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Globalization impacts on local commons: multiscale strategies for socioeconomic and ecological resilience

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Abstract: Globalization can have substantial impact on local commons by reducing sustainability of ecosystems and their vital services. Without effective local institutions, these resources are at high risk of exploitation, especially to feed global markets. This study proposes a multiscale ecosystem framework (MEF) that incorporates information on ecosystem components, socio-economic processes, and their interactions. This includes inter and intra common interactions and multi-scale processes to evaluate inter and intra scale changes in socioeconomic and ecological processes of commons. Local participation and multi-disciplinary information are critical in achieving sustainability. Using a global dataset of selected indicators, a general decline is observable in local commons that face globalization. The need for increasing resilience of commons through multi-scale adaptation strategies can inform decisions at the national, state and local levels. Increased resilience through ecosystem-based approach can minimize impacts of globalization using information on multiattribute processes, equity considerations, development of robust institutions, and effective strategies for adaptation.

Keywords: Ecosystems, globalization, local commons, multiscale

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I. Introduction

Local commons are highly vulnerable to the impacts of globalization, especially under increasing pressure for extracting ecosystem products and services to supply local and global markets. Unmanaged exploitation (Hardin 1968, 1994) of water, timber, wildlife, tourism, and forest products can influence the capacity of these local commons to sustain these services. These commons face increasing stress from rapidly changing environments and there is a need to minimize unintended consequences (negative externalities) of globalization. Without effective governance and regulatory mechanism, globalization may intensify environmental harm (Nordstrom and Vaughan 1999). Identification of strategies that enhance ecological and institutional resilience of local and regional social and ecological systems can increase the adaptive capacity of local commons to withstand potential stressors and unsustainable exploitation. Additional stress to these systems include growth in population demand on commons (Burger and Gochfeld 1998) and, increased and frequent impacts from climatic stressors (IPCC 2007). National policies that focus on short-term economic gains, often place low priority to resilience building and enhancement of coping mechanisms of local commons at multiple scales. This study aims to review these impacts and develops an ecosystems-based, multi-scale framework to manage local commons exposed to globalization. Aquatic commons are a focus to demonstrate the use of this framework.

1.1. Globalization and local commons

Countries adopt globalization, the process of growing integration of economies and societies around the world (Sheehan 2010), to improve their economic status through gains from trade (Bhagwati 2000). It brings in increased flow of information (Held et al. 1999), multilateral trade, and higher financial openness (Li and Reuveny 2003). This increased trade and market openness has the potential to impact local commons (Ehrenfield 2005) and could spur environmental investments. There is a high likelihood that rapid extraction under globalization can deplete commons for short-term gains. For example, the depletion of Atlantic Cod is a result of over exploitation and unmanaged extraction (Finlayson and McCay 1998) in a global market.

Externalities, influences that reach outside of an activity domain, can traverse between global, regional, and local scales and influence local commons. Ecological footprint (Wackernagel and Rees 1996) analysis can characterize impacts of human activities. Another relevant concept in evaluating impacts of globalization is the trade in embodied water of trading commodities referred to as virtual water (Hoekstra and Chapagain 2008). Ostrom (2012) uses the term “Nested, Polycentric Externalities” for the case of climate change for decisions that impact units organized at different scales. Development of adaptation strategies to handle these complex, often negative externalities becomes essential to sustain commons. An approach is to use ecosystem theory to guide adaptation

strategies that could impart commons to adapt to new environments created by globalization. This study proposes a multi-scale (Ostrom 2010) systems approach (Randhir and Hawes 2010) to improve adaptive capacities of many local commons threatened by globalization.

1.2. Globalization impacts

Globalization can increase resource exploitation in exporting countries, with rapid geographic and temporal spread in extraction rates. For example, exploitation of sea urchins spread to several countries with increased globalization (Berkes et al. 2006). Impacts of globalization include rapid exploitation of specific energy sources, exploitation of virtual water (Hoekstra and Chapagain 2008), increase in pollution, loss of biodiversity, depletion of fish stocks, and biological invasions (Ehrenfield 2005). Forest loss and recovery is also at risk and the potential loss from double exposure to climatic change and economic globalization is a serious threat (O'Brien and Leichenko 2000).

Globalization has resulted in an alarming loss of plant and animal biodiversity in moist tropical forests, wetlands, and Mediterranean plant biodiversity (Given 1990; Medail and Quezel 1997) and Antarctica (Frenot et al. 2005). Other impacts include simplification of food webs, homogenized landscapes, and high energy and nutrient inputs (Western 2001), that diminish ecosystem services and increase economic losses in countries without a coping mechanism in place. In general, the diminished ecosystem functionality of commons can inflict economic and ecological losses at a local scale (Randhir and Hawes 2010). Developing countries rely heavily on local commons for sustaining crop and livestock production, fishing, hunting, fuel wood, and minor forest product collection (Dasgupta 1993) and their disruption could have substantial effect on local livelihoods (Randhir and Hawes 2010).

Globalization increases the number of interconnections and invokes new variables in socio-ecological systems that influence resilience processes (Armitage and Johnson 2006). Social and ecological resilience thus depends on making cross-scale institutional connections that characterize globalization process (Armitage and Johnson 2006). In conditions of missing or weak institutions to govern, the globalization process can result in long-term cost (losses in ecosystem services) that can far outweigh their benefits.

There is a need for resilient biophysical capacity and adaptive socioeconomic institutions to deal with new and rapidly expanding, and open market conditions. Decrease in the environmental quality (Baek et al. 2009), rapid extraction of forest commons (Lofdahl 2002) are some direct effects of globalization. Indirect impacts of globalization include increased pollution, loss of habitat and biodiversity, and diminished quality of air, soil and water resources (Vig and Axelrod 1999).

There is a critical need for evaluating the impacts on local commons in an ecosystem framework in order to identify opportunities to increase resilience and to increase adaptive capacity of social and ecological systems to cope with new

stressors. The need for such ecosystems-based approach is evident from the case of rapid depletion of fish stock, especially the Atlantic Cod (Finlayson and McCay 1998) and can guide extraction of fisheries and marine ecosystems (Botsford et al. 1997). Ecosystem resilience is the capacity of an ecosystem to withstand shocks and rebuild itself (Resilience Alliance 2002), while the resilience of social systems is the added capacity of humans to anticipate and plan for such changes. Resilience frameworks like Megacity Resilience Framework (Butsch et al. 2009), and Hyogo Framework (UN-ISDR 2007) emphasize resilience of inhabitants.

Such integrated approaches enable identification, restoration, and enhancement of structure and functional components of ecosystems and in the development of appropriate institutions to govern them. These approaches can also encourage stakeholder participation, use information on multiple attributes (Randhir and Shriver 2009a), mitigate impacts at multiple scales, and improve resilience. Ecosystem-based framework like nested, watershed systems (Randhir and Shriver 2009a) is useful to assess and identify opportunities to increase adaptability and resilience at multiple scales. Assessment of impacts as a hierarchy of systems and components can diagnose system-wide impacts, and in identifying and mapping impact pathways (Randhir and Genge 2005). Ostrom (2007) proposed a diagnostic method for SES using a nested, multitier framework involving resource system, resources units, users, and governance system. Ostrom (2009) proposed a general SES framework for sustainability and self-organization to evaluate worldwide loss of fisheries, forests, and water resources. This paper reviews the impacts of globalization on terrestrial local commons and proposes a multiscale, ecosystems framework (MEF) to manage the effects of globalization. The MEF adds to the SES framework through explicit treatment of ecosystems, nested multi scales, and dynamics across scales and across common pools in dealing with impacts of globalization. Potential impacts of globalization on aquatic commons are discussed in detail to identify opportunities to mitigate impacts.

2. Multi-scale, ecosystem framework (MEF)

Given the high value attributed to ecosystem services throughout the world (Costanza et al. 1997), reducing the impact of globalization on local commons makes economic and ecological sense. Increasing the resilience of the local commons to withstand and to recover from major disturbances (resilience) at multiple scales can lead to long-term sustainability of these fragile systems.

Reasonable and protective strategies (Ostrom 2010) to increase ecosystem resilience include measures at both the larger (international/national) and smaller scales (regional/local) (Whitesell 1996; Sandbrook 1997) that can enhance the ability of these multiscale systems to absorb and quickly recover from external shocks. For example, changes in the trade and environmental agreements between countries at global or regional levels can have varying and multiple effects at regional and local scales that need to be part of the strategy. A localized strategy at a watershed or other ecosystem scales can be used as an integrating framework to

integrate information on physical, biological and human components within and among scales of social-ecological systems (SES) (McGinnis and Ostrom 2014). Such integrated framework can link assessment, management of impacts from lower to higher scales.

At terrestrial scales, watershed ecosystems provide assessment and policy advantages (Randhir 2006) given their nested hierarchy in assessing multi-scale impacts and governance possibilities from local, to state/province, regional, national, and global scales. They are also natural landscape units helpful in evaluating interactions, identifying sensitive components of an ecosystem, and for developing participatory outcomes involving stakeholders (Randhir and Shriver 2009b).

There is a vital need that institutions and technologies coevolve with changing ecosystem conditions (Dietz et al. 2003). Thus, ecosystem approaches to manage globalization can be dynamic strategies that also co-evolve with changing institutions. A site-specific and scale dependent information on ecosystem components, economic processes, and their interactions within systems and multiple scales is possible through such a framework. This is possible by using ecosystem theory in evaluating complex economic and ecologic interactions that are dynamic in nature (system dynamics) and involve feedbacks (cybernetics). For example, enhancing resilience of forest and agricultural commons can minimize runoff, soil loss, and allow infiltration that improves resilience of aquatic commons through changes in water quality that improves resiliency of fisheries. Such mutual influences across commons in regional systems can result from using an ecosystem as a framework of assessment. This framework is also consistent with Millennium Assessment Goals that link ecosystem services to human wellbeing at multiple scales (MEA 2003; Reid et al. 2006). Such framework also enables local participation, facilitates adaptive institutions, and can act as a common platform for multidisciplinary information. While localized and dynamic effects of globalization are often difficult to account in cost-benefit estimation, an assessment of cumulative and long-term impacts in this framework could result in development of adaptation policies that vary with scale and local requirements. Such policies can consider and inform decisions at the national, state and local levels.

2.1. Conceptual model of MEF

Ostrom (2007) proposed a strong interdisciplinary science of complex, multilevel systems to match specific problems. By extending this approach to identify opportunities that increase resilience to multiple dimensions, a multiscale, ecosystem framework – MEF (Figure 1) is proposed to systematically develop ecosystem-based strategies that address sustainability of commons across scales (spatial and temporal) and across commons types. This framework also allows linking across commons types through a higher ecosystem scale for enabling interaction within specific common and between commons. The MEF framework

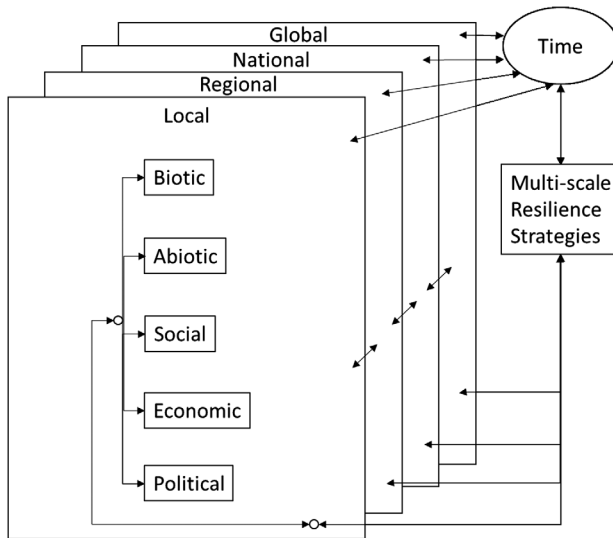


Figure 1: Multiscale ecosystem framework (MEF) for protecting local commons.

uses a hierarchical depiction of each scale – local, regional, national, and global. One can define additional intermediate scales within this framework to reflect characteristics of a particular system. For example, district or provincial scale that can occur between local and regional scales or multinational/international scale between national and global scales. The MEF framework extends the nested, polycentric concept developed by Ostrom (2012) to allow system-wide changes, inter and intra common interactions, and polycentric governance interactions using hierarchical systems of economic, ecological, and social systems of multiple commons. Each scale connects to the scale above and below in social, economic and ecological flows. Components of each scale could include biotic (plants and animals), abiotic (soil, water, air), and socioeconomic/political components. The robustness of ecological and economic processes at each scale is vital to the sustainability and resilience of the complete multi-scale system. A nested and hierarchical pathway can evaluate inter-scale effects using this framework. For example, globalization impacts on economic and ecological conditions at a local scale can include implications at national, regional, and local effects as they pass through intermediate scales. This framework can facilitate study in pathways of virtual water (Hoekstra and Chapagain 2008) and changes in embodied energy (Costanza 1980) across and within scales. Governance and policies designed for each scale effects other scales at varying degree under this framework. Information of these multiple effects of various governance and policy options is useful in development of comprehensive and optimal design of systems at multiple scales.

Using a systems approach, MEF approach accommodates interaction between local commons. This is because of using a system boundary rather than a boundary of a particular common. Thus, this accounts for biophysical and socioeconomic impacts of changes in one common and its impact on another common within the ecosystem and is useful in planning for multiple commons. Examples of such interaction include wetland protection that improves aquatic commons downstream.

In using the MEF for developing resilience strategies, it is possible to enhance capability of biotic, abiotic, and socioeconomic components to handle increased pressure from globalization. The resilience capacity and thresholds are useful as limits or constraints for extraction of goods and services. For example, limiting withdrawal of surface waters to rate of hydrologic inflows of the watershed. This requires a mix of strategies that increase or maintain the resilience of biotic and abiotic components through management of the structure and function of an ecosystem. Socioeconomic and institutional characteristics at local scale also reflect the nature of constraints and incentives that drive the usage and conservation of a local common. Resilience of socioeconomic systems at a particular scale depend on the nature of cooperation, trust among users, extraction rules, coping mechanisms, adaptive rule making, social capital, incentives, enforcement of rules, resource condition, and other institutional factors. These factors are dependent on the nature of these factors at other higher and lower scales, thus forming a multi-level, interconnected system.

This paper uses the MEF approach to review the impacts of globalization on watershed and coastal local commons. To develop deeper insights into the MEF approach and methods, aquatic commons is a focus for detailed treatment. Nevertheless, the MEF approach is applicable to studying forest commons, wetlands, marine systems, urban systems, and earth systems.

2.2. Empirical methods

We use the MEF approach to develop a simple method to test impacts of globalization on specific local commons. Given the complex nature of globalization and common pool systems, use of indices that represent selected systems is a first step toward analysis for resilience strategies.

2.3. Index of globalization

A preliminary global assessment evaluates current states of selected commons under changing globalization levels. If Y represents the state of a local common and X represents the extent of globalization, then the impact can be evaluated by representing $Y=f(X|Z)$, where $f(.)$ represents the multi-scale system and Z represent other variables. A negative dY/dX is indicative of depletion of local common. This assessment is useful in providing a framework to implement MEF and to study the impacts at global to local scales. This assessment guides a general discussion related to the commons discussed in this study. A metric of globalization is related to selected indicators of the state of local commons. The

comprehensive index of globalization (COG) developed by Dreher et al. (2008) incorporates economic, social, and political factors in quantifying the extent of globalization of a country. Economic globalization in COG uses data on trade flows, foreign direct investments, portfolio investments, income payments to foreign nationals, hidden import barriers, mean tariff rate, taxes in international trade, and capital account restrictions. Social globalization in COG is assessed using telephone traffic, transfers, international tourism, foreign population, international letters, internet users, television access, trade in newspapers, and data on cultural proximity to international firms. Political globalization in the COG method is assessed using embassies in country, membership in international organizations, participation in U.N. missions, and international treaties (Dreher et al. 2008). The overall globalization index combines economic, social, and political components and is used to evaluate relationships to specific indicators of local common. The indicators of the status of local commons are quantified from the EarthTrends Database (World Resources Institute 2007) using Geographic Information Systems (ArcGIS) and statistical assessments for each country. We focus on aquatic commons by using two case studies: Connecticut River watershed (USA) and Huanchaco fishing community in Trujillo (Peru) to discuss multi-scale linkages and strategies.

3. Aquatic commons

Fisheries in inland and coastal ecosystems are classic examples of the “tragedy of the commons”, an overexploitation of unmanaged common pool resources described in Hardin (1968). Overexploitation of fisheries can be local (freshwater streams or lakes), regional (for example, North Atlantic) or global depending upon the type of fishery. Some examples of sharply declining fish stocks include ocean fish with large geographic ranges, such as Atlantic salmon, Bluefin tuna, and Swordfish (Lane 2006). These fish stocks have suffered overexploitation due to the difficulty of exclusion (even though local restrictions might be present) as well as pressure from fishers who aim to maximize the catch in order to remain economically viable. There remains a poor understanding of the inter-scale issues in management of such aquatic commons. While the US has successfully enforced an economic zone for fishing in its coastal waters to effectively eliminate international fishing pressure, US fishermen are still able to exploit these fish resources (Burger and Gochfeld 1998).

Multiple, nested scales are characteristic of aquatic commons. In river systems, scales are reach, tributaries, river network, and large rivers and their drainage areas. Multiple scales are at reach, subwatersheds, watersheds, river basins, continental collection of basins, and global set of basins. These scales connect to each other through flow of ecological, economic, and social processes. Two cases are used to apply the MEF approach to the depletion of specific commons: (i) decrease in quality of aquatic habitat for migratory fish in New England watersheds; and (ii) loss of coastal wetlands that support indigenous practices by the Huanchaco fishing community in Trujillo, Peru.

3.1. Connecticut River watershed

A nested and multiple scales are clearly observable in the Connecticut River that drains into the Long Island Sound in the New England region of the USA (Randhir 2006). Tan brook is a subsystem of the south branch of the Mill River (Amherst) watershed, which is part of the Mill River watershed, which is one of subwatersheds of the Middle Connecticut watershed. The Middle Connecticut watershed is a component of the Connecticut River watershed (CRW) of New England, one of the South flowing watersheds in New England. New England watersheds are part of Continental set of watersheds, again a part of global set of watersheds. During the industrial revolution, the demand for industrial goods changed the very nature of the watershed through creation of multiple dams to harness hydropower for industrial production of multiple goods. Each mill village had implications on a local river with cumulative impacts on migratory fish populations whose stocks can deplete rapidly. Over time as markets changed, much of the mills are abandoned with substantial effect on the connectivity of freshwater systems. Building an understanding from one tributary, the Tan brook is impounded in North Amherst for non-industrial (aesthetic) purpose of campus scenery. Downstream of the Tan brook is the Lake Warner dam, a retired textile mill. After the Mill River enters Connecticut River main stem, another major hydroelectric dam occurs in the Holyoke region. Such series of dams that are remnants of rapid industrial growth in textiles has resulted in significant impacts on migratory fish in the river. In addition, these dams at multiple scales have water quality impacts through sediment accumulation (Randhir 2006). Across-scale impacts in this case are cumulative impacts of local to regional watershed and coastal ocean systems. Between commons, implications are from aquatic commons that connect to terrestrial commons through biogeochemical and geological flows. Implication of dams on riparian habitat is also significant with inundation upstream and low flow downstream of the dam, thereby changing ecosystem continuity and integrity. Understanding these linkages within aquatic commons at multiple scales and commons types is vital to understand the system-wide changes that result in an impact of globalization process. For example, excessive demand for hydropower to satisfy growing energy demand can increase local and regional impacts of dams and turbines that reduce migratory fish and ecosystem quality.

3.2. Trujillo coastal ecosystems

A second case of destruction of aquatic common is the loss of fish stock and indigenous cultures of the Moche civilization (Swenson 2007; Velasquez 2015) still followed by the Huanchaco fishing community in beaches of Trujillo, Peru. These communities had specialized knowledge of coastal resource extraction and traditional claims to fishing grounds (Sandweiss 1992). Impacts of globalization in the form of increase in modern fishing vessels to satisfy regional and global markets has depleted fish stocks in the coastal ocean that is fished by indigenous fishers using reed boats called Caballito (Hammel and Haase 1962) built with

Totora, a wetland reed grown and harvested by fishermen in coastal wetlands. Increasing commercialization and European influences have markedly changed the fishing and extraction techniques in the region (Hammel and Haase 1962). The challenges of such small-scale fisheries (Salas et al. 2007) can stem from competition and conflicts with commercial and recreational fleets. The modest fishing effort with these boats occur from ancient times to catch for subsistence needs. With competition from modern fishing vessels, the fish stock is depleted and with rapid increase in industrial exploitation and coastal tourism, the livelihood of the fishermen is at stake. The fishing technique is unique and traditional from cultural practices of Moche civilization, which is being lost to globalization pressures. Land pressures from international tourism and commercialization affect available wetlands in the coastal zone, which also compounds these issues.

3.3. Resilience strategies

A general strategy for resiliency of these commons (that are local or international commons) is management of the ecological footprints (Wackernagel and Rees 1996) at multiple scales in systems framework. An ecological footprint is a measure of anthropogenic impact on nature; defined as the productive land and water required to support human consumption levels and to absorb its waste. In the case of CRW, the footprint analysis of the impoundment to the river and resulting changes in ecosystem services at sub-watershed to cumulative system-wide impacts on river basin scales is useful to evaluate the nature of human impacts on this aquatic common. Such a footprint for coastal fisheries in Trujillo and aquaculture production elsewhere needs to be substantially below the regenerative capacity of the ecosystem, with a least possible footprint of exploitation from local and higher scales. In the case of Trujillo, there is a need to protect local wetlands from the expanding footprint of commercial fisheries and tourism in order to sustain this multi-scale coastal common as a complex system. A strong sustainability measure that maintains sustainability at all scales and components (social, economic, and environmental) is a need to manage sensitive stocks that are vulnerable to changes in lower and higher scales of the system. Multi-scale footprint analysis in a systems framework is useful to identify resiliency that is comprehensive in scale and time dimensions. In general, the ecological footprint of marine and coastal fisheries and coastal aquaculture production appears far larger than what is currently considered sustainable for a long-term. Swartz et al. (2010) highlights the state of ecological footprint of global marine fisheries that is at the limits to growth. Depending on the methods of aquaculture and fishing, the appropriated area, including that for production and waste assimilation may be as high as 50,000 ha/ha of activity. For example, 85 million people of the Baltic Sea region depend on an area of marine ecosystems equal to three Baltic Sea areas for their seafood consumption (Folke et al. 1998). World market signals often do not take into account the capacity of marine and coastal ecosystems to sustain current levels of production (Folke et al. 1998) and there is a critical need to use MEF approach to sustain these commons.

An aspect of MEF approach is for levels of economic activities to be within the capacity of an ecosystem to recover from multiscale impacts. In case of CRW, impoundments impair connectivity of aquatic ecosystems to support migratory species and change flow dynamics of the river at multiple scales, needing new strategies that include removal or retrofitting an impoundment. In the case of Trujillo, tourism and coastal fishery under MEF can focus on limiting activities that go beyond the capacity of coastal ecosystems to sustain and reduce pressure on local cultures and rights.

In coastal ecosystems in general, mangrove wetlands are important commons that provide multiple ecosystem services. The international market for seafood is leading to destruction of mangrove habitats in tropical watersheds. Mangroves are spawning areas for many fish species, often replaced by shrimp farming often owned by corporations with adequate capital to develop the farms. The farms are usually productive for a few years after which they become abandoned or operated in unsustainable condition. Since the farms lack local ownership and control, local fishing communities are left impoverished and the coastal watershed ecosystem on which their livelihoods depend is severely impaired (Burger and Gochfeld 1998). Another major threat is emergence of tourist resorts that displace ecosystem services and local cultures. There is a need for a MEF-based planning to protect and restore mangrove that are critical to the sustainability of coastal economies and ecosystems.

Regarding property rights, there is a need for establishing ownership and control by local communities (Randhir and Lee 1996) who are motivated to sustain coastal watersheds over a long-term. A systems-based design of rights can help in participatory decisions and management of local ecosystems. Dependence of these communities for long-term survival and livelihood can provide an incentive for conservation, as in the case in several successful commons (Randhir and Lee 1996). Active community participation in ecosystem conservation is an important part of strategy to enhance adaptability and resilience of commons to globalization. While there is much attention for participation within a scale, there is a critical need for interaction and participation between scales.

There is a need for an ecosystem-wide assessment of population dynamics and extraction rates to maintain and sustain biodiversity and viable populations. The nature of system-wide interactions is clear in the demand for horseshoe crabs for use as bait and for medical uses, which has reduced their population recovery in the east coast of North America. The severity of reduction in their numbers now threatens migratory shorebirds that feed on horseshoe crab eggs during migratory stopovers in the Atlantic coast, particularly in the Delaware Bay (Burger and Gochfeld 1998). In addition, coastal zone management using a multi-scale assessment and protection with MEF need to use coastal watershed ecosystems as units in developing long-term strategies for sustaining the economic activities and coastal ecosystems. Development of reserve areas is useful in some coastal ecosystems to allow recovery of population and improve the resilience of the

system. An example is the Shuster Horseshoe Crab Reserve established off the Delaware Bay, USA, through collaboration between state and federal agencies.

International cooperation and comprehensive local and regional strategies are necessary to protect coastal and marine life, including marine mammals (Vidal 1993). One such strategy is to maintain fisheries through preserving coastal habitats that support local communities with equitable sharing of common resources. There is a need to create indices of fundamental indicators of marine fishery ecosystem health at multiple scales that can guide management decisions and to communicate easily to stakeholders (Done and Reichelt 1998).

Often the effects of globalization can vary from local, regional, international, to global in scale, thus needing comprehensive resilience policies. The loss of mangroves for aquaculture can result in a loss of resilience in coastal ecosystems with depletion of spawning grounds for fish and shellfish (Burger and Gochfeld 1998; Folke et al. 1998) that could affect multiple scales. The ecosystem impoverishment that occurs in the coastal waters of one country can cause diminished yields of fish in other countries, thus resulting in “transboundary externality” to other local commons (Folke et al. 1998). An international collaboration in implementing MEF approach requires cooperative strategies of these activities for efficiency and equity with and across scales.

Multiscale strategies to remedy coastal ecosystem impacts also include integrated data collection, analysis, and active enlistment of stakeholders representing coastal interests at multiple scales. A multi-attribute framework (Turner et al. 1998) includes feedback process in coastal areas to identify critical issues, data needs, land use, and institutions involved in decision-making at local, regional, and international scales. A broad range of characteristics to identify tradeoffs includes socio-economic and environmental pressures, environmental state changes and impacts, policy response, and stakeholder gains and losses at multiple scales. An example is Canada’s four Maritime Provinces, where stakeholders are involved in management of coastal resources and include residents, local government officials, businesspersons, and academia (Robinson 1997).

Empirical analysis of changes in inland and coastal fisheries using a globalization index of world countries (Figure 2) is useful in rapid assessment of impacts. Increase in globalization index by one unit decreased inland fish catch by 2%, while the marine catch decreased by 1.7%. This could be because of depletion in fish stock with increasing efforts to supply global markets. Globalization represents an increase in knowledge, wealth, and trade that might have resulted in rapid exploitation of these commons. The multi-scale nature is evident through small-scale fishing efforts and increase in demand that extends to other scales by influencing regional and global stocks. This is consistent with findings by FAO (2010) that identifies 53% of world’s fisheries as fully exploited and 32% as overexploited. Even though globalization can achieve economic gains, without proper governance the state of both inland and coastal fish stocks in the world are vulnerable to the process of globalization. This emphasizes the need for a multi-scale governance strategy to protect these sensitive commons.

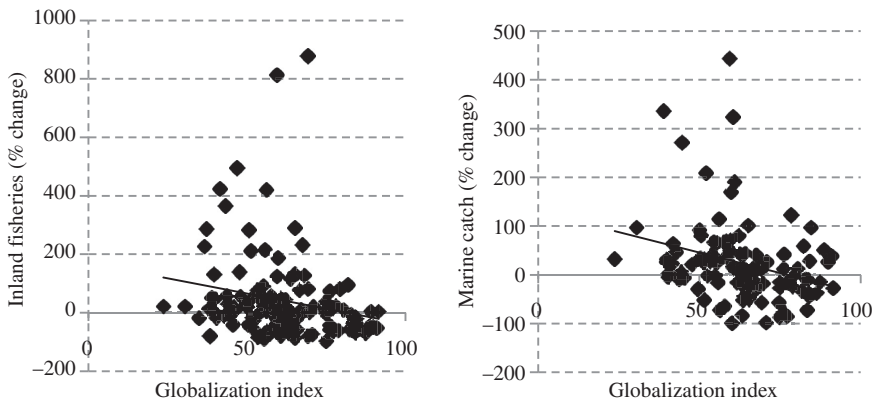


Figure 2: Impact of globalization on inland and coastal fisheries.

4. Conclusions

Globalization and international development can cause ecosystem stress and degradation to local commons. These stresses threaten the long-term viability and resilience of fisheries, coastal, agricultural, forest and riverine/riparian ecosystems. Resource extraction to satisfy global demand can create negative externalities, which are often not reflected in the supply cost. There is a need for increasing resilience of local commons through multiscale policies and incentive systems that use system information and public participation. It is necessary to develop mechanisms to reallocate gains from resource extraction and reinvest them to restore and strengthen local commons and increase resilience to globalization. Equitable outcomes at multiple scales is also a critical aspect of MEF strategies for sustainability of local commons. These mechanisms could take the form of direct changes in the system involving local commons and indirect policies such as educational programs. Cooperative mechanisms that kept these intricate systems intact are being lost to global pressures that transmit through scales. Cooperation among commons, between scales, and among components (economic, social, and environmental) of the MES becomes important for resilience and transformative properties of local commons facing globalization pressure.

To better evaluate and mitigate the local impacts of global environmental problems induced by international development, there is a need for a variety of strategies at multiple scales from global to local scales. Strategies developed using a MEF approach use system-wide interactions and thus can improve resilience between scales and between commons using a systems approach. Strategies need to integrate international conservation agreements with national environmental policies and the public participation by local citizens' groups and nongovernmental organizations at multiple scales.

Policy implications of managing local commons using MEF include multi-scale strategies, resilience enhancement, cooperative mechanisms, equitable outcomes, adaptation enhancement, integration of multiple commons using nested ecosystem principles, earth democratic principles that empower grassroots, and economic institutions that build resilience and development of MEF strategies that are multiattribute-based and multidimensional in strategies.

Integrated assessments of watersheds and ecosystems to determine impacts to the physical, biological and human environments are critical. Large river basins that cross international boundaries could be an important scale for assessment and the creation of policies governing resource extraction and ecosystem restoration. International agreements and treaties exist which govern water use in international river basins (Kliot and Shmueli 2001) and which could form the basis for policies to manage and protect river basin ecosystems. International river basins can serve as ecohydrological units for integrating international and local conservation efforts.

Literature cited

- Armitage, D. R. and D. Johnson. 2006. Can Resilience be Reconciled with Globalization and the Increasingly Complex Conditions of Resource Degradation in Asian Coastal Regions? *Ecology and Society* 11(1):2. [online] URL: <http://www.ecologyandsociety.org/vol11/iss1/art2/>.
- Baek, J., Y. Cho, and W. W. Koo. 2009. The Environmental Consequences of Globalization: A Country-Specific Time-Series Analysis. *Ecological Economics* 68(8–9):2255–2264.
- Berkes, F., T. P. Hughes, R. S. Steneck, J. A. Wilson, D. R. Bellwood, B. Crona, C. Folke, L. H. Gunderson, H. M. Leslie, J. Norberg, M. Nyström, P. Olsson, H. Österblom, M. Scheffer, and B. Worm. 2006. Globalization, Roving Bandits, and Marine Resources. *Science* 311(5767):1557–1558.
- Bhagwati, J. 2000. On Thinking Clearly About the Linkage between Trade and the Environment. *Environment and Development Economics* 5(4):485–496.
- Botsford, L. W., J. C. Castilla, C. H. Peterson. 1997. The Management of Fisheries and Marine Ecosystems. *Science* 277(5325):509–515.
- Burger, J. and M. Gochfeld. 1998. The Tragedy of the Commons 30 Years Later. *Environment* 40:10.
- Butsch, C., B. Etzold, and P. Sakdapolrak. 2009. *The Megacity Resilience Framework: Policy Brief*. Bonn, Germany: United Nations University, Institute for Environment and Human Society.
- Costanza, R. 1980. Embodied Energy and Economic Valuation. *Science* 210(4475):1219–1224.
- Costanza, R., R. D'Arge, R. De Groot, S. Farber, M. Grasso, B. Hannon, K. Limburg, S. Naeem, R. V. O'Neill, J. Paruelo, R. G. Raskin, P. Sutton, M. Van den Belt. 1997. The Value of the World's Ecosystem Services and Natural Capital. *Nature* 387:253–259.

- Dasgupta, P. 1993. *An Inquiry into Well-being and Destitution*. Oxford: Clarendon Press.
- Dietz, T., E. Ostrom, and P. C. Stern. 2003. The Struggle to Govern the Commons. *Science* 302(5652):1907–1912
- Done, T. J. and R. E. Reichelt. 1998. Integrated Coastal Zone and Fisheries Ecosystem Management: Generic Goals and Performance Indices. *Ecological Applications* 8(1):S110–S118.
- Dreher, A., N. Gaston, and P. Martens. 2008. *Measuring Globalization Gauging its Consequence*. New York: Springer.
- Ehrenfield, D. 2005. Environmental Limits to Globalization. *Conservation Biology* 19(2):318–326.
- FAO. 2010. *State of World Fisheries and Aquaculture (SOFIA) – SOFIA 2010*. Rome, Italy: FAO Fisheries and Aquaculture Department, FAO.
- Frenot, Y., S. L. Chown, J. Whinam, P. M. Selkirk, P. Convey, M. Skotnicki, D. M. Bergstrom. 2005. Biological Invasions in the Antarctic: Extent, Impacts and Implications. *Biological Reviews* 80(1):45–72.
- Finlayson, A. C. and B. J. McCay. 1998. Crossing the Threshold of Ecosystem Resilience: the Commercial Extinction of the Northern Cod. In *Linking Social and Ecological Systems: Management Practices and Social Mechanisms for Building Resilience*, eds. B. Fikret and F. Carl, 311–338. Cambridge, UK: Cambridge University Press.
- Folke, C., N. Kautsky, H. Berg, A. Jansson, and M. Troell. 1998. The Ecological Footprint Concept for Sustainable Seafood Production: A Review. *Ecological Applications* 8(1):S63–S71.
- Given, D. 1990. Conserving Botanical Diversity on a Global Scale. *Annals of the Missouri Botanical Garden* 77(1):48–62.
- Hammel, E. A. and Y. D. Haase. 1962. *A Survey of Peruvian Fishing Communities*. *Anthropological Records*. 21:2. Berkeley: University of California Press.
- Hardin, G. 1968. The Tragedy of the Commons. *Science* 162:1243–1248.
- Hardin, G. 1994. The Tragedy of the Unmanaged Commons. *Trends in Ecology and Evolution* 9:199.
- Held, D., A. McGrew, D. Goldblat, and J. Perraton. 1999. *Global Transformations: Politics, Economics, and Culture*. Stanford, CA: Stanford University Press.
- Hoekstra, A. Y. and A. K. Chapagain. 2008. *Globalization of Water: Sharing the Planet's Freshwater Resources*. Oxford, UK: Blackwell Publishing.
- IPCC. 2007. Climate Change 2007: Impacts, Adaptation and Vulnerability. In *Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, eds. M. L. Parry, O. F. Canziani, J. P. Palutikof, P. J. van der Linden and C. E. Hanson. Cambridge, UK: Cambridge Univ Press.
- Kliot, N. and D. Shmueli. 2001. Development of Institutional Frameworks for the Management of Transboundary Water Resources. *International Journal of Global Environmental Issues* 1(3/4):306–328.

- Lane, J. 2006. *Globalization and Politics: Promises and Dangers*. Hampshire, England: Ashgate Publishing Limited.
- Li, Q. and R. Reuveny. 2003. Economic Globalization and Democracy: An Empirical Analysis. *British Journal of Political Science* 33:29–54.
- Lofdahl, C. 2002. *Environmental Impacts of Globalization and Trade*. Cambridge, MA: MIT Press.
- Medail, F. and P. Quezel. 1997. Hot-Spots Analysis for Conservation of Plant Biodiversity in the Mediterranean Basin. *Annals of the Missouri Botanical Garden* 84(1):112–127.
- McGinnis, M. D. and E. Ostrom. 2014. Social-Ecological System Framework: Initial Changes and Continuing Challenges. *Ecology and Society* 19(2):30. <http://dx.doi.org/10.5751/ES-06387-190230>
- Millennium Ecosystem Assessment (MEA). 2003. *Ecosystems and Human Well-being: A Framework for Assessment*. Washington, DC: Island Press.
- Nordstrom, H. and S. Vaughan. 1999. *Trade and Environment*. Geneva: World Trade Organization.
- O'Brien, K. L. and R. M. Leichenko. 2000. Double Exposure: Assessing the Impacts of Climate Change within the Context of Economic Globalization. *Global Environmental Change* 10:221–232.
- Ostrom, E. 2007. A Diagnostic Approach for Going Beyond Panaceas. *Proceeding of the National Academy of Sciences of the United States of America* 104(39):15181–15187.
- Ostrom, E. 2009. A General Framework for Analyzing Sustainability of Social-Ecological Systems. *Science* 325:419–422. <http://dx.doi.org/10.1126/science.1172133>.
- Ostrom, E. 2010. A Multi-Scale Approach to Coping with Climate Change and Other Collective Action Problems. *Solutions* 1(2):27–36.
- Ostrom, E. 2012. Nested Externalities and Polycentric Institutions: Must We Wait for Global Solutions to Climate Change Before Taking Actions at Other Scales? *Economic Theory* 45(1–2):1–17.
- Randhir, T. O. 2006. *Watershed Management: Issues and Approaches*. London, UK: International Water Association Publishing.
- Randhir, T. O. and J. G. Lee. 1996. Managing Local Commons in Developing Economies: An Institutional Approach. *Ecological Economics* 16(1):1–12.
- Randhir, T. O. and C. Genge. 2005. Watershed-Based Institutional Approach to Develop Clean Water Resources. *Journal of American Water Resources Association* 41(2):413–424.
- Randhir, T. O. and A. G. Hawes. 2010. Ecology and Poverty in Watershed Management. In *Integrating Ecology into Poverty Alleviation and International Development Efforts: a Practical Guide*, eds. F. DeClerck, J. C. Ingram and C. R. Del Rio. New York: Springer Verlag Publication.
- Randhir, T. O. and D. M. Shriver. 2009a. Multiattribute Optimization of Restoration Options: Designing Incentives for Watershed Management. *Water Resources Research* 45(3):W03405. doi:10.1029/2008WR007169.

- Randhir, T. O. and D. M. Shriver. 2009b. Deliberative Valuation Without Prices: A Multiattribute Prioritization for Watershed Ecosystem Management. *Ecological Economics* 68(12):3042–3051. doi:10.1016/j.ecolecon.2009.07.008.
- Reid, W. V., F. Berkes, T. Wilbanks, and D. Capistrano, eds. 2006. *Bridging Scales and Knowledge Systems: Concepts and Applications in Ecosystem Assessment/ Millennium Ecosystem Assessment*. Washington, DC: Island Press.
- Resilience Alliance. 2002. Resilience. URL://http://www.resalliance.org/index.php/resilience. Accessed 2/12/2015.
- Robinson, G. M. 1997. Community-Based Planning: Canada's Atlantic Coastal Action Program (ACAP). *The Geographical Journal* 163(1):25–37.
- Salas, S., R. Chuenpagdee, J. C. Seijo, and A. Charles. 2007. Challenges in the Assessment and Management of Small-Scale Fisheries in Latin America and the Caribbean. *Fisheries Research* 87(1):5–16.
- Sandbrook, R. 1997. UNGASS has Run Out of Steam. *International Affairs* 73(4):641–654.
- Sandweiss, D. H. 1992. The Archaeology of Chincha Fishermen: Specialization and Status in Inka Peru. *Carnegie Museum of Natural History Bulletin* 29:162.
- Sheehan, M. 2010. Globalization: Conundrums and Paradoxes for Civil Engineering. *Leadership and Management in Engineering* 10(1):10–15.
- Swartz, W., E. Sala, S. Tracey, R. Watson, and D. Pauly. 2010. The Spatial Expansion and Ecological Footprint of Fisheries (1950 to Present). *PLoS ONE* 5(12):e15143. doi:10.1371/journal.pone.0015143.
- Swenson, E. R. 2007. Adaptive Strategies or Ideological Innovations? Interpreting Sociopolitical Developments in the Jequetepeque Valley of Peru during the Late Moche Period. *Journal of Anthropological Archaeology* 26(2):253–282.
- Turner, R. K., I. Lorenzoni, N. Beaumont, I. J. Bateman, I. H. Langford, A. L. McDonald. 1998. Coastal Management for Sustainable Development: Analysing Environmental and Socio-Economic Changes on the UK Coast. *The Geographical Journal* 164(3):269–281.
- UN-ISDR. 2007. Hyogo Framework for Action 2005–2015: Building Resilience of Nations and Communities to Disasters. United Nations – International Strategy for Disaster Reduction. UN/ISDR-07-2007, Geneva.
- Velasquez, G. 2015. *Archeological Heritage in a Modern Urban Landscape: The Ancient Moche in Trujillo, Peru*. New York: Springer. doi 10.1007/978-3-319-15470-1_2.
- Vidal, O. 1993. Aquatic Mammal Conservation in Latin America: Problems and Perspectives. *Conservation Biology* 7(4):788–795.
- Vig, N. J. and R. S. Axelrod, eds. 1999. *The Global Environment Institutions, Law and Policy*. Washington, DC: Congressional Quarterly Press, 1–26.
- Wackernagel, M. and W. Rees. 1996. *Our Ecological Footprint. Reducing Human Impact on Earth*. Gabriola Island, BC: New Society Publishers.

- Western, D. 2001. Human-Modified Ecosystems and Future Evolution. *Proceedings of the National Academy of Sciences of the United States of America* 98(10):5458–5465.
- Whitesell, E. A. 1996. Local Struggles over Rain-Forest Conservation in Alaska and Amazonia. *Geographical Review* 86(3):414–436.
- World Resources Institute. 2007. *EarthTrends: Environmental Information*. Washington DC: World Resources Institute. Available at: <http://earthtrends.wri.org>.