

OPINION

Harnessing economic tools for Indigenous climate resilience: Insights from Arctic marine resources

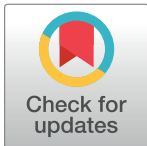
Melina Kourantidou ^{1,2,3*}

1 University of Western Brittany, AMURE, Plouzané, France, **2** Department of Sociology, Environmental and Business Economics, University of Southern Denmark, Esbjerg, Denmark, **3** Woods Hole Oceanographic Institution, Marine Policy Center, Woods Hole, Massachusetts, United States of America

* mkour@sdu.dk

Abstract

Economic tools remain under-used in addressing multiple challenges faced by indigenous communities in the rapidly changing Arctic. While there are multiple explanations for this under-use, perceptions that economic principles diverge from indigenous value systems and are rooted in Western paradigms limit the uptake of these tools to bolster resilience in the face of climate change. Nevertheless, Indigenous communities are expected to integrate their traditional systems with the historically imposed colonial systems of resource extraction to sustain their economies and community wellbeing that are challenged by environmental shifts and socioecological transitions. These changes manifest in resource use, availability and management and affect the ways Indigenous knowledge has traditionally guided resource exploitation decisions and practices. Using select examples, this paper argues that economic approaches to the management of marine resources have the potential to improve the well-being and resilience of indigenous Arctic communities. While more work is needed to tailor economic tools to the specific needs of indigenous people, the integration of resource economics and traditional approaches to resource management holds promise for strengthening Indigenous resilience in the face of the profound challenges posed by climate change.



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1. Introduction

Indigenous communities (ICs) in the rapidly changing Arctic face complex challenges as climate change disrupts access to essential resources. The challenges are pronounced in marine environments and communities depending on them. Ongoing efforts to strengthen climate resilience largely focus on natural science approaches, with less attention to social sciences and particularly economics.

The sparing use of economic tools is partly rooted in patronization concerns and assumptions of models misaligned with ICs' needs. Resilience of Arctic ICs and marine governance are intricately tied to self-determination, a connection underscored by the historical context of colonial legacies in marine resource management. Such legacies often failed to align with local

needs, resulting in marginalization of ICs [1,2], raising concerns regarding exclusionary and disempowering approaches. The prevailing Western-centric approaches to research coupled with lack of concerted efforts to meaningfully integrate Indigenous Knowledge (IK), exacerbates these concerns. Exploring how economic approaches can be tailored to accommodate needs of ICs is necessary to unlock the potential of economics in enhancing their climate resilience.

2. Re-thinking economics for Indigenous climate resilience

Indigenous knowledge on marine systems and Bayesian applications

Climate change disrupts ecological dynamics, rendering IK, rooted in historical observations, inaccurate in predicting marine resource availability and access. While ICs will adapt and update their knowledge, this process may lag behind the rapid pace of environmental change. This disparity hinders wellbeing from marine resource utilization. Integrating IK with observations or employing Bayesian methods to integrate it with empirical data offers a nuanced approach to climate resilience.

Bayesian applications in a marine context could encompass establishing a prior distribution for sustainable harvest, grounded in IK. In the face of uncertainties surrounding measurements of this harvest quantity, Bayes' rule can be applied to combine these into a posterior distribution. Despite inherent difficulties, the translation of knowledge and perceptions into prior distributions has been explored [3]. Bayesian elicitation requires statements translatable into probabilistic terms—a challenge given the diverse forms IK takes (beliefs, species' behavior, habitat knowledge, ice conditions, oral traditions, cultures). The challenge for successful Bayesian applications is to translate this input into probabilistic terms while acknowledging implicit uncertainties.

Fairness and distributional equity in fisheries allocations

Fairness and equity in fisheries rights' distribution are persistent concerns across Arctic ICs, with climate change exacerbating disparities. Shifting fish stock distribution, including poleward shifts and establishment of new harvestable species, induces socioecological changes involving both opportunities and losses [4,5]. These are further complicated by colonial histories that have shaped Indigenous fishery allocations. New allocations must be approached with sensitivity to historical contexts and economic tools can help navigate these complexities. Insights from economics research [6] exploring wealth accumulation and distribution can help clarify how historical wealth disparities persist and shape today's landscape.

While existing fishery management plans often integrate equity principles, robust definitions and tools to address equity in practice are absent. In anticipation of more pronounced effects of climate change in the Arctic, there is an urgent need to proactively design policies that minimize conflicts from shifts in fish stock abundance and distribution. Economic approaches can aid in this direction, depending on the definition of equity and scope considered [7].

Commonly used inequality metrics include the Lorenz curve and the Gini coefficient assessing benefit distribution among different fishing groups. Generalized entropy measures (i.e. Theil index) identify disparities within and between fishing groups, while the Atkinson index considers society's aversion to inequality in assessing distribution of fishing benefits. The Herfindahl-Hirschman index assesses the concentration of fishing rights while the Robin Hood index gauges the redistributive impact of fisheries management measures. Ratios such as decile dispersion highlight the disparity between the most and least privileged fisher groups, while the Palma and 20/20 ratio provide insights into distributional disparities in fisheries benefits and the disparity between the most and least affluent fisher groups, respectively. The

index choice depends on context, data availability and relevant equity aspects [7]. In general, the notion of a uniform distribution as fair is narrow with many arguing for progressivity, where lower percentiles (less privileged groups) receive greater percentage of benefits. Importantly, Indigenous perspectives may diverge from conventional income-centric approaches encompassing considerations such as historical connection and access to harvest grounds. Such differences highlight the need to understand alternative notions of equity and develop suitable measurement methods.

Beyond inequality indices, impact assessments, including fishery economic assessment models, social accounting matrices and computable general equilibrium models are other tools capturing the sector's economic impacts [8]. Economic impact assessments can help understand climate change effects on the wellbeing of Arctic ICs. This involves assessing various indicators, including income, employment and other economic factors associated with fisheries. Income and wealth distribution analyses identify disparities and assess whether fisheries' benefits are equitably distributed. Input-Output analyses enable understanding of economic linkages and impacts of changes in the fishing industry on other sectors and the overall economy [7]. While insightful, these tools have limitations, especially in small ICs where data are scarce. Their focus on transfer payments rather than consumer and producer surplus hinders estimation of net benefits and allocation decisions. Additionally, income impacts, often used as a surplus proxy, may overstate consumer or producer value. These tools also overlook economic efficiency considerations, such as minimizing production costs or optimally allocating resources. Despite these drawbacks, they offer a useful framework for understanding fishing sector linkages and evaluating the economic impact of management decisions.

Arctic coastal/ocean predictions and value of information

Forecast tools predicting weather, ice conditions and other marine or oceanographic parameters that inform the status of resources have revolutionized the climate resilience of Arctic ICs. While essential for safe resource access, sustaining these tools in remote Arctic areas is challenging due to high costs and limited infrastructure. Despite evident benefits of predictions to Indigenous wellbeing, communicating these to secure investments in sustaining forecast systems requires a compelling tool. The Value of Information (VOI) serves this purpose, demonstrating the difference in economic consequences of adopting a policy action, with-and-without the knowledge from investments in prediction and research [9].

Sea ice forecasts aid harvesters in navigation planning, temperature and ocean forecasts help optimize fishing seasons, and predictions of extreme weather events enhances preparedness, safeguarding infrastructure and coastal habitats. Continued investments in such forecast systems supporting climate resilience hinge on understanding their benefits.

Assessing the VOI on climate scenarios and their impact on fish stocks allows communities to adapt fisheries management strategies effectively, minimizing overexploitation through redistributing harvest across time and space. Similarly, VOI for more accurate stock assessments and migration patterns improves harvesting patterns enhancing long-term sustainability. The VOI also empowers communities to lead conservation efforts by integrating weather forecasts with fisheries management plans, preventing unnecessary stress on fish populations during vulnerable times.

Early warning systems for Harmful Algal Blooms are critical to human health, particularly for subsistence and recreational harvesters [10], as observed in Alaska. Beyond just commercial shellfish harvest testing, timely risk identification underscores the benefits of forecast programs, contributing to climate resilience, food security and preservation of economic, social, and cultural values [11].

3. Economic tools and future directions in enhancing Indigenous climate resilience

The examples highlight the range of economic tools applicable to Arctic marine resource use and their potential for strengthening Indigenous climate resilience. However, economic approaches are often absent or inadequately tailored to Indigenous contexts. Although limitations of conventional economic indicators in capturing dynamics of ICs are well known, alternative metrics are scarce. Food security for example requires a shift beyond affordability measures to encompass various subsistence harvesting dimensions (from households' structure associated to harvest capacity to opportunity costs of wage employment and community catch sharing) [12,13]. Broadening the scope of economic analysis to encompass comprehensive indicators, allows economists to better understand Indigenous needs and values, recognizing sources of value for Arctic ICs, from local resource control to job security and access to marine resources for subsistence harvest [2].

In addressing equity concerns which are ubiquitous in Indigenous Arctic marine resource use, intergenerational equity requires more attention by economists, considering shifting values over time shaped by climate change. Evaluating access to opportunities in marine resource exploitation, intricately linked to discounting, becomes crucial for intergenerational equity. Recognizing that ICs may prioritize intergenerational benefits in management interventions across various timescales, economists need to re-evaluate and incorporate these preferences to optimize resource management, particularly in sectors like fisheries.

In understanding such shifting values, economists should collaborate across disciplines, embracing qualitative and hybrid methodologies to address complex marine socio-ecological systems under climate change stress. Data scarcity in Arctic ICs can impede rigorous data-driven analysis, emphasizing the importance of economic tools for data-poor settings to enhance sustainability and exploitation benefits [14]. Additionally, economic tools can untangle complexities and conflicts across different resource uses (commercial, subsistence, recreational fisheries) and their co-existence dynamics, which are becoming more complex with climate change [15].

Economic tools, with their potential for actionable pathways, are critical in supporting resilience and adaptation. Shifting mindsets away from traditional economic applications is paramount to understanding Indigenous wellbeing. This shift requires institutional commitment to advance economic tools acknowledging that relying solely on natural sciences or technology falls short in addressing Indigenous resilience. Transitioning from mere inclusion in proposals to fostering meaningful contributions from economics, coupled with substantive engagement with Arctic ICs, holds substantial promise in bolstering climate resilience.

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