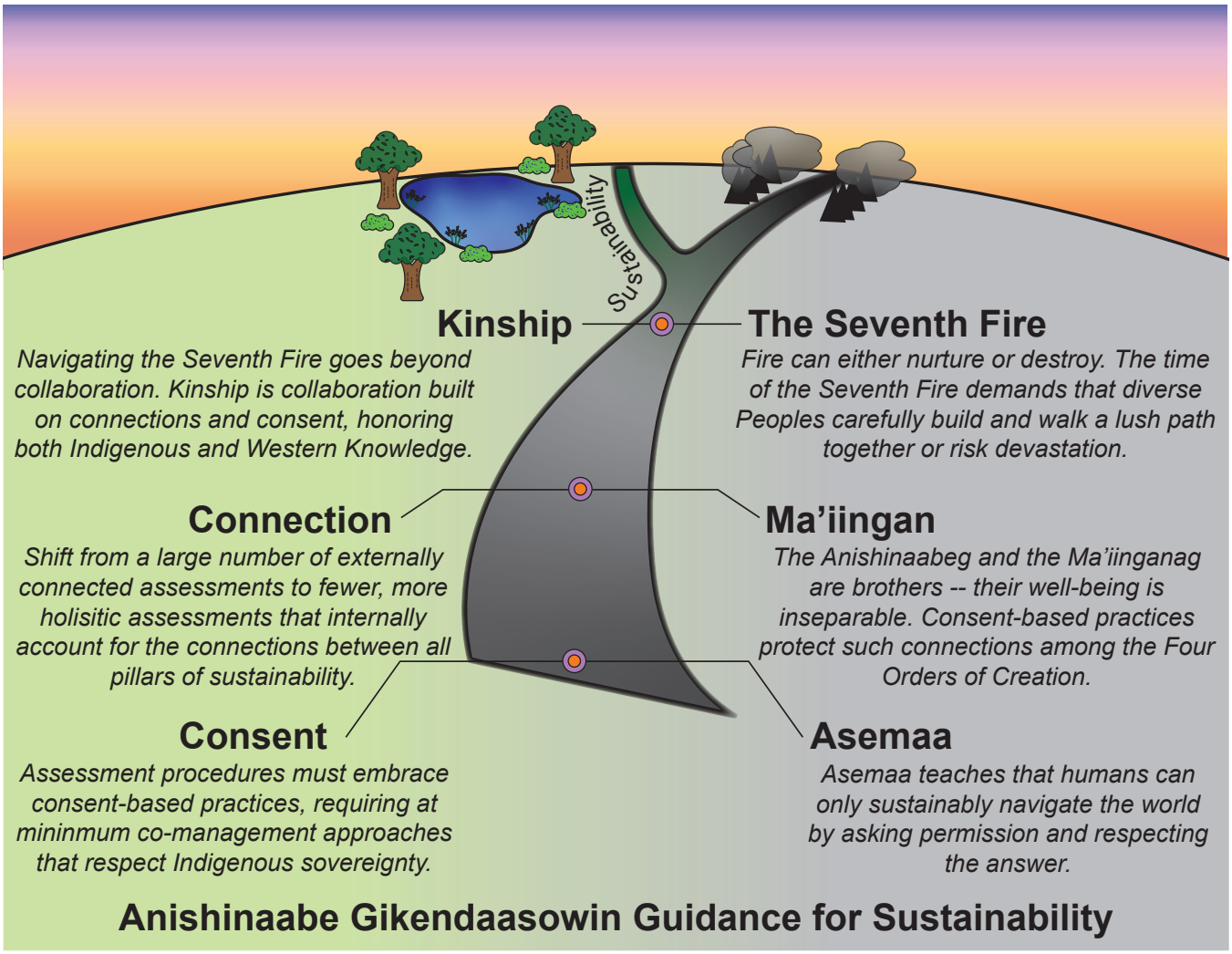


Figure 4: The relationship between the Anishinaabe Gikendaasowin guiding this work and the analysis conclusions.

There is a significant gap between current assessment protocols and practices that support sovereignty. Consultation and mere IK inclusion can reinforce extractive tendencies that exploit IK only as a supplement to Western scientific Knowledge and only when convenient.[55] Kinship-based approaches demand that sustainability assessment methods evolve from such "check-the-box" consultative practices to practices that support Indigenous participation according to their own values, knowledge, and leadership.[38] Given that only eight out of the seventeen assessment methods evaluated here contain any reference to IK, TK, and/or TEK (Fig. 1), sustainability assessments in the U.S. largely lack such kinship-based approaches. White House directives (2021, 2022) may encourage IK inclusion, but Table 1 outlines examples of language in sustainability assessment protocols that act as barriers to legitimate Indigenous engagement .[10,34,36,55]

Table 1: Barriers to Indigenous engagement in assessment protocols – shaded boxes indicate assessments containing barrier language

Assessments (Shaded = Barrier Present)				Barriers	Description
CIA	**CumulIA**	**EcoRA**	**EIA**	Constrained knowledge systems (A)	Western Scientific Knowledge is privileged over Indigenous Knowledge as seen through preference for technocratic, externally-imposed approaches; defining importance, value, and/or significance based on narrow, human-centered considerations; inflexible use of standardized language or methods; assuming ecological relationships can be replaced; excluding impacts not yet understood by Western science; and/or the misuse of Indigenous Knowledge ("cherry-picking," lack of Tribal control, etc.) This theme also includes the diminishment of community input as potentially unreliable or unaligned with scientific integrity and the diminishment of values or methods not standard to Western science.
ELCA	**HealthRA**	**HeritageIA**	**HIA**		
LocTHIRA	**NatTHIRA**	**NRDA**	**Permits**		
RIA	SIA	**SLCA**	TEA		
CIA	CumulIA	**EcoRA**	**EIA**	Exclusionary expertise (B)	Emphasizing the use of scientific literature, standards, peer review, and/or the judgement/expertise of experts, professionals, or specialists without clarification that Indigenous Knowledge is a form of expertise and Indigenous Knowledge holders are experts.
ELCA	**HealthRA**	**HeritageIA**	**HIA**		
LocTHIRA	NatTHIRA	**NRDA**	**Permits**		
RIA	SIA	**SLCA**	TEA		
CIA	**CumulIA**	EcoRA	EIA	Quantitative bias (C)	Preferring or prioritizing quantitative methods over qualitative approaches, including the use of quantitative indicators or impacts that lack flexibility for qualitative considerations.
ELCA	**HealthRA**	**HeritageIA**	**HIA**		
LocTHIRA	**NatTHIRA**	**NRDA**	**Permits**		
RIA	SIA	**SLCA**	**TEA**		
CIA	**CumulIA**	EcoRA	EIA	Economic fixation	

ELCA	HealthRA	**HeritageIA**	**HIA**	(D)	There is a focus on economic impact indicators and/or monetization of impacts, including the use of compensation as a means to mitigate impacts via relocation or other means. This theme also includes emphasis on functional value in opposition to intrinsic value and limiting what assessment is conducted, what methods are used, and what alternatives are considered based on economic considerations.
LocTHIRA	NatTHIRA	**NRDA**	**Permits**		
RIA	**SIA**	**SLCA**	**TEA**		
CIA	CumulIA	EcoRA	EIA	Discounted future (E)	Explicit references to discounting impacts to future generations and/or discounting impacts the more in the future they occur.
ELCA	HealthRA	HeritageIA	HIA		
LocTHIRA	NatTHIRA	NRDA	Permits		
RIA	SIA	SLCA	TEA		
CIA	**CumulIA**	EcoRA	**EIA**	Assumed proportionality (F)	Assuming that a project's impact/significance is directly proportional to the size of the project, with impacts limited to the project area with little to no consideration of indirect or remote impacts. This includes the use of less vigorous assessments based on perceived project insignificance, limiting participation if impacts are not considered severe enough, assumptions that generic data can substitute for site-specific data, and demanding brevity by restricting descriptive information inclusion.
ELCA	**HealthRA**	**HeritageIA**	**HIA**		
LocTHIRA	NatTHIRA	**NRDA**	**Permits**		
RIA	SIA	**SLCA**	TEA		
CIA	**CumulIA**	EcoRA	EIA	Stringent capacity demands (G)	Time, technical, personnel, financial, and/or other resource demands are described as limiting either the community's ability to perform or participate in the assessment or limit the scope, methods, and/or participation approaches used by an external assessment
ELCA	**HealthRA**	**HeritageIA**	**HIA**		
LocTHIRA	NatTHIRA	**NRDA**	**Permits**		

RIA	SIA	**SLCA**	TEA		practitioner. This theme also includes the use of deadlines for participation that do not account for potentially limited capacities and dissemination via the Internet alone.
CIA	CumulIA	EcoRA	**EIA**	Environmental disconnect (H)	An assessment specifically notes that it considers only environmental impacts without consideration of social or economic impacts or vice versa. Includes cases where the consideration of interconnected environmental and social effects is specifically noted as optional.
ELCA	HealthRA	HeritageIA	HIA		
LocTHIRA	NatTHIRA	NRDA	Permits		
RIA	SIA	**SLCA**	**TEA**		
CIA	CumulIA	EcoRA	EIA	Failure to disclose (I)	The assessment is described as often going undisclosed based on practitioner discretion.
ELCA	HealthRA	HeritageIA	**HIA**		
LocTHIRA	NatTHIRA	NRDA	Permits		
RIA	SIA	SLCA	TEA		
CIA	CumulIA	**EcoRA**	**EIA**	Sovereignty violation (J)	Indigenous sovereignty is violated due to unilateral decision-making; avenues for bypassing Tribal agreements, laws, and/or authority; Tribal authorities are not included as decision-makers or are categorized as part of broader public without sovereignty recognition; participatory processes are described as optional without clarifying requirements for respecting Tribal sovereignty; and/or free, prior, and informed consent is described as an aim and not a requirement.
ELCA	**HealthRA**	**HeritageIA**	**HIA**		
LocTHIRA	NatTHIRA	**NRDA**	**Permits**		
RIA	**SIA**	**SLCA**	TEA		

Real-world assessment performance may pose additional barriers or demonstrate improvements in sovereignty affirmation not reflected in protocol language; the level of ambiguous language (Fig. 2 and 3) leaves the degree of Indigenous engagement to the assessment practitioner's discretion. Moreover, several of these barriers exist to maintain decision-making processes informed by scientific data, ideally independent of corrupting influences (described in the middle column of Table 2). A sustainable future requires scientifically-informed, expert-backed decisions; at the same time, a sustainable future also requires respect for human rights and Indigenous sovereignty. "Expert" and "scientific" must include Indigenous Knowledge holders and IK-based methods. The barriers outlined in Table 1 act as tipping points where assessments could slide down toward sovereignty violation (left column of Table 2) or step up to sovereignty affirmation (right column of Table 2).

Honoring Indigenous Knowledge does not mean diminishing Western science; many Indigenous Knowledge holders recognize both the value of Western science and the opportunities for it to learn from IK. Respect for both knowledge systems is likely one reason TribalCumulIA maps closer to "*by*" than "*as*" on the Wehipeihana Model; the protocols co-developed by Anishinaabe Tribes and the U.S. EPA Region 5 emphasize partnership and coordination while the draft protocols written by Honor the Earth and the Minnesota Chippewa Tribe outline examples of Western methodologies that could align with Anishinaabe values.[43,44] Kinship is not about replacing one hierarchy with another; kinship breaks down hierarchy to foster collaborations based on consent and connection. To begin this process, Western science must respect the intellectual heritage IK represents. This heritage stems from the deep, irreplaceable understanding of ecological relationships and responsibilities upheld by Indigenous Peoples from generations of lived observation.

Table 2: Steps toward sovereignty affirmation

Sovereignty Violation	Potential Barrier Explanation	Sovereignty Affirmation
Description of potential risks should protocol language be interpreted or adjusted in a manner that further violates sovereignty.	Possible reasoning behind the existence of some language that, while potentially well-intentioned, risks sovereignty violation if not further clarified. Note that Barrier J, which involves language that directly violates sovereignty, is not listed in this column as there are no acceptable partial measures when if comes to upholding sovereignty.	Examples of steps that would shift barrier language into the realm of sovereignty-affirming protocols.
Violating	**Barriers A & B**	**Affirming**
Indigenous Knowledge holders not considered experts	Scientific Knowledge provides valuable information	Indigenous methodologies applied in parallel with scientific methodologies
Actors with conflicts of interest skew or undermine scientific findings	Expert knowledge must be valued	Indigenous Knowledge and Indigenous Knowledge holders are treated with the same authority as scientific experts
Violating	**Barriers C & D**	**Affirming**
Anything current Scientific Knowledge cannot quantify is excluded from decision-making considerations	Quantitative results can aid in decision-making and provide a guide for expedient comparisons	Indigenous Knowledge treated with the authority of quantitative science, especially when scientific uncertainty is high
The guise of scientific objectivity obfuscates underlying bias	Quantitative results often considered an objective means to limit biased influences	Indigenous values shape considerations that, while not "objective," include morality and ethics
Risk defining value based only on what can be monetized	Economic implications are important to consider – decisions should not burden already financially strained communities	Economics are considered as one part, not as the whole; compensation is not a substitute for intact health and ecosystems
Violating	**Barriers E, F, G, & H**	**Affirming**
The full extent of impacts go unaccounted for, and those who are remote, are impacted indirectly, and/or future generations suffer	Assessment scope does need to be limited to ensure that analyses can be feasibly completed to provide timely information for decision-making	Assessments utilize a seven-generation approach that honors the connection between human and environmental health
Forms of knowledge that focus on oral-based, descriptive understandings are excluded	Brevity can help avoid an inundation of information that obfuscates conclusions	Indigenous Knowledge relayed through story-telling is treated with respect
Historically marginalized voices with less capacity go unheard	Assessments need to be performed with rigor	Capacity-building programs are implemented so marginalized groups can conduct assessments themselves, and strict time limits for assessments are adjusted to account for capacity limits
Violating	**Barrier I**	**Affirming**
Failure to disclose can enable violations and prevent accountability and enforcement practices	Disclosure protocols are needed to protect data sovereignty	Transparency remains central, with Indigenous Knowledge holders deciding what knowledge of theirs can or cannot be disclosed
Barrier J		**Affirming**
Indigenous history, sovereignty, and inherent right to govern their ancestral lands is ignored and violated		Recognize and honor Indigenous sovereignty and decision-making authority Require, at minimum, assessment, decision-making, and implementation practices that utilize co-management approaches

Sustainability as connection, consent, and kinship

Sovereignty stands at a crossroads in many arenas. After failing to meaningfully consult with the Ojibwe, Wisconsin's 2021 wolf hunt devastated the kinship between Ma'iinganag and their Physical, Plant, Animal, and Anishinaabeg relatives.[47,56,57] Meanwhile, the Minnesota Legislature's repeated attempts for the benefit of mining activities to remove or weaken the sulfate standard that protects manoomin (wild rice) ignore both Indigenous and Scientific Knowledge.[58] Still, there are opportunities for kinship. For example, the governor of Minnesota vetoed the efforts to repeal the sulfate standard, noting that delegates "decided — based upon their own subjective analyses — that they do not like the science."[58] The Supreme Court of the United States affirmed the Anishinaabeg's usufructuary treaty rights, stating that "Indian treaty rights can coexist with state management of natural resources."[59,60] Recent EPA regulations require states to consider such Tribal reserved rights when developing water quality standards,[61] and in 2021 the U.S. Department of the Interior and Department of Agriculture issued a joint order for co-stewardship with Indian Tribes.[62]

As regulators hopefully continue to trend towards consensus and co-management, sustainability assessment frameworks must likewise shift from methods of consultation to methods of consent, honoring Indigenous sovereignty and weaving IK and SK together. Here, we embrace Anishinology and Two-Eyed Seeing approaches. Western science-based techniques guide our methods, while Anishinaabe Gikendaasowin shared over years of relationship-building frame the concepts of sustainability and sovereignty at the heart of our work. White House guidance may change. Government agency procedures may change. Against the often-unreliable attitudes of U.S. federal and state decision-makers, Anishinaabe Gikendaasowin holds firm and has held firm since time immemorial.[55] These teachings illustrate that sustainability respects the connection between nature and people, between the Ma'iinganag and the Anishinaabeg. Sustainability restores reverence for the Four Orders of Creation and the practice of consent. Sustainability means working together and working with care, ensuring that the Seventh Fire yields a just path walked together.

Methods

Author Positionality:

Margaret G. O'Connell: Margaret (Maggie) is a PhD candidate in the Department of Chemical and Biological Engineering at Northwestern University. Maggie lives in Chicago, IL and works in Prof. Jennifer Dunn's lab (the Systems Analysis Research Group). Over the past three years, Maggie has attended numerous events hosted by Ojibwe Tribes and/or the Great Lakes Fish and Wildlife Commission (GLIFWC), building relationships that go much deeper than typical Western science research collaborations.

Kathleen Smith: Kathleen Smith is a member of Gakiiwe'onaning (the Keweenaw Bay Indian Community of the Lake Superior Band of Chippewa Indians). She is the Manoomin Ganawandang (She Who Takes Care of the Wild Rice) at GLIFWC in Odanah, WI. Previously managing firefighting crews in the southwest U.S., her relationships to ishkode (fire) and nibi (water) combine with her ecological knowledge to root her stewardship of manoomin (wild rice) in both science and culture.

Mike Wiggins Jr.: Mike Wiggins Jr. is a member of Mashkiiziibii (the Bad River Band of Lake Superior Chippewa), where he served as Tribal Chairman and Executive Director from 2011-2023. Mike is now the director of the Madeline Island Museum where he emphasizes Ojibwe heritage and ancestral connections to the region.

Marvin DeFoe Shingwe Bines, Neme Clan: Marvin DeFoe Shingwe Bines, of the Neme (Sturgeon) Clan, is a member of Gaa-miskwaabikaang (the Red Cliff Band of Lake Superior Chippewa) where he serves as Tribal Historic Preservation Officer. Marvin carries on many teachings from his ancestors, including crafting wiigwaasi-jiimaanan (birchbark canoes) and steadfastly advocating for the Anishinaabeg's brothers, the ma'iingangag (wolves).

James Rasmussen: James Rasmussen is a policy analyst at GLIFWC in Odanah, Wisconsin. He has a B.S. in Life Sciences Communication from University of Wisconsin-Madison and a Juris Doctorate from University of St. Thomas School of Law. At GLIFWC, James focuses on asserting the sovereignty of the 11 Ojibwe Tribes GLIFWC serves and protecting natural resources for future generations.

Esteban Chiriboga: Esteban Chiriboga is an Environmental Specialist with GLIFWC in Madison, Wisconsin. He has a B.A. in Geography and Geology from Indiana State University and a M.S. in Geography from the University of Wisconsin-Madison. For over 25 years, Esteban has provided a

variety of research and mapping services to the Commission, including the development of data, methods, and maps in areas such as hydrology, climate change, pipelines, dam relicensing, aquatic invasive species and mercury contamination. He also provides technical review of proposed mining and industrial development projects with an emphasis on the identification of their impacts on tribal traditional lifeways and the natural resources that those lifeways depend upon.

Michael Waasegiizhig Price: Michael Waasegiizhig Price is Anishinaabe, and he works both as the traditional ecological knowledge specialist at GLIFWC in Odanah, Wisconsin and as an adjunct professor at University of Minnesota Duluth. At GLIFWC, his knowledge of Ojibwemowin (Ojibwe language) and Ojibwe teachings ensures the Commission's work to protect natural resources throughout the Ceded Territories is grounded in Ojibwe culture.

Kimberly R. Marion Suiseeya: Kimberly R. Marion Suiseeya is an environmental social scientist at Duke University's Nicholas School of the Environment. She specializes in global environmental politics, environmental justice, and political ecology.

Jennifer B. Dunn: is a Professor in the Department of Chemical and Biological Engineering at Northwestern University. Together with Prof. Suiseeya, she has secured funding to support research to incorporate Indigenous Knowledge into sustainability decision making. GLIFWC members have attended workshops she has organized on the topic of sustainable minerals in Santiago, Chile, and Evanston, Illinois to contribute their insights to the development of this research.

This work began with a series of three listening sessions in February and March of 2021.[27] The listening sessions included Ojibwe Tribal Members and staff from the Great Lakes Indian Fish and Wildlife Commission (GLIFWC), and they were conducted as part of a National Science Foundation (NSF) award encouraging Tribally-led research (NSF Award No. 2044053). Researchers at the listening sessions brought their skills to the discussion, but worked to not bring pre-conceived ideas of research projects. Instead, Ojibwe Tribal Members, GLIFWC staff, and Northwestern University researchers co-generated collaboration ideas based on the Knowledge and concerns shared by Tribal Members. Since 2021, the authors of this paper based at Northwestern University have attended numerous events, meetings, and gatherings hosted by Ojibwe Tribes and/or GLIFWC. Over the course of these years of listening, sharing, and relationship-building, a common theme arose from conversations: the vital role of sovereignty in

Tribal efforts to preserve lifeways and mitigate/adapt to climate change. Essentially, the vital role of sovereignty in sustainability. Many discussions referenced the capacity challenges of navigating federal/state decision making and the assessments that are part of decision-making processes, and the teachings guiding this analysis were shared in multiple contexts over the years.

The concept for this analysis was not formulated until after this period of relationship-building and listening (efforts that remain ongoing); it was critical that authors have a foundation of trust and a shared understanding of how sustainability presents itself in Ojibwe teachings. Moreover, these relationships extend beyond this analysis, with continuing collaboration and partnership. Before embarking on the analysis, Margaret O'Connell asked permission from Kathleen Smith, Mike Wiggins Jr., and Marvin DeFoe Shingwe Bines to understand if it would appropriate to center the teachings of the Seventh Fire, Asemaa, and Ma'iingan in the analysis.[1,26,28] When permission was granted, she sought guidance on how to respectfully honor the teachings in the work. O'Connell – a chemical engineer by training – worked with Anishinaabe Gikendaasowin holders and other coauthors with backgrounds in law, political science, and ecology to co-produce this work with an Anishinology foundation and Two-Eyed Seeing methodology:

> *Anishinology*: Anishinology is a knowledge system named by Ojibwe Elder Marvin DeFoe.[26,27] DeFoe describes Anishinology as a process of blending science and humanity in a way that honors "Natural Law."[26] This Natural Law is not made by humans, nor can it be changed by humans; it is the Law that governs relationships among the Four Orders of Creation and serves as the fundamental basis for sustainability.[26] DeFoe notes that for too long Western SK has separated itself from IK and from the practice of humanity.[26] Ojibwe Elder Kathleen Smith elaborates on this, explaining that while Western science excels in the practice of listening and seeing, the crossroads of the Seventh Fire demands that we use all of our senses; it demands that we feel.[1] The Seventh Fire demands that we allow emotion to connect us to the Natural World, restoring kinship with the Physical, Plant, and Animal Worlds as well as with each other.[1]
>
> *Two-Eyed Seeing*: Mi'kmaq Elders Albert Marshall and Murdena Marshall alongside Dr. Cheryl Bartlett developed Etuaptmumk ("Two-Eyed Seeing") to describe a practice employing the strengths of both Indigenous and Western Knowledge systems.[18–21] Two-

> Eyed Seeing involves Knowledge systems co-producing without overruling, respecting the strengths and limitations of both SK and IK so that they most effectively improve outcomes for all.[18–21]

The teachings framing this analysis were not extracted to supplement analysis efforts – the teachings *are* the analysis; they are the motivation behind the analysis and the basis for understanding sustainability and sovereignty in the analysis. Above all else, the authors wish to emphasize the critical role listening plays in the methods for this research. The remainder of this Methods section details the analysis steps that took place after meaningful listening and relationship-building formed the foundation for the collaboration.

The assessments considered here were chosen based on literature searches of Indigenous involvement in various forms of impact assessment, author expertise and experience with different assessment methods, and an informal "snowball sampling" approach incorporating assessments referred to by other assessments. The analysis focuses on the protocols for conducting the assessments, and Table S.1 in SI Section 1 lists the protocol sources evaluated for each assessment method. U.S. federal rules, regulations, or agency policies were given first priority for analysis; followed by state rules or policies – specifically guidance from Hawaii on Cultural Impact Assessment; Minnesota's mining permitting requirements; and guidance from international organizations such as the United Nations, International Organization for Standardization, the International Association for Impact Assessment, and others. Hawaii was the only state the authors could find at the time of writing with guidance for Cultural Impact Assessment specifically, and while permitting requirements will vary by state, mining permitting requirements from MN were analyzed given MN's history of mining, the present push for critical minerals mining within the state to satisfy electric vehicle demand, and the location of MN within Anishinaabe ancestral homelands. Academic literature and organization websites also served as sources.

Analysis took place on over 50 sources to yield a robust understanding of the assessment protocols. Some assessments required analysis of more individual protocol documents than others based on complexity, variability of sources of protocols, and/or quantity of documentation available. As assessment protocols evolve over time, future efforts should expand on this form of analysis to include updated protocols and even additional assessment methodologies. Here, we considered assessments both directly tied to federal, state, or local decision-making and

assessments frequently referred to in literature regarding Indigenous participation in impact assessment, generating an analytical framework that can be broadly applied to future research efforts as assessments ideally develop improved participatory, sovereignty-affirming methods. This analysis includes assessments that cover all four pillars of sustainability (environmental, social, economic, and cultural). SI Section 1 Table S.2 gives descriptions of each assessment, quoted from their own protocols in Table S.1.

Each assessment method was thematically coded with the assistance of the qualitative data analysis software NVivo 20 1.6.2. Coding is a method for discovering patterns and themes in qualitative data that allow the researcher to identify connections within and across data.[63] Coding identified a) participatory language (Figures 1 and 2), b) direct connections among assessments (Figure 3), and c) challenges to Indigenous Knowledge inclusion (Tables 1 and 2).

The first round of analysis involved pulling language regarding participation into a condensed document. This language was then coded as either community-owned, co-management, consultation, notification, or a combination of two or more. Combinations of participation levels were grouped together as "ambiguous." The assessment step associated with the language was also coded initially as one of the following options: screening, scoping, data collection, analysis, decision, implementation, dissemination, and/or unspecified. Unspecified refers to general statements about the role of Tribal, community, public, and/or other forms of participation in the assessment without specifying a particular aspect or step of the assessment during which such participation would occur. SI Section 1 Table S.3 provides additional descriptions of these codes. One particular segment of language may refer to multiple assessment steps, with some having different participation levels than others. In these cases, annotations specified which participation level is associated with which participation step. Subsequent iterations of analysis re-examined each coded instance based on participation level to ensure consistent coding across participation level definitions, followed by re-examination of each coded instance of assessment steps to ensure consistency.

Within each assessment, the total number of participation references was summed, and frequency was calculated based on the percentage of references to a certain assessment step at a certain participation level out of the total number of participation references in the assessment. Therefore, in Figure 1, the frequency bars for each assessment sum across assessment steps to one

hundred percent. This calculation method enables both qualitative comparison of how frequently participation during one step of the assessment is referenced compared to other steps and qualitative comparison of the frequency of different kinds of participation (community-owned, co-management, etc.) referenced within each participation step. While the exact quantitative results may vary depending on if more or less protocol documentation is included and individual interpretation of language, the qualitative trends in participation level and assessment step frequency should remain consistent, with this analysis providing a critical baseline understanding of the current landscape of Indigenous participation within assessment protocols.

After measuring the frequency of each participation level within each participation step, and the frequency of participation in each participation step throughout the overall assessment, an overall score was assigned to the assessment following the Wehipeihana Model of Indigenous evaluation to generate Figure 2. *To* scores at a -2, *for* scores at a -1, *with* at 0, *by* at +1, and *as* at +2 based on their relative positions along the decision-making axis. Accordingly, for each assessment, community-owned language references were weighted with a +2, co-management references were weighted with a +1, consultation was weighted with a -1, and notification was weighted with a -2, producing a weighted average normalized by the total number of community-owned, co-management, consultation, and notification references in the assessment protocol. The weighted average was then re-calculated assuming all ambiguous references are applied as community-owned (+2) and then assuming all ambiguous references are notification (-2) to produce the upper and lower error bounds, respectively.

It should be noted that "consultation" as used in this analysis differs from how consultation is applied in many U.S. federal government settings. Without specific requirements by the U.S. federal government, community-owned, co-management, and notification forms of interacting with Tribes could all be considered different types of "consultation." Consultation is often categorized as either "Big C" Consultation or "Little c" consultation, where "Big C" Consultation involves formal government-to-government interactions between Tribal leaders and U.S. federal decision-makers while "Little c" consultation encompasses more informal communications between agencies and Tribes not at a government-to-government level.[64] Lack of clarity on consultation definitions means that, in practice, there is often ambiguity on when Big C

Consultation is required, and Little c consultation too often acts as a substitute to meaningful government-to-government consultation.

In practice, "consultation" can therefore range from notification to consensus-building. The Congressional Research Services describes the "Federal-Tribal Consultation Spectrum" as ranging from "Communication – Parties communicate about a proposed federal action" to "Consent – Tribe or other Indigenous entity gives or withholds agreement with a proposed federal action."[39] For the purpose of this analysis, we employ methods that distinguish consultation as more than notification but less than co-management or community-ownership (see SI Table S.3 for details on how this definition was applied). Distinguishing between these modes of participation enables a greater level of clarity than classifying all as some form of consultation and highlights the need for language that more specifically recognizes sovereignty than the current consultation paradigm. As a result of the myriad, inconsistent application of consultation, we mapped "consultation" to "*for*" on the Wehipeihana Model of Indigenous evaluation – implying minimal Indigenous input within almost exclusively Western frameworks and no final decision-making authorty.[41,42] "*With*" implies a level of collaboration not currently guaranteed by consultation requirements.

The next aspect of this analysis illustrated the direct connections between the assessments. Direct connections are instances where one assessment directly mentions another assessment in its protocols, with these direct references largely referring to data sharing, sharing legal/regulatory mandates, similar framework basis, improvements or expansions of another assessment, integration with another assessment, acting as a subcomponent to another assessment, or broadly referring to another assessment by name without specifying in what capacity they are connected. Table S.4 in the SI Section 4 outlines additional indirect, thematic connections between assessments.

The final aspect of this analysis identified barriers to full Indigenous participation in assessments; barriers limiting the respectful honoring of Indigenous Knowledge within assessment procedures. Referring to Anishinology and Two-Eyed Seeing as guiding examples of Indigenous ontologies, these barriers prevent the weaving of knowledge systems together. The barriers reflect challenges identified by our collaborators through their own experiences with these assessments and parallel many challenges identified in previous studies as well.[10,34,36,55] In particular, instances

of capacity burdens and restrictions on worldview, ways of knowing, and/or ways of communicating knowledge were coded into themes as they arose while analyzing protocol language. These themes were then condensed into the primary categories of barriers listed in Table 1, with Table 2 subsequently highlighting tangible steps needed to overcome these barriers.

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