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## Mobilizing Community Capitals to Support Biodiversity

Cornelia Butler Flora  
*Iowa State University*  
USA

### 1. Introduction

The mobility of living species is increasing dramatically. When these species reproduce without control, they are viewed as invasive, crowding out native species and reducing biodiversity. While humans are often instrumental in knowingly or unknowingly introducing these invaders, increasing temperatures and extreme weather events provide environments that enhance the growth of these pests. Climate change creates more extreme weather events, and rising temperatures and increased rainfall provide favorable conditions for pests to thrive while endemic plants and animals are threatened. Human commerce and policy is accompanied by the introduction of new pests, both consciously (as the introduction of kudzu in the South of the United States by the Soil Conservation Service to restore cover to land deprived of nutrients by over-production of cotton, or rabbits in Australia introduced by “gentlemen farmers” to promote recreational hunting) or inadvertently, as pests were part of shipments of (as with Russian thistle, also known as tumble weed, in the U.S. introduced to South Dakota in the US by Russian migrants as a contaminant in flax seed) or pests on packing pallets or in shipping containers.

Biodiversity contributes to ecosystem health, which is a part of the triple bottom line that also includes economic security and social inclusion (Flora, 2001, Blewett, 2008). When there is social inclusion and economic security, it is easier to mobilize collective action to promote biodiversity. By investing in all seven of the community capitals (natural, cultural, human, social, political, financial and built), local communities can collaborate with scientists to enhance all three aspects of the triple bottom line. The community capitals framework has been successfully mobilizing in maintaining and increasing endemic biodiversity (Flora, 2001, Cepeda, et al. 2008) and ecosystem health (Flora 2004a; Gutierrez-Montez, 2005, Flora and Delaney, forthcoming). Capitals such as human, social and built (technological) are particularly important in adaptation to climate change, according to Gardener, et al. 2009).

Multiple capitals have been used by development practitioners to foster a holistic approach (Bebbington, 1999; DIFD 1999, 2000, 2001; Carney, 1998; Pretty, 2000, 1998). Building on their experience and our practice and scholarship in the U.S. and Latin America, we have found that consideration of these seven capitals is critical in making sure that programs are both sustainable and effective. (Figure 1) In our analysis, we separate individual facts from social facts Durkheim (1902, 2001). While individuals may have access and control of each of the seven community capitals, the community’s stocks and flows of these capitals these

are more than the sum of individual attitudes and possessions. Thus, you explain how individuals behave based on their attitudes and characteristics, and you explain how communities behave by looking at their structures and their collective histories.

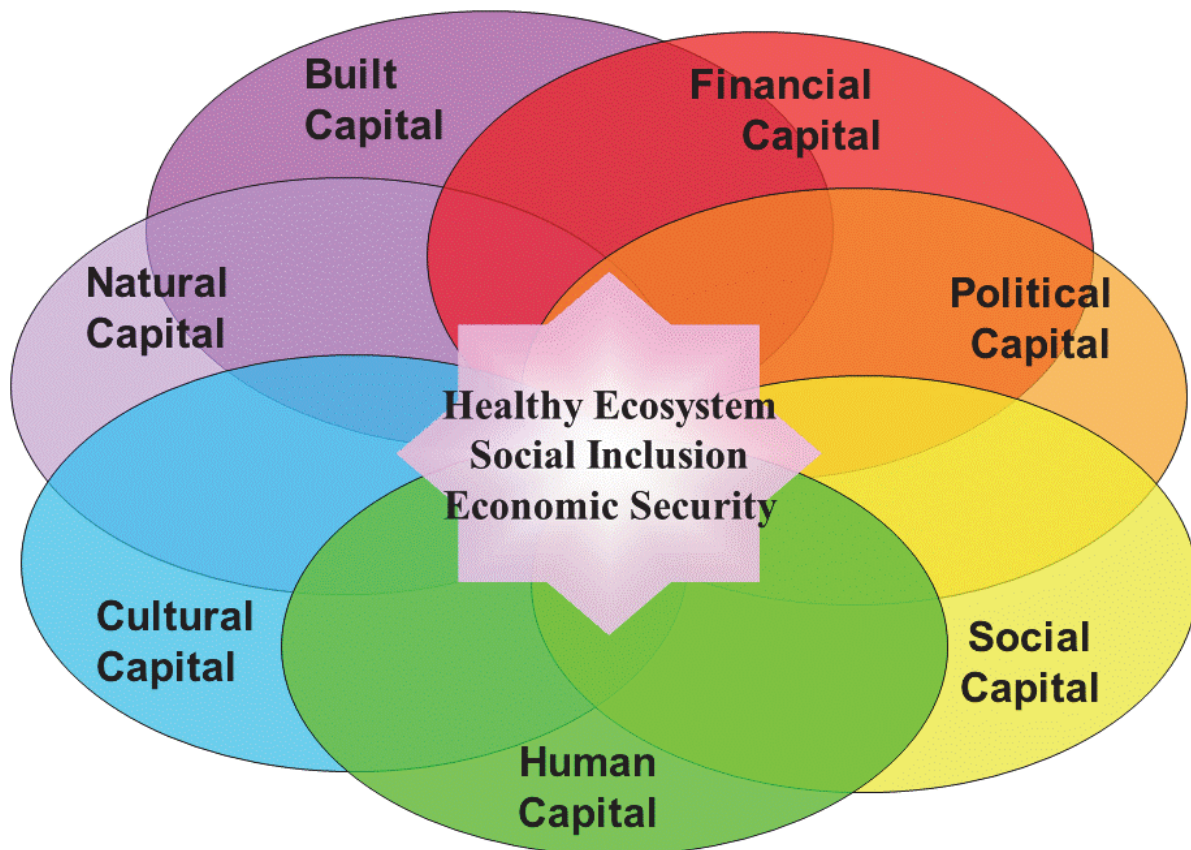


Fig. 1.

## 2. Community capitals

No matter how poor or how rich, all communities have resources that can be depleted, saved for future use, or invested to create new resources. Those resources, when invested to create new resources over a long time, are referred to as “capital”. Stocks and flows of the seven capitals are ends in themselves and means to achieve desired future conditions. A dynamic balance among the capitals and investments in them support sustainable strategies to address the emergent threats of invasive species and decline of biodiversity in a global economy and a changing climate that lead to ecological regime shifts (Lin, 2011; Flora and Flora, 2008).

### 2.1 Natural capital

The natural assets of a location, including weather, geographic isolation, natural resources, amenities, and natural beauty, make up natural capital. Water, soil and air – their quality and quantity – are a major building block of natural capital, as is biodiversity (Costanza, et al. 1997; Altieri, M.A. 1999). Biodiversity may increase with invasive species, but invasive species may damage endemic biodiversity, which then impacts the landscape, water quality and even water quantity. Urban and rural forests in the U.S. are impacted by several

recently introduced invasive species, including the Asian Longhorned Beetle (ALB). The eradication program for ALB has greatly impacted the local areas where this beetle has been found because of the removal of thousands of trees, which has cost millions of dollars. The United States has implemented stricter trade regulations to prevent further introductions. If the established populations of ALB are not eradicated, the beetle could threaten the maple sugar industry, fall-foliage tourism, natural ecosystems, recreational areas, and many beloved backyard and street trees (Sawyer, et al. 2010). And as the climate warms, maple trees are more susceptible to ALB.

The dying out of native tree species in the U.S. where the emerald ash beetle is decimating ash forests, contribute to global warming. Rural development activities influence natural capital, often negatively, decreasing long term development. Because different groups in our obesogenic society (Parkin, 2010) have different access to and understanding of natural capital, they have important firsthand knowledge of changes that are occurring on the landscape. For example, new immigrants are more likely to fish and gather wild foods than are native born populations. Linking to their daily experiences of linking to the natural world can help determine subtle changes in the flora and fauna of a place where they hunt, fish and gather.

A community-based approach to natural capital develops healthy ecosystems with multiple community benefits, where human communities act in concert with natural systems, rather than simply to dominate these systems for short term gain (Ostrum, 1990; Ostrum et al. 1994). As climate changes, conflicts over natural capital increase (Sondorp and Patel, 2003; Barnett and Adger, 2007). Utilizing climate science and local knowledge allow adaptations which include increasing biodiversity (Ensor and Berger, 2009).

## 2.2 Cultural capital

Cultural capital reflects the way people “know the world” and how to act within it as well as their traditions and language. It includes *cosmovisión* (spirituality and how the different parts are connected), ways of knowing, food and language, ways of being, and definition of what can be changed (Flora and Flora, 2008). Very often local people will have multiple terms for stages of plant and forest growth which reflect an intimate understanding and close observation of these growth stages and enable these people to give an early warning that a situation is abnormal and an exotic pest may be present. That ability to see differences is very important in identifying the possible presence of a new pest or condition (Flora, 2008).

It is often easy to discount local voices in discussions of biodiversity. Hegemony privileges the cultural capital of dominant groups (Bourdieu 1986, Flora, *et al.*, 2004). An important part of cultural capital involves the collective belief that despite changing climate conditions and seemingly unconquerable invasive species, things can change. Generally, that comes from working across groups to increase endemic biodiversity through controlling invasive species. The increase temperatures affect plant species and invasive exotic species move farther North, including the multiflora rose in the river in Chico, California. The Friends of Bidwell Park in Chico, California are a group that cares about a specific place and the biodiversity it supports. They periodically gather together wearing closed-toe shoes and long pants to remove the multiflora rose. They are convinced that by working together they can at least contain this spreading pest that threatens their endemic biodiverse park. They build on cultural differences, are patient with those who originally were enchanted by the “pretty flower” and show reverence for endemic biodiversity around Chico.



### 2.3 Human capital

Human capital has long been identified as critical for positive social change by scholars (Becker, 1964; Schultz, 1961, 1963, 1964). However, human capital champions often focus on formal education. To preserve and enhance biodiversity, the concept must be broadened to include the skills and abilities of people to develop and enhance their resources, and to access outside resources and bodies of knowledge in order to increase their understanding, identify promising practices, and to access data to enhance community capitals. Human capital also includes health and leadership.

Age and gender impact the skills and abilities available to a community seeking to enhance biodiversity. Boys and girls are sometime taught about quite different aspects of their environment. In the highland of Peru, women know about where to take livestock to graze the best mixture of forbs and grasses and which potatoes taste the best and cook with less fuel. Men know the amount of manure to put into the soil and which soils are best for each type of potato (Flora and Kroma, 1998).

Endemic biodiversity enhances human capital by providing a varied landscape and potential plants and animals for human curing and consumption, cultural capital by maintaining native species of sacred uses, social capital by providing pleasant places to gather together, and political capital to justify maintaining habitat.

Scientists often think of themselves as the major creators of high level human capital, transferring knowledge from scientists to beneficiaries. However, addressing human capital to enhance natural capital, especially biodiversity, requires more nuance than the expert transferring knowledge that has been generated from the scientists or their faculties. Partnerships aimed at enhancing natural capital and biodiversity, such as the Raccoon River Watershed Association, use capital framework to identify the motivations and abilities of each individual to improve natural capital, increase the skills and health of individuals to act to enhance natural capital, and recombine the skills and motivation of the community to a more sustainable collective future. Partnering with local communities to enhance biodiversity requires transferring knowledge about how to combat invasive species and enhance endemic based on what is already in place: local knowledge its complementarity with scientific knowledge in order to promote biodiversity (Gasteyer and Flora, 2000).

### 2.4 Social capital

Social capital is increasingly recognized as critical for ecosystem health (Triglia, 2001; C. Flora, 1995, 1998a, 2000; J. Flora, 1998). It reflects the connections among people and organizations or the social glue to make things, positive or negative, happen (Coleman, 1988; Portes and Sessenbrenner, 1993). It includes mutual trust, reciprocity, groups, collective identity, sense of a shared future, and working together (Putnam, 1998, 1995; 1993a, b).

Bonding social capital refers to those close ties that build community cohesion. Bridging social capital involves loose ties that bridge between organizations and communities (Narayan, 1999; Daasgupta and Serageldin (2000). A specific configuration of social capital – entrepreneurial social capital (ESI) is related to community economic development (Flora and Flora, 1989; 1993; Flora, et al., 1997). ESI includes inclusive internal and external networks, local mobilization of resources, and willingness to consider alternative ways of reaching goals. Entrepreneurial social capital can be invested in enhancing ecosystem health.

An example of use of social capital to fight an invasive plant is the group, Fighting Phragmites, in Oakland County in central Michigan. Phragmites has been present in North America for over 3,000 years; however, over the past century, it has come to dominate many

mid-Atlantic marshes. Scientists attribute the plant's rapid expansion to an aggressive, competitively superior genetic phragmites strain introduced from Eurasia in the 19th century via dry ballast from ships. They destroy native species in shallow lakes and marshes. Michigan State University Extension used bridging and bonding social capital to successfully combat the invasive. The Michigan Conservations Stewards brought together scientific knowledge from Michigan State University, local ingenuity of volunteer engineers employed by the automobile industry and volunteer monitors and workers to harvest and pull out the roots of these plants in local marshes.

It is critical that local people who most feel the pressure of the invasive species provides a portion of the knowledge as well as the work to address the issues of invasive species and biodiversity. When outsiders provide resources to a community without the community determining how those resources can contribute to sustainable development, any traditional dependency on political parties and politicians, based on personal relations of one or two people, may be simply transferred to the scientists involved. The group already working conservation stewardship demonstrated bonding social capital through local action for the common good. Through bridging social capital, help build flexible and porous boundaries that increased the human capital to address the issue. Social capital can be a key vehicle of cutting transaction costs in linking local and scientific knowledge to control and eradicate invasive species.

In this case and others of citizen participation to decrease the presence of invasive species and maintain endemic biodiversity, the long term institutional presence in the community through Extension served as links to other institutional actors can be key to project success. Indicators of a balanced increase in bridging and bonding social capital include a shared vision (which takes time and trust to develop), building first on internal resources (which means the community has together determined existing assets that can be turned into capitals for participatory rural development, looking for alternative ways to respond to constant changes (rather than the one solution of a certain investment to solve everything), the loss of the victim mentality (feeling overwhelmed by globalism or climate change), and loss of a cargo cult mentality (where the community waits for an outside investment to rescue them) (Flora et al. 1999; Flora, et al. 1996).

## 2.5 Political capital

Political capital is the ability of a group to mobilize their norms and values to influence standards, regulations and enforcement of those regulations that determine the distribution of resources and the ways they are used (Flora and Flora, 2008). When a community has high political capital, its people have the collective ability to find their own voice and to engage in actions that contribute to the well being of their community. In Fighting Phragmites, the norms and values surrounding invasive species not only mobilized human and social capital, but got the local county and the state Department of Natural Resources to invest in the effort.

Political capital has been commonly operationalized as the power to disrupt or stop something from happening, or to get specific goods from a central authority (Aiger, *et al.* 2001). By increasing bridging and bonding social capital to all segments of the community, the community's power of negotiation, particularly in identifying allies that share their vision for a sustainable future with increased biosecurity, grows.

Indicators of increased political capital that can enhance endemic biodiversity include organized groups working together for biodiversity and a healthy ecosystem, local people

knowing and feeling comfortable around powerful people, including scientists and government functionaries, and local concerns becoming part of the agenda in the regulation and distribution of resources related to increasing ecosystem health. Focusing only on the technical or mechanistic means to maintain biodiversity serves to mask or obscure the fundamentally political nature of remediation and adaptation processes. Engaging a broad range community residents in the discussion of policy issues around biodiversity and a healthy ecosystem builds political capital.

## **2.6 Financial capital**

Financial resources available to invest in community capacity building, to underwrite invasive pest management and business development, to support civic and social entrepreneurship, and to accumulate wealth for future enhancement of the other capitals make up financial capital. Financial capital is often privileged as an indicator of progress and dominates evaluation and monitoring when looking at changes in natural capital. There is a tendency to monetize other capitals, rather than considering the reverse: money gained from natural resource destruction results in the decline of natural and often human capital as well. In an era when profitability for private actors is viewed as the most important measure of success, biodiversity should be creatively linked to financial capital to help legitimize the activities undertaken by local people as scouts for invasive species and as actors to control them.

Bridging social capital can enhance financial capital (Grannovetter, 1973; 1985). Appropriate investment in financial capital can create an appropriately diverse and healthy economy and to increase biodiversity if that social capital includes biodiversity considerations. Otherwise, bridging social capital can foster more rapid decline in biodiversity as water quality declines, as is happening in areas in the states of Pennsylvania and New York where hydraulic fracturing (fracking) is used to mine natural gas. When there are public investments in increasing biodiversity, poverty can be reduced, business efficiency can be enhanced, economic diversity can increase, and the assets of those who live in the community can grow. A number of projects of the USDA Forest Service in New Mexico were aimed at maintaining forest health and biodiversity through the harvesting of small timbers by local people and the creation of small saw mills to process that wood.

## **2.7 Built capital**

Physical and technical infrastructures make up built capital. It includes such diverse human-made objects and systems as sewers, water systems, electronic communication, soccer fields and processing plants. For control of invasive species, it can be as simple as hand tools such as picks and shovels and wheel barrows to physically remove the plants. Or it can include chemical substances that can make pests sterile

Built capital can enhance or decrease biodiversity. Indeed landscaping for new subdivisions is often a source of major invasive plants, such as privet, used decoratively for hedges and which can readily invade a hardwood forest. An example of such potential for both enhancement and degradation is a rural water system, which can run sewage into the stream the community depends on for drinking water, or provide for appropriate and cost-effective sewage treatment (Flora, 2004).

Built capital can enhance other community capitals when it serves multiple users (human capital), it can be locally maintained and improved (human and financial capital), it links local people together equitably (bonding social and cultural capital), and it links local

people, institutions and businesses to the outside (bridging social and financial capital). And appropriate investments in infrastructure can discourage the growth of invasive species, while other build capital decreases it.

### **2.8 Spiraling down**

Loss of one capital can lead to disinvestment in other capitals (Waquant, 1997). Decline in natural capital, which is often triggered by invasive species, has been linked to decreased financial capital (lowered productivity and income), decreased human capital (out-migration and illness), decreased cultural capital (loss of bio-diversity and village rituals), and decreased social capital (as there is increased inequality). Responses to invasive species often are based on technological fixes (a form of built capital) in hopes of at least stemming the downward spiral. By addressing only the immediate threat of invasive species, sustainable actions to increase the community's ability to respond to future ecosystems changes will not occur.

### **2.9 Spiraling up**

Built capital is not the first investment necessary to reverse the downward spiral of biodiversity decline (Cepeda, 2008; Gutierrez, 2005). Investment in both bonding and bridging social capital, including accepting the time it takes to build trust and reciprocity, is often a key entry point. Maintaining biodiversity and combating invasive species is a way to build trust and reciprocity through giving all members of the community to do what they say they will do and to give local people a way to reciprocate in a way that maintains their dignity and meaning.

## **3. Conclusions**

The increasing vulnerability of local landscapes to invasive species requires on-going mobilization of all community capitals in order to have the agility of prompt and effective responses. Bridging social capital among communities can serve as an early alert that can mobilize local residents and scientists to work together to experiment with and implement appropriate remedial action. But when all the capitals are invested in, including cultural capital so that local populations understand that they do not have to accept crop and forest destruction as inevitable, scientist-community partnerships can increase biosecurity for a healthy ecosystem and a vital economy with a high level of social well-being (Flora, 2003).

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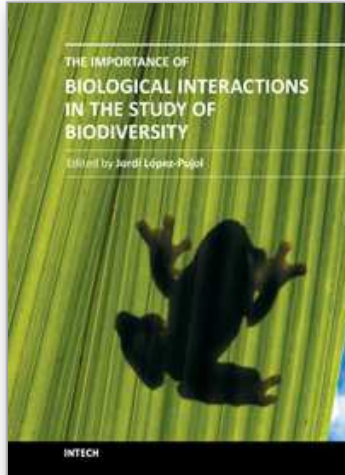
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## **The Importance of Biological Interactions in the Study of Biodiversity**

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The term biodiversity defines not only all the variety of life in the Earth but also their complex interactions. Under the current scenario of biodiversity loss, and in order to preserve it, it is essential to achieve a deep understanding on all the aspects related to the biological interactions, including their functioning and significance. This volume contains several contributions (nineteen in total) that illustrate the state of the art of the academic research in the field of biological interactions in its widest sense; that is, not only the interactions between living organisms are considered, but also those between living organisms and abiotic elements of the environment as well as those between living organisms and the humans.

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Phone: +86-21-62489820  
Fax: +86-21-62489821



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