

**Lessons from the Equator Initiative:
Cananéia Oyster Producers' Cooperative,
Brazil**

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1. Introduction

1.1. The Context

Our planet is losing biodiversity at an alarming rate. Anthropogenic pressures are accelerating extinction rates by one to ten thousand times greater than natural extinction rates (Stuart 2000). Accelerating extinction rates are partly attributed to socio-economic pressures as countries strive for economic development. Compounded with a growing global economy and the potential rapid alteration of ecosystems, biodiversity conservation is facing an uncertain future.

Biodiversity loss threatens the sustainability of biospheres of our world since biodiversity maintains ecosystem health and confers ecosystem resilience to change (i.e. climate, pests, and disease) (Holling 2001). When change occurs, socio-economic flexibility and security can be maintained with access to a rich biodiversity. The full potential of biological resources has not been thoroughly investigated; potentially invaluable species may be lost forever without conservation efforts.

Because natural systems are complex, non-linear, and poorly understood (Holling and Meffe 1996), conservation efforts need to account for such complexity and uncertainty. Natural systems will never be fully understood since controlled and replicated experiments are impossible to perform on large-scale systems and large natural variations presents numerous confounding variables (Ludwig et al. 1993). Moreover, conservation does not imply stasis; conservation must maintain the diversity of the ever-evolving variety of life on Earth (Knapp 2003). Consequently, a very high level of uncertainty and complexity in natural systems makes managing for the conservation of biodiversity difficult (Ludwig et al. 1993).

However, our attention to only complex natural systems is not adequate for conservation goals; social contexts and elements are equally or often more important in such efforts. For example, conservation dilemmas can also not be separated from problems of equity and governance. Ethics and social justice are needed to solve environmental problems (Ludwig 2001; Costanza 1996). Environmental degradation is generally viewed as the direct consequence of increasing human population and economic development, however, over consumption, use of inappropriate technologies, unequal access to resources and poverty are the underlying forces of the environmental crisis (Landa 1997; Folke et al. 1996).

Disciplinary approaches to environmental problems and crises have serious shortcomings because of their narrow, reductionist focus and coverage (Costanza 1996). To adequately address the environmental crisis, research endeavours must adopt a multidisciplinary, systems approach (Berkes et al. 1998; Holling and Gunderson 2002). A systems approach considers how each part interacts with every other part, ignoring important interactions by simply understanding how each part functions independently may lead to false conclusions on natural and social systems (Dobson et al. 1997; Capra 1996). An interdisciplinary approach linking both natural and social systems is crucial.

In order to link social systems with natural systems, application of resilience thinking has proved to very significant (Berkes and Folke, 1998). As defined by the

Resilience Alliance (2002), resilience is the ability of a system to absorb perturbations and to build capacity for self-organization, learning, and adaptation. Learning and adaptation are possible through adaptive management, which is crucial for building resilience and maintaining sustainability. Sustainability is attainable with adaptive management, since modifications in resource use are made based on monitoring socio-economic and ecological systems responses to management decisions. Thus, management is treated like an experiment and refinements may be made to account for changing ecological conditions and socio-economic demands (Walters 1986).

Consequently, institutions that are closer to the resource, flexible, diverse, and open to feedback from the environment are more likely to achieve sustainable natural resource management (Berkes 1999). Natural resource management cannot be done only at the local or national level, there is a need for engaging institutions from diverse scales for natural resource management (Brown and Rosendo 2000). Natural resource management is a cross-scale issue with larger scale institutions hindering or supporting smaller scale institutions through various mechanisms (Berkes 2002). If the management is too centralized, there is a delay or no feedback about the resource base (Berkes 2002). However, if the management is too decentralized, feedback between user groups of different resources or of adjacent areas may be lost (Berkes 2002). Thus, new institutions and cross-scale linkages at various hierarchical levels of ecological, economic, and social systems are necessary to achieve justice across the different scales (Ludwig 2001, Holling 2001).

1.2 Statement of the Problem and Research Issues

Achieving ecological and socio-economic justice is crucial. Especially since most countries striving for rapid economic development are located within the tropics, and thus contain the majority of the world's biological diversity (Huston 1993). Poor residents of developing countries in the tropics often have limited options to commit to conservation of their nation's teeming biodiversity. New approaches need to be discovered and undertaken that can achieve both the conservation of biodiversity and the alleviation of poverty.

A reconciliation of development goals with conservation goals is required to achieve sustainability. The compatibility of development goals with conservation goals is currently being debated in the conservation literature (Hackel 1999; Redford and Sanderson 2000). Development and biodiversity conservation are commonly thought of as being antagonistic (Clark 1995). Rapid human population growth has led to the destruction of "pristine" habitats through urban sprawl and the destruction of grasslands and forests for agriculture (Dobson et al. 1997). Thus to conserve biodiversity, it would appear that we must protect biodiversity from use by humans.

However, humans are an active part of this biosphere and our traditional practices have shaped the evolution of biodiversity for numerous years (Striplen and DeWeerd 2002). Some researchers (i.e. Diegues 1998) consider "untouched" wilderness to be a

myth and that conservation through exclusion is not always a suitable solution for the conservation of biodiversity.

Conservation through exclusion is not very effective (Diegues 1998; Brown 2002). Most habitats are already populated with people that need to earn a living so it is difficult to obtain local support, which thus makes it difficult to enforce with very costly measures needed for monitoring (Diegues 2002). Left with limited options for survival, displaced people are often forced to move to crowded slums in larger cities.

Maintaining people on the land may actually help to conserve biodiversity since it is assumed that they have a genuine concern for the land (Diegues 1998). Rural populations in Brazil may help prevent unscrupulous logging and mining industries from taking over, claiming short-term benefits and leaving long-term ecological degradation (Diegues 1999). Thus the most valuable instrument for conservation is not the park fence in isolation but policies and reforms that also achieve environmental and social justice (Folke et al. 1996).

There has been a paradigm shift in biodiversity conservation from exclusive protected areas towards people-centered conservation, known as New Conservation (Brown 2002). New Conservation adopts an understanding of the dynamics and disequilibria of ecological systems and rejects the myth of wilderness and pristine areas, and includes integrated conservation and development projects, extractive reserves and wildlife utilization, community-based natural resource management (Brown 2002). Community-based natural resource management (CBNRM) involves (1) incorporating local residents into land-use policy and management decisions, (2) giving people ownership of biological resources, and (3) returning economic benefits for conservation to local people (Hackel 1999).

However, it is difficult to integrate conservation with economic needs. Traditional options conducive for conservation may not be flexible enough for demographic and economic developments and changing values. Some traditional communities may want change from traditional lifestyles. For example the Masai would like to convert their traditional range into more lucrative agricultural land (Norton-Griffiths 1995 *In* Hackel 1999). Furthermore, community aspirations may differ as a result of breakdown of traditional authority, commercialization, modernity, social change and new urban aspirations, immigration of different people and/or intrusion of unsuitable state policies (Leach et al. 1999). Impoverished communities may overlook conservation goals in pursuit of short-term economic gain (Hackel 1999). Intense demand for short-term economic gain constrains sustainable alternatives, which are more beneficial in the long-term but less lucrative for immediate needs. Furthermore, Hardin's (1968) "Tragedy of the Commons" predicts that most individuals usually selfishly seek short-term gains, resulting in the inevitable decimation of common property resources from overexploitation.

Nevertheless, evidence from recent work suggests that self-organized communities, with access to favourable resource networks, have attained some success in

the management of common property resources, ensuring the sustainability of the resource and the conservation of biodiversity (UNDP Equator Initiative, 2002).

As population and consumption demands increase toward the environmental carrying capacity, there is limited time to resolve socio-economic inequalities that are linked with the present state of resource use and conservation (Gómez-Pompa and Kaus 1999). With a limited time frame to learn by trial an error, studies of success stories, such as the Cananéia Oyster Producer's Cooperative are important since such knowledge is vital to speed up adaptive management (Holling et al. 1998) and thus help conserve biodiversity and achieve sustainability.

1.3 Purpose

To determine what lessons may be learned from the Cananéia Oyster Producers Cooperative in Brazil on the **reconciliation of development and conservation goals**. During the study, local input will be used to further refine the objectives to help increase relevance of study results for the Cooperative.

This research is one of several EI case studies in a coordinated team project at the Natural Resources Institute, University of Manitoba, in cooperation with IDRC and the Biodiversity Conservation Office of Environment Canada. By documenting how biodiversity conservation and economic development can be simultaneously achieved, the research findings will be used to further the theory and practice of community-based conservation

1.4 Objectives

I. What can be learned from the Cooperative in terms of self-organization?

Research will focus on the precipitation of the Cooperative; how the Cooperative was funded and organized; the role of leadership in the evolution of the project; capacity development; identification of any obstacles to self-organization and how the obstacles were overcome.

II. What can be learned from the Cooperative in terms of cross-scale institutional linkages?

This objective will identify and determine the extent of involvement of the Cooperative with various levels of government, NGO's, and development agencies. Key institutional linkages that facilitated, or hindered, the development and security of the Cooperative will be particularly addressed.

1.5 Methods

Fieldwork was conducted from September 2003 to February 2004. Research methodology included a variety of Rapid Rural Appraisal methods. Thorough archival reviews were conducted at libraries at government agencies the Forest Foundation and Fisheries Institute as well as at the University of São Paulo, particularly within the library at the Nucleus of Support for Research on Populations in Humid Areas in Brazil (NUPAUB; *Núcleo de Apoio à Pesquisa Sobre Populações em Áreas Úmidas no Brasil*). Semi-structured interviews were conducted with active Cooperative members and inactive Cooperative members (n = 28). However, some Cooperative members were interviewed more than once. Semi-structured interviews were also conducted with representatives from various organizations involved with the Cooperative (n = 13). As with the Cooperative members, some representatives were interviewed more than once, particularly representatives from the Forest Foundation and Fisheries Institute who were interviewed on an almost weekly basis. A technical understanding of oyster aquaculture was developed through the participation in a 3-day oyster aquaculture seminar. Participant observation of the complete cycle of oyster harvesting and aquaculture operations provided further insights into oyster aquaculture and Cooperative operations. The Cooperative structure and function was also directly examined at 9 Cooperative meetings, which ranged in focus from implementation of an extractive reserve, an appraisal by FUNBIO, and an urgent need to increase profits for the Cooperative. Data collected to date has been verified by Cooperative members and key organizational representatives. A partnership for information exchange was also developed with a student at the University of São Paulo who is conducting a socio-economic evaluation of the Cooperative for her Master's Thesis. This partnership enabled for the exchange of additional information and further verification and discussion of results.

2. Background Information

2.1 Cananéia Natural History

The Cananéia lagoon estuarine system is located on the coast of São Paulo, Brazil at 25°S (Schaeffer-Novelli and Cintrón-Molero, 1990). The region is subtropical and has a mean annual temperature of 21.4°C (Schaeffer-Novelli and Cintrón-Molero, 1990). The total intertidal area covered by the entire Cananéia Lagoon estuarine system is about 90km² and mangroves dominate this intertidal region (Schaeffer-Novelli and Cintrón-Molero, 1990). The Cananéia lagoon estuarine complex is considered by the IUCN to be the third most productive estuary in the world in terms of primary productivity.

This high level of productivity is the basis for a complex marine food chain, thereby providing food for fish stocks in the open ocean (Schwamborn et al. 1999, Medeiros et al. 1999). Dense mangrove roots also provide shelter for small organisms and are known to serve as nurseries for various organisms, some of which are important renewable food resources (Blankensteyn et al. 1997; Glasser and Grasso, 1998). Mangroves also improve the quality of water flowing into the ocean by filtering out pollutants and allowing for the sedimentation of particulates (Rönnbäck 1999).

Consequently, mangroves are vital for the maintenance of water quality required by coral reefs and other marine ecosystems (Moberg and Folke 1999). Interlocking mangrove roots also help protect against shoreline erosion (Kairo et al. 2001). Furthermore, mangroves serve as important nesting and rookery sites for various species of birds (Olmos and Silva, 2002). Mangrove organisms may also yield valuable products, i.e. pharmaceutical compounds in sponges, sea anemones, and sea cucumbers (Bell and Gervis, 1999).

Mangrove forest is an important floristic community of the Atlantic Forest, which has exceptional levels of biodiversity and is also composed of humid forest, and *restinga* (dune forest) floristic communities. The region around Cananéia contains some of the largest fragments of Atlantic Forest left in Brazil. The Atlantic Forest holds the world record for the largest diversity of woody tree species within one hectare of land with 458 species identified within one hectare of land (Pinto 2002). However, it is highly threatened since it is situated within the most populated region of Brazil, which is occupied by 70% of the Brazilian population; approximately 110 million people (Pinto 2002). Initially the Atlantic Forest spanned over 3,000km of the Brazilian coast, but urbanization, industrialization, and intensive agriculture have completely decimated the forest to less than 8% of its initial domain (Pinto 2002).

2.2 Brief History and Socio-economic Context

Cananéia is considered to be one of the oldest towns in Brazil established by Portuguese colonialists in 1531 and currently has a regional population of approximately 30,000 (See Fig. 1). From the 17th to 19th century, Cananéia prospered through economic cycles of gold mining, shipbuilding, and agriculture (Bernardo et al. 1993). During the 19th century, landowners prospered from a strong agricultural based economy and cheap labour provided by slavery. In the mid 19th century, one such landowner had a son with a slave and this son, Francisco Vicente Mandira, ended up inheriting 1,200 hectares in the municipality of Cananéia. Today that area is known as Bairro Mandira, and continues to be occupied by descendents of Francisco Vicente Mandira (See Fig. 1). However, the community has limited financial resources because expansion of the coffee market in the 20th century shifted economic development and wealth to interior regions of Sao Paulo and neighbouring states. Since the region is not suitable for coffee plantations, Cananéia and the entire region of the Vale de Ribeira were economically and politically marginalized (Bernardo et al. 1993). To this day the region is considered the poorest region in São Paulo state. With very limited economic development, the Mandira community primarily engaged in shifting-agriculture and extraction of rain and mangrove forest products for subsistence.

2.3 Description of Resource Use Problem:

The Mandira community was legally banned from traditional farming, hunting, and gathering practices in 1970, when the Cananéia region was transformed into an Area for Environmental Protection (Area Proteção Ambiental – APA) The Mandira community had to give up their subsistence agriculture and hunting livelihoods and began to rely on oyster harvesting (*Crassostrea brasiliiana* or *C. rhizophorae*) to earn a living. For the past 30 years, the Mandira community has relied on oyster harvesting for more than 90% of their livelihood earnings.

However, economic returns obtained by the Mandira community from the oyster harvest were very small. Before the Cananéia Oyster Producers Cooperative was established, middlemen would claim large portion of the profit. The community did not have direct contact with the market. Furthermore, the gathering and preparation of the oysters used to be conducted in secrecy, since the community did not have the means to meet strict sanitary and harvesting regulations. The low economic return obtained from the oysters, lead to the community to overexploit the oyster resource to attain a minimal standard of living to survive. The exploitation of mangrove products was further intensified by outsiders¹ who also were usurping the mangrove resources. Consequently, such open access conditions coupled with low economic return were resulting in overexploitation and the subsequent decimation of oyster stocks.

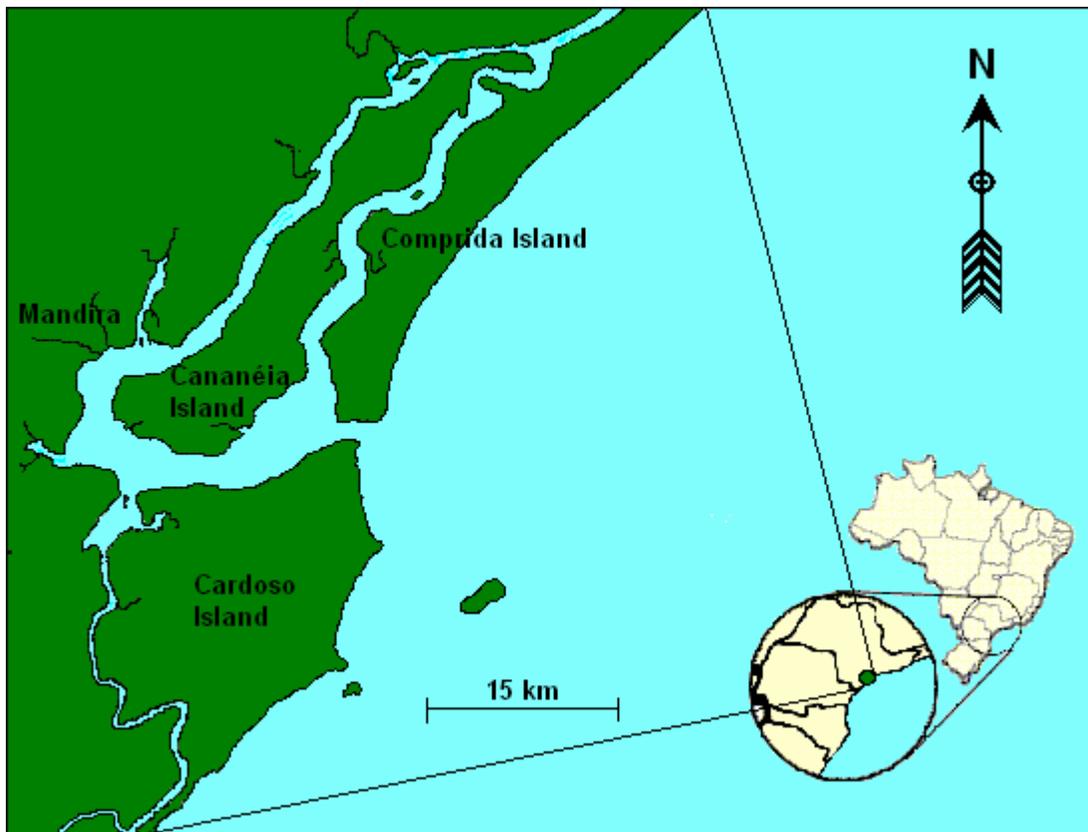


Figure 1. Map of Cananéia and its location in southeast Brazil.



Without autonomy over the oyster resource, the traditional community is also obligated

¹ People from neighbouring states often enter the mangrove region in Cananéia and usurp what they can with disregard for sustainability since they do not intend to permanently settle there. There are also various people from Cananéia city which periodically gather mangrove resources to supplement their livelihoods.

to follow legal sanctions established by the Brazilian Institute of Environment and Renewable Resources (IBAMA). Oyster harvesting was prohibited from December-February, the principle reproductive period of the oysters, which also coincides with the time of the year with greatest demand as numerous Brazilians seek coastal regions for summer holidays. There were also size restrictions on the harvest; oysters less than 5cm and greater than 10cm in length could not be harvested. Thus the Mandira community had very limited options to secure a sustainable livelihood.

2.4 Cooperative Member Structure:

The Cooperative concept was initially created by government researchers for the Mandira community, however, logistical considerations for the construction of the depuration centre resulted in expansion of the Cooperative to other rural communities. The depuration station was built 6km from Cananéia city since land there was more suitable for construction and had access to reliable supplies of electricity and water. The current location is also conveniently located off of highway SP-226, which connects to the major thoroughfare Rodovia Régis Bittencourt (BR-116), the principal highway in southeastern Brazil with links to major metropolises such as São Paulo and Curitiba. Furthermore, the land for the depuration station was also donated by the municipal government. Because of all these considerations, other oyster collectors from the region were also recruited for the Cooperative. There are currently Cooperative members from 6 rural communities including Mandira, Acaraú, Ariri, Porto Cubatão, Retiro, and Itapitanguí (See Table 1). However, slightly more than 50% (12/23) of the Cooperative's active members are from Mandira.

Table 1. Total active and inactive COOPEROSTRA members from each location (Garcia 2003, pers. comm.).

Location	Active	Inactive	Total
Mandira	12	5	17
Itapitanguí	2	7	9
P.Cubatão	1	3	4
Acaraú	7	0	7
Retiro	0	2	2
Ariri	1	0	1
Total	23	17	40

Some basic socio-economic characteristics for 31 Cooperative members are summarized below in Table 2. Most cooperative members have large families and the average education obtained is approximately equivalent to a grade 4 level (See Table 2). However, most of the children have surpassed or presumably will surpass the level of education attained by their parents. Most families own electronic goods, for example 27 own a television set and 28 own a refrigerator (See Table 2).

Table 2. Socio-economic characteristics for 31 Cooperative members (Garcia 2004).

Age (Years)	<30 8	31-40 8	41-50 9	51-60 4	>61 2	Min 22	Max 67
Marital Status	Married 23	Single 4	Common Law 3	Widowed 1			
Education	Illiterate 2	Grade 2 4	Grade 4 15	Grade 7 8	Jr. High 2	High School 0	
Household Size	1 - 3 3	4 - 6 15	7 - 10 10	>10 3			
Education of Children	Not of Age 3	All Study 11	1-2 Study 12	>1 High Sch. 7	Mentally Handicap 2		
Housing	House		Own 30	Rent 0	Borrowed 1		
	Lot	Own 15		Inherited 6	Bought 9		
		# of Rooms		1 - 3 2	4 - 5 19	6 - 7 6	> 8 4
	Material		Brick 27	Wood 1	Mixed 3		
	Sanitary System	Open Sewer 20	Plumbing 11				
Electricity	100%						
Health Plan	Yes 1	No 30					
Dental Plan	Yes 29	No 2					
Monthly Wages			Revenue from Oysters		Revenue Incl.	Revenue	
			Before COPC	After COPC	Other Sources	Per Capita	
	Max		600	800	800	300	
Min		20	0	120	0		
Production	0	1 - 2	3 - 4	5 - 7	8 - 10	> 11	
	After COPC	4	11	10	4	2	
	Before COPC	2	8	8	7	6	
		Max	Min				
	After COPC	1000	0				
	Before COPC	2400	0				
# of Rearing Beds Owned	0 1	1 - 2 10	3 - 4 10	5 - 7 5	8 - 10 4	> 11 1	
Sell %	100% COPC 19	100% other 3	Mostly COPC 1	Mostly others 6	Uncertain 2		
Own Consumer Goods	TV 27	VCR 1	Terr. Vehicle 26	Boat 19	Motor 13	Other Elect. 17	
	Refrigerator 28	Telephone 4	Cell. Phone 2	Iron 26	Radio 13		

3. Major Findings and Discussion

3.1 Community organization

a. *Origins of the project*

- i. *Date of community initiation (Date community 1st contacted)*
Early 1990's
- ii. *Date of formally established (EI date)*
Cooperostra established November 1, 1997
- iii. *What inspired or precipitated the project? What were the sources of inspiration for the project?*
 1. *Whose idea was it? Locals, outsiders, gov't, NGOs, etc*

Oyster Aquaculture in Cananéia (1960's -1980's)

Idea and initial methodology developed by Wakamutsu (1960's and 70's) a biologist from the Oceanographic Institute at the University of São Paulo. Other researchers such as Akaboshi and Bastos (1977), Akaboshi and Perreira (1981), and Perreira (1983) further developed oyster aquaculture knowledge in the areas of oyster biology, time and location of occurrence of oyster larvae, types of oyster larvae collectors, conditioning, and cultivation.

Oyster Aquaculture for Sustainable Development (1989)

Ecological and Socio-economic Zoning Project by the Secretariat of the Ministry of Environment (1989) concluded that aquaculture is the only economically important activity with potential to alleviate poverty and preserve environmental quality and urged the development and application of an aquaculture program to initiate economic development and conserve biodiversity

Oyster Rearing Beds (1993)

Fisheries Institute, São Paulo Secretariat of the Environment, and the local fisher organization in Cananéia (Colônia de Pescadores de Cananéia) developed a proposal (1993) on the viability of oyster aquaculture in Cananéia (*Viabilidade da ostreicultura e criação de outros bivalves marinhos na região de Cananéia*), which specifically explored the possibility of introducing oyster rearing beds to increase oyster economic yield.

Oyster Rearing Beds introduced into Mandira (1994)

National Center for Sustainable Development of Traditional Communities (CNPT) and the Brazilian Institute of Environment and Renewable Natural Resources (IBAMA) contacted NUPAUB to help create an extractive reserve in Coastal Atlantic Rain Forest. Also formed partnership with State Ministry of the Environment, and Fisheries Institute, and NUPAUB, and commenced studies on the socio-environmental viability of extractive reserves in Cananeia. The Mandira community was selected based since strong family and social ties would presumably facilitate the development of tight community organizations.

Further developments on rearing, depuration, and commercialization (1995):

Funds were obtained through the Program for Decentralized Execution (PED) from the Brazilian Ministry of the Environment (MMA) and World Bank, for the project “Uso sustentável do Complexo Estuário Lagunar de Iguape, Cananéia, e Ilha Comprida” which proposed a subproject in the “Management of natural oyster beds: rearing, depuration, and commercialization.” This project was co-executed by the Fisheries Institute along with the Forest Foundation, and proposed the expansion of the oyster rearing beds for 25 families within the extractive reserve, the construction of a depuration station, and support to initiate community organization and commercialization of oysters.

Creation of Cooperostra (1997):

With the release of PED funds from the government in 1997, the proposal for Cooperostra was carried out.

2. *Trigger events*

I. Environmental law passed banning farming and hunting in the 70's so Mandira community had to rely on oyster harvest

II. Decreasing oyster yields from high extraction pressure

i) Low return

- middlemen² claimed most profits

- lack of certification to command higher prices on market

- small size and irregular appearance yielded less profits

ii) Increased demand of oysters due to the construction of roads in 1970 which opened access along entire São Paulo coast, increasing the number seafood craving tourists flocking to the coast and connected Cananéia to large tourist centers.

iii) Extraction by “outsiders” and open access conditions

III. IBAMA legislation Portaria N^o40 (1986-1987) banning year-round harvesting

3. *Catalytic element*

National Center for Sustainable Development of Traditional Communities (CNPT), an organization linked with IBAMA, wanted to create an extractive reserve in non-Amazonian Regions. Thus, CNPT formed partnerships with São Paulo Secretariat of the Environment, Fisheries Institute, and NUPAUB to synergize efforts to create an extractive reserve.

² Middlemen are from various coastal cities including Cananéia, São Vicente and Santos.

Quilombola Law helped the community attain access rights to land since the Brazilian government grants land rights to quilombola communities. Quilombola communities are communities which were established by freed or runaway slaves.

b. *Knowledge (note gender)*

i. *Sources of knowledge: local/TEK and/or outside knowledge*

Both – fusion knowledge. See response to 2.a.iii.1 for development of oyster aquaculture technology.

ii. *If there is local knowledge and if relevant, who holds this knowledge?*

Oyster collectors (primarily male)

iii. *If there is outside knowledge used in the project, was there capacity building (education, training, knowledge exchange)? Yes Who was involved in providing capacity (e.g., other communities, NGOs, Gov't, universities, researchers)?* Numerous meetings (>50) were undertaken with government researchers from the Fisheries Institute and the Forest Foundation to exchange outside and local knowledge. Several courses are also offered by the Fisheries Institute on oyster aquaculture and the Forest Foundation on the benefits and requirements of Cooperatives and associations.

c. *Leadership and key people (note gender)*

i. *Individuals: locals and/or outsiders (e.g., local leaders, researchers).*

ii. *What role did they play?*

Table 3. Role, origin and gender of key people involved with the Cooperative.

Leader	Origin	Gender	Role
I (State University → State Forest Foundation)	outsider	male	1 st principal research on viability of extractive reserve and introduction of oyster beds
A (Mandira community)	local	male	Regularly provided Leader I feedback on plans and results
B (Mandira community)	local	male	Current president of Cooperative
II (State Forest Foundation)	outsider	male	2 nd principal researcher, further developed oyster bed viability and helped obtain health certification
III (State Fisheries Institute)	outsider	female	Current primary technical researcher, collaborated with Leader II and now collaborates with Leaders IV and V
IV and V (State Forest Foundation)	outsiders	both female	Primary administrative coordinators of project

How did their role change during the course of the project?

Leader I brought the project from the State University to the State Forest Foundation. Leader II undertook leadership of project once Leader I left the Sate Forest Foundation. Leader II collaborated extensively with Leader III from the State Fisheries Institute. When Leader II left the Forest Foundation, Leader IV undertook leadership, followed by Leader V, and both continued to collaborate with Leader III. Leader A's role decreased with time and Leader B became president of the Cooperative (See Table 4).

Table 4. The role and connections of different external leaders throughout different phases of the project.

	PHASE				
Phase	I	II	III	IV	V
External Leader	Leader I (1990-1996)		Leader II (1995-1999)	Leader IV (2000-mid2004)	Leader V (mid2004 – present)
			Leader III (1995 - present)		
Org. Affiliation	State University Research Institute	State Forest Foundation	State Forest Foundation	State Forest Foundation	State Forest Foundation
			State Fisheries Institute		
Role	grad student: research socio-ecological viability of reserve	government researcher: start attempt to implement reserve	government researchers: contact all oyster harvesters, initiate cooperative	government researchers: capacity development of oyster harvesters, establish reserve	government researchers: assist Cooperative secure a market
Connections	Environmental Ministry, State Secretariat of the Environ. [State Forest Found.]	State University Research Institute, State Fisheries Institute, Community -Based Org., Leader II and III	State University Research Institute, State Health Organization, Municipal Government, Local NGO, Local Religious Organization, Leader IV	National and International Funding, State University Research Institute, State Health Organization, Local NGO, Education Agent, Economic Planning Agent, Market Development Agent, Leader V	National Funding, State Health Organization, Market Development Agent

iii. Key organizations: locals and/or outsiders (e.g., traditional authority, gov't, NGOs). What role did they play?

Please see Table 5.

Table 5. Specific assistance, role, and origin of different organizations linked to the Cooperative.

Organization	Origin	Role	Specific Assistance
Cananéia Oyster Producers Cooperative	Organization of Oyster Producers/Collectors	Project Participants	Organization of oyster collectors
Mandira Reserve Association	Community Organization	Project Participants	Organization of community members, experimentation with aquaculture methods
Forest Foundation of São Paulo (State Secretariat of the Environment)	São Paulo State Government	Coordination of the Program for oyster use in mangrove regions within the estuary of Cananéia	Technical support to conduct projects, obtaining financial resources, diffusion of initiative, political and financial support.
Fisheries Institute (State Secretariat of Agriculture and Supply)	São Paulo State Government	Co-coordination of the Program	Research on oyster stocks in mangrove and aquaculture; education and training
NUPAUB	University of São Paulo	Technical and Financial Support	Sociological research; political and financial Support
C.E. Gaia Ambiental	NGO	Technical Support	Organization of oyster collectors, participation in studies conducted
Margaret Mee Botanical Foundation	NGO	Financial Support	Help obtain financial support, administrative support
Comissao Pastoral da Pesca	NGO	Political Support	Organization of collectors, political support
Adolfo Lutz Institute (State Secretariat of Health)	São Paulo State Government	Technical Support	Quality control; laboratory analyses
Ministry of the Environment (PED and PD/A Funds)	Federal Government	Financial Support	Financial Support
Cananéia Municipal Government	Municipal Government	Financial Support	Donated land where the purification station now stands
Shell Brazil	Private Initiative	Financial Support	Financial Support
World Vision	NGO	Financial Support	Financial Support
Brazilian Fund for Biodiversity	Fund	Financial Support	Financing for the elaboration and implementation of the Business Plan

How did their role change during the course of the project?

- Forest Foundation and Fisheries Institute are the key organizations that are involved in the administration and collaboration of the project. However, Cooperative members would like greater independence over their operations. Both the Cooperative members and outsiders would like to see the roles of the Forest Foundation and Fisheries Institute decrease over time.
- All external financial assistance has since been depleted except for the FUNBIO loan. The Cooperative now must deal with growing debt. See: *e. Funding* for more specific information on how financial support has shifted between organizations over the years.

d. Learning

i. What learning processes did the project go through?

The Cooperative is going through learning processes in different areas:

- **Water quality studies**

Researchers at the Fisheries Institute and the Adolfo Lutz Institute conducted studies on potential contaminants that may risk consumer safety, which was also a key requirement to obtain certification from the Federal Inspection Service (SIF):

 - Machado et al. (2002) examined heavy metal (lead, cadmium, mercury, and copper) levels within oyster tissue that were very low and thus safe for consumption
 - Machado and other researchers examined fecal coliforms within estuarine waters (1998a) as well as within oyster tissue and fluids (1998b). Coliform counts with oyster tissue and fluids was found to be more a useful parameter since coliform populations fluctuate greatly within estuarine environments due to high levels of organic material and microorganisms, the spatial heterogeneity of the environment, along with the effect of currents, rain, tides, and winds. Water quality studies were a prerequisite for SIF certification. With SIF certification the Cooperative can command higher prices for their oysters. Initially oysters were sold along the coast but the black market dealers, without SIF certification, were undercutting their sales. Consequently, the Cooperative has been trying to increase its market by selling to high-end restaurants in São Paulo, which are concerned about providing a safe and reliable product to its patrons.
- **Oyster aquaculture/rearing**

First attempts to start aquaculture projects in Cananeia focused on the complete aquaculture cycle of oysters, however, the total cycle takes about 2 years and this is not conducive for the immediate needs of the population. Rural inhabitants cannot live comfortably while they wait 2 years for the first stock of oysters to attain commercial size. Consequently, the project focused on the use of oyster rearing beds to

allow the oysters to grow to a larger, more profitable size, while continuing to reproduce and thus replenishing natural stocks.

Fisheries researchers and project members are now trying to complete the oyster aquaculture cycle, however, both outsider and local experimentation have yielded poor results even though various methods have been tried (i.e. using submerged cages, which are used very successfully to rear Pacific oyster (*Crassostrea gigas*) in Santa Catarina, Brazil., the use of PET (empty carbonated beverage bottles), etc.). The main problem identified with “wild” oyster aquaculture in South Brazil is that there are more than one species of oyster, both *Crassostrea brasiliiana* and *Crassostrea rhizophorae* (Ignacio et al. 2000) and evidence for a third species *C. gasar* has also been discovered (Lapègue et al. 2002). The species have different rearing requirements (i.e. since *C. brasiliiana* is a sub-tidal [occurs at depths continually submerged underwater] whereas *C. rhizophorae* is an inter-tidal species [occurs at depths where it is exposed at low tides]). [Detailed methods for experiments on each step of the aquaculture cycle can be provided.]

- **Oyster processing**

Before the oysters were only cleaned once they arrived to the depuration station now they are cleaned (removal of mud and sedentary marine organisms, such as barnacles and seaweed) while on the rearing bed so as to let them recover from the stress of cleaning for awhile before they are sent to consumers. This has helped increase the resistance of oysters, decreasing the frequency of mortality during shipping. The Fisheries Institute scientists also conducted experiments on the length of depuration necessary to reduce fecal coliforms to meet safety regulations so as to use resources more efficiently and prevent the overexposure of oysters to the depuration process which weakens them, which could result in increased mortality during the shipment of oysters. The ideal depuration time was found to be 6 hours.

- **Environmental Certification**

The Cooperative is also attempting to obtain environmental certification. They have attempted to receive certification from the Marine Stewardship Council (MSC), however, it is difficult since parameters used are suited for fish stocks and not for raised oysters. Meeting the demands of report writing to obtain MSC certification will also be costly for the Cooperative since the MSC requires detailed multidisciplinary reports to achieve and maintain certification. Contacts made with Meredith Lopuch (Director - Community Fisheries Program World Wildlife Fund - California Marine Office) as well as Dr. Yemi Oloruntuyi from the Marine Stewardship Council in London may help obtain financial assistance in the future for the Cooperative to conduct further research and obtain MSC certification.

- **Oyster transportation and connecting product to market**
 Now the Cooperative has come to the realization that perhaps sellers (legal middlemen) could be used to sell their product. They can transport the product to one place in Sao Paulo and sellers will pick the product up from there and transport it to various locations in the city. Alternatively they are also considering hiring sellers to obtain the product directly from the depuration station and avoiding dealing with transportation. Marketing plans are being devised by a professional marketing firm. However, both outside researchers and Cooperative members are disappointed with the results of this marketing firm; both parties feel that they are not learning anything new from the reports produced by the firm.
- **Cooperation**
 The Cooperative members undertook courses to learn how to cooperate. Initially Cooperative members outside the Mandira community were reluctant to join the Cooperative since they thought that the Cooperative would mainly benefit the Mandira residents, however, courses on cooperation and associations helped resolve these concerns. Nevertheless, there are still minor grudges between some Mandira and non-Mandira Cooperative members. There has been some development in Cooperative thinking and such development has led to the teamwork used in the construction of the depuration station and the Mandira Extractive Reserve headquarters. However, some Cooperative members say that pure cooperation only happens on paper and they are upset about the unfair distribution of resources. For example, a fair allocation system needs to be devised to decide the quantity of oysters each Cooperative member may submit for sale. The current sale of oysters to the Cooperative by each member is highly biased; a few Cooperative members are handing in the majority of oysters for sale. The allocation system also needs to consider the size and quality of oysters each Cooperative member is handing to discourage the handing in of weak oysters which die readily during depuration and transportation. The Cooperative is encountering problems with high mortality rates since the Cooperative members are not leaving the oysters in the rearing beds long enough. Furthermore, some Cooperative members have been observed to clean the oysters over several days so as to partition the workload, however, the cleaned oysters are placed into mesh bags which do not allow a sufficient flow of water to allow the oysters in the bag to feed properly. Consequently, oysters that are crammed early into these bags cannot eat and become very weak.
 Another situation that Cooperative must learn to deal with is conflict resolution (See 6.a.iii - Conflict-management mechanisms).

- **Business**

The Cooperative has had three official managers. The first manager was a zoologist who knew very little about business and consequently encountered a lot of problems and had limited success. The second manager knew a lot about running a business, however, the Cooperative members and other external researchers have strong reason to believe that he stole a lot of money from the Cooperative. It is believed that he also kept the Cooperative members from developing a strong basic understanding of the business operations so as to facilitate the fraudulent use of money. The third manager was a geographer who also knew very little about running a business. A large debt was incurred under his supervision with his poor management. The Cooperative is currently self-administering their business.

ii. Was there adaptive management (learning-by-doing)?

- Yes, there is adaptive management even though it is not drafted into a formal management plan. Adaptive management is occurring in all the processes outlined above (2.d.i) since the Cooperative is learning through experience and is generally receptive to change, when financially feasible. There are various examples of adaptive management, for instance initially bamboo structures were used to construct oyster rearing beds but now concrete is used, when affordable, since it is more durable. In response to high oyster mortality from solar heat stress, Cooperative members started to cover oyster beds with palm fronds in the summer to protect the oysters from intense sunlight (local adaptation). The fisheries researchers (outsiders) suggested mediating the heat stress by elevating the top mesh like a tent to prevent the mesh, which gets very warm when exposed to the sun, from touching the oysters directly. Now both the local and outsider mediation mechanisms are used. Another example to consider is that initially the delivery truck did not have an emergency kit, however, after the first breakdown, the Cooperative invested in an emergency kit to speed up recovery and avoid high costs imposed by the need for immediate assistance. Furthermore, the cooperative members also started placing the oyster crates on PVC tubing during the depuration process. They realized that this was important to keep the oysters away from purged contents that settle to the bottom of the depuration tank.
- Monitoring of the oyster stocks by Cooperative members and fisheries researchers is also ensuring that the oysters being harvested in the region are not being depleted. If oyster stocks were progressively being depleted then appropriate actions would be taken to limit the harvest (i.e. stronger enforcement of regulations with increased vigilance; more severe penalties for infringements; extended temporal

(quantity harvested) and spatial restrictions (extension of extractive reserve). Again this is not drafted in a formal management plan, but both fisheries researchers and Cooperative members understand that actions would be taken to secure the valuable oyster stock. The Cooperative members would require assistance (monitoring to prevent others from harvesting and income alternatives during stricter regulations) from governmental agencies to help secure their resource.

iii. Were there learning networks (self-organized groups consisting of people from different organizations, who are engaged in problem-solving, subsequently recycling their experience to tackle new problems)?

Yes, people from the diverse institutions work together to tackle new problems during periodic meetings. During these periodic meetings, Cooperative members share their experiences with outside researchers, from the Fisheries Institute and Forest Foundation and sometimes with assistance from representatives of other technical/outside organizations (i.e. FUNBIO, IBAMA, etc.). Furthermore, during the formulation of the proposal for the creation of the Mandira Extractive Reserve, members from Amazonian extractive reserves were brought in several times to share their experiences of living in an extractive reserve with the Mandira community and help draft regulations for the new reserve.

e. Funding

i. If there was funding for initial community organization, who provided the funding?

ii. If there was capacity building, including training workshops, who funded it?

iii. If there was initial investments, who funded it?

iv. If there was funding for office, office personnel, vehicles, etc., who funded them?

Answers to i-iv:

Depending on the year, the funds obtained for that time were used to cover the total costs of capacity building, initial investments, expansion, and operational costs.

NUPAUB, Forest Foundation, and Fisheries Institute (since 1991)

World Vision (since 1994)

PED Fund – Ministry of Environment and World Bank (1997-1998)

Shell Brazil (1998-1999)

Demonstrative Projects Type A Fund (PD/A) – Ministry of the Environment (1999-2001)

Equator Initiative Award (2002)

FUNBIO [Brazilian Fund for Biodiversity] (2003-present)

Cooperative (2000-present)

NUPAUB, Fisheries Institute, and Forest Foundation – materials and courses for pilot project on oyster rearing – covered transportation costs for technical and administrative support staff to attend numerous meetings

World Vision – relatively minor contributions during the construction of the depuration station

PED- Expansion of oyster rearing bed project to 25 families, construction materials for the depuration station, support for community organization and commercialization of oysters

Shell- start construction of depuration station, motor boat,

PD/A- completion of depuration station, Mandira Reserve Association Headquarters

Equator Initiative Award – Maintenance costs

FUNBIO – large truck, new collector boat, small truck, maintenance of vehicles and infrastructure, packaging materials (very expensive), telephone bills, receipts, computer, contract a marketing firm to devise a marketing plan (**Funbio is not money that is granted but actually a no interest loan that is expected to be paid back once the Cooperative has attained economic self-sufficiency.)

Cooperative – pays salaries to workers, some maintenance fees

f. Human resources for initial organization (in-kind work as opposed to money)

i. Volunteer support from pre-existing groups

The Cooperative members themselves engaged in teamwork to build the depuration center and headquarters for the Mandira Extractive Reserve.

ii. NGO and Gov't personnel providing their time or services for free

Although it's the job of NUPAUB, Fisheries Institute, and Forest Foundation to work on specific projects such as the Cooperative, a lot of extra time (outside normal work hours) is supplied by the researchers to help the Cooperative. The Marget Mee Foundation helped secure the great financial support from Shell Brazil.

iii. Enlisting free help from outside groups, e.g., proposal writing, information, contacts, communication, etc.

There were no other groups, other than the NGO'S and government organization which provided free help.

iv. Were there pre-existing relationships between these groups and the community?

The Forest Foundation, NUPAUB, and Fisheries Institute have had pre-existing relationships with the community. The Forest Foundation secured the connection between Margaret Mee Foundation and the community.

- g. Use of free facilities (e.g., community radio, office space, community television)*

The municipal government of Cananéia granted land to the project for the construction of the depuration center. The local church provided space to have meetings to help organize Cooperative members. The NGO GAIA granted free use of a computer it obtained for the Cooperative.

3.2 Cross-Scale Linkages

- h. Identification of main stakeholders (community groups, business groups, gov't, NGOs, development agencies) by levels of organization. Produce a table as way of checking off all the combinations, and enter the names of organizations/agencies into the matrix of the table.*
- i. local/community/village level*
 - ii. regional administrative level: municipality, district, etc. as appropriate*
 - iii. state/provincial level*
 - iv. national, including national NGOs*
 - v. international, including international development agencies*

Table 6. Names and different levels of organizations linked to the Cooperative.

	LEVELS OF ORGANIZATION				
	Local/ community	Municipality	State	National	International
Cananéia Oyster Producers Cooperative	X	X			
Mandira Reserve Association	X				
Forest Foundation of São Paulo			X		
Fisheries Institute			X		
NUPAUB			X		
C.E. Gaia Ambiental	X				
Margaret Mee Botanical Foundation				X	
Local Fisher Group	X	X			
Adolfo Lutz Institute			X		
PED and PD/A Funds Ministry of Environment				X	
Cananéia Municipal Government	X	X			
Shell Brazil				X	
World Vision					X
Brazilian Fund for Biodiversity				X	

X = Specific level organization located in

 = Levels organization active in

- i. Institutional linkages related to the project*
 - i. What were the key linkages?*
 - 1. facilitating/enabling the project*

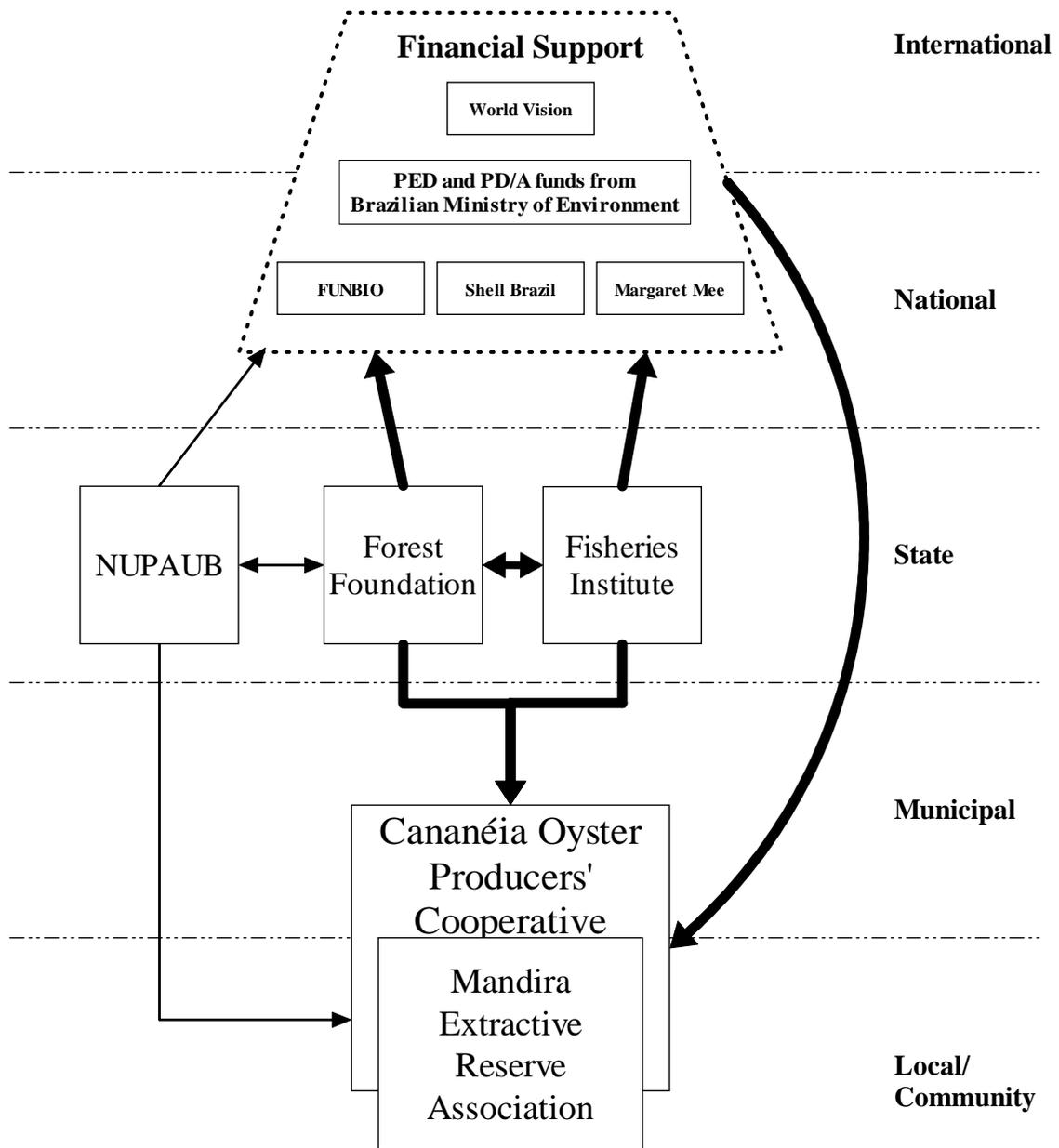


Figure 2. Key institutional cross-scale linkages that facilitated creation and development of the Cananéia Oyster Producers' Cooperative.

- As can be seen in Figure 2, the Forest Foundation and the Fisheries Institute are key in the administration of the project.
- Financial support for the project was secured by the combined efforts of both the Forest Foundation and Fisheries Institute. Researchers from both institutions actively engaged in seeking

financial assistance and writing subsequent applications for support.

- Financial assistance was obtained from various national and international organizations (See Fig. 2). Nevertheless, the national support received i.e. FUNBIO and PED and PD/A funds from the Brazilian Ministry of the environment also have international connections since these funds originate from the World Bank.
- The Forest Foundation and Fisheries Institute coordinate the various partners of the project (See Fig. 3, below). The Fisheries Institute has been instrumental in the development and ongoing support of the Cooperative's aquaculture methods employed to rear the oysters. The Fisheries Institute was also key in helping the Cooperative obtain health certification (S.I.F.) through its linkages with the Adolfo Lutz Institute (See Fig. 3). The Forest Foundation, along with NUPAUB, conducted socio-economic studies of communities within the region and played key roles for the creation of the Mandira Extractive Reserve.
- NUPAUB continues to support academic and applied research of the Cooperative and the Mandira Extractive Reserve
- Most Cooperative members also belong to the Mandira Reserve Association, however, there are also members from surrounding communities.
- Mandira Reserve Association and Gaia Ambiental were key to obtain funding (PD/A-MMA) to build the depuration center, since it was easier for members of an extractive reserve to obtain funds than a rural Cooperative (See Fig. 3).
- Financing from the PD/A and PED funds from the Ministry of Environment [secured by the Forest Foundation] and Shell [secured by Margaret Mee Foundation] were crucial in the construction of infrastructure and covering other start-up costs of the Cooperative (See Fig. 3).

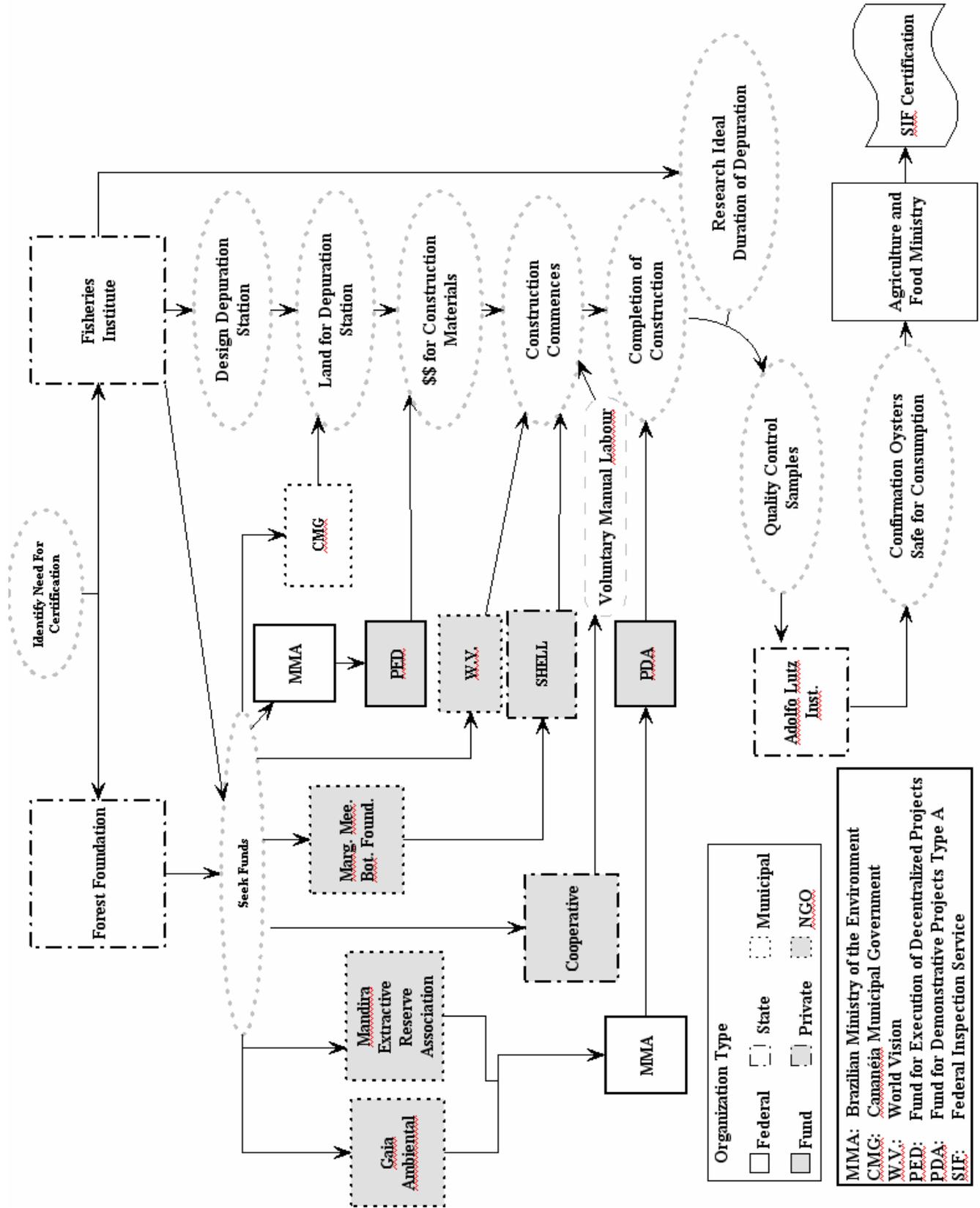


Figure 3. Organizational cross-scale linkages which enabled the Cooperative to obtain health certification from the Federal Inspection Service for its oysters.

2. *as barriers/hindrance to the project*

- Some Cooperative members feel that although the Forest Foundation has been instrumental in the beginning, it is not currently providing the Cooperative with enough responsibility to grow and become self-sufficient.
- There are some dilemmas in the project from internal struggles between Mandira residents and Cooperative members from other regions. The Mandira have been crucial in starting the project and even obtaining funding (as noted previously) however, some Cooperative members feel that the Mandira community favour themselves. This affects decisions of the Cooperative since the majority of Cooperative members are from Mandira.

ii. *Whose initiative established these linkages?*

CNPT/IBAMA contacted NUPAUB to help create an extractive reserve in Coastal Atlantic Rain Forest. A graduate student at NUPAUB who was studying the implementation of an extractive reserve in São Paulo, helped form partnerships between NUPAUB, the State Secretariat of the Environment, and the Fisheries Institute. NUPAUB along with the State Secretariat of the Environment commenced studies in 1994 on the socio-environmental viability of extractive reserves in Cananéia. The NUPAUB graduate student then went on to work for the Forest Foundation and took the project with him and the Forest Foundation began coordinating the project.

iii. *Key horizontal institutional linkages (i.e., linkages across space and sectors, such as networking with other community groups, NGOs, development agencies, etc)*

Co-ordination of the project is only possible by the very strong linkage of the Forest Foundation and Fisheries Institute, for which there is no formal, written agreement. Gaia Ambiental (NGO) and the Fisheries Institute coordinated their efforts to conduct oyster aquaculture and oyster harvest research for the Cooperative. The networking between the Margaret Mee Foundation and Shell Brazil was key for securing the great financial support from Shell Brazil for the Cooperative. The organization of the Mandira Reserve Association was important to help organize the Cooperative and obtain PD/A funding, however, now it appears to be causing minor internal struggles.

iv. *Key vertical institutional linkages (i.e., linkages across levels of organization, such as linking with key gov't agencies)*

The link of the Forest Foundation with the São Paulo Secretariat of the Environment helps fund the Forest Foundation's projects and gain political support. Fisheries Institute is linked vertically to the São Paulo Agency of Technology and Agrobusiness (APTA) which is

linked and receives political and financial support from the São Paulo Secretariat of Agriculture and Food. (However, researchers from the Fisheries Institute feel that they are hindered from achieving support from the state since they must apply and receive support through APTA; this increased bureaucracy leads to longer delays.)

How does the policy environment impact the project? (e.g., policies, legislation, political space for experimentation)

- The Fisheries Institute has less freedom since it needs seek approval/capital from APTA and then Secretariat of Agriculture and Food, whereas the Forest Foundation only has seek approval/capital from Secretariat of the Environment.
- Although the municipal government has granted land to the project, they have not granted any tax breaks to the Cooperative and a large portion of the Cooperative's debt is from unpaid taxes and fines for not paying on time.
- The requirements of SIF (Federal Inspection Service) are also very demanding and not suited to small-scale businesses such as the Cooperative (i.e. SIF demands office space for inspectors at the depuration station).

v. *What change (if any) did the project trigger in government legislation or policy?*

The project has not triggered any changes in government legislation or policy at either the municipal, state, or federal level. However, researchers from the Fisheries Institute would like the Federal Inspection Service to become more flexible for small-scale producers.

- Fisheries Institute researchers have also developed a rule that could help create laws that would help secure oyster stocks from overexploitation and guarantee socio-economic and environmental equity. Small-scale oyster suppliers should be permitted to collect oysters in sustainable manner and should have minimal harvest restrictions. Mid-scale oyster suppliers should be required to fatten oysters in rearing beds and should have moderate harvest restrictions. Large-scale oyster suppliers should require aquaculture and have severe harvest restrictions. Nevertheless, the Fisheries Institute researchers feel that attempting to change government policy would be futile considering the current Brazilian policy environment.

j. *Are there any unusual interactions among gov't agencies, NGOs, development agencies, etc, that impact the project positively or negatively (e.g., competition over gov't department jurisdiction, or NGOs competing over funding) Yes*

i. *What motivates these linkages? What are the drivers of positive or negative interactions?* The non-governmental organization Gaia was created to help capture funds more quickly and more readily, since the Fisheries institute along with the Cooperative would have a more difficult time seeking funds. The Fisheries Institute is already funded by the government, making it difficult to seek additional, necessary funding for the project. Since the Cooperative has lucrative endeavours it is relatively more difficult to obtain financial support from the government or non-government organizations. It is easier for a non-governmental, non-profit organization, such as Gaia, to obtain funds for research. However, a negative interaction occurred when a previous presumably fraudulent and vengeful manager wrote the Ministry of the Environment stating that Gaia was a method for researchers from the Fisheries Institute to earn larger salaries for themselves. A counter suit has been filed against this accusation. This case will go to trial but date yet to be set by Brazilian judicial system. Thus the negative outcome from a potentially positive interaction was driven by apparently one dishonest person.

ii. *Learning occurring in which processes and stages?*

The Cooperative members learned to be very cautious of hiring outside help. The Cooperative now understands they need to understand as much as possible of the entire process and not leave it to just one person. They are currently managing the Cooperative themselves.

3.3 Biodiversity Conservation and Environmental Improvements

a. *Conservation/improvement of what target resources (species and environmental resources)*

The mangrove rain forest and coastal Atlantic rain forest should be conserved since the collection and rearing of oysters has been generating minimal impact in the area. The effect of oyster rearing beds on mangrove biota has not been studied, but is likely negligible. Unlike large-scale aquaculture operations, mangrove forest does not need to be cleared to provide rearing space, since the oyster rearing beds are placed in shallow lagoons and water ways. Only a small number of lagoons and waterways within the entire estuary contain rearing beds. The rearing beds also only occupy a small portion of the lagoon or waterway and thus do not completely disrupt tidal flow or the movement of mangrove organisms. Consequently, the impact of the oyster rearing beds on the mangrove ecosystem is likely to be minimal. The oyster rearing beds may actually enhance the biodiversity and productivity of the mangrove by increasing the surface area for algae and other sedentary macrofauna to grow on, thereby serving as an artificial reef. Various species of fish and crustaceans were observed on and around the rearing beds.

- The creation of Mandira Extractive Reserve on December 13, 2002 was the first step to prevent open access conditions since now only the inhabitants of the reserve, the Mandira's, would have access to the oysters. However, efficient and consistent enforcement is still being built up to prevent outsiders from illegally harvesting within the reserve. IBAMA is providing some financial support for the placement of signs to mark boundaries and for policing of the reserve.

b. *Changes in resource state*

Cooperative members stated that they have observed an increase in oyster stocks. Fisheries researchers conducted a study which took two years to complete (1999 – 2000) to estimate oyster populations within mangrove forest stands (Pereira et al. 2000) and along rivers and creeks (Pereira et al. 2001). Pereira and others (2000 and 2001) estimated that there are 16, 774, 686 dozen oysters, of which only 1,550,000 dozen oysters are of commercial size (> 5cm). The annual maximum sustainable yield of oysters was estimated to be 700,000 dozen oysters (Pereira et al. 2001). Studies to re-assess the oyster stock have not been repeated due to a lack of financial and technical support.

- c. *Indicators of biodiversity conservation or improvement (e.g., birds or butterflies started to come back; water became clearer, etc)* Indicators of biodiversity conservation or improvement have not been measured. There is a severe lack of benchmark taxonomical data. At the landscape level, aerial photographs may be used to observe conservation trends over large areas. However, due to the irregularity of the data available, it is not possible to assess whether any observed trends may be correlated to the Cooperative's actions.

3.4 Poverty Alleviation

a. Indicators of poverty alleviation (e.g., number of jobs, increased income etc)

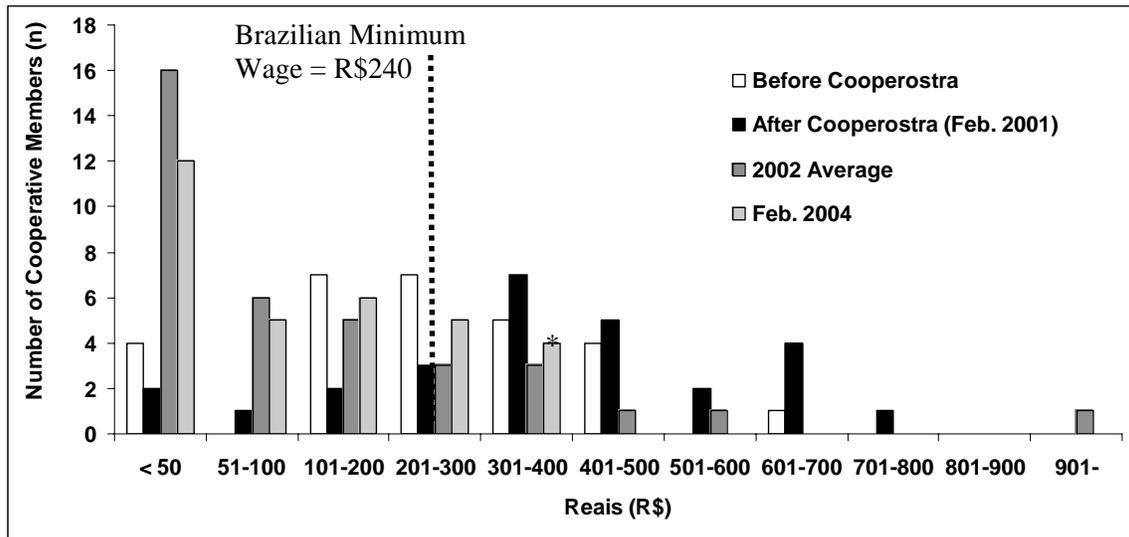


Figure 4. Distribution of earnings of Cooperative members, before the Cooperative was started, after the Cooperative was started (Feb. 2001, 2002 Average, and Feb. 2004) [Data obtained from Cooperative's records].

After the initiation of the Cooperative, salaries for each Cooperative member improved slightly and uniformly (See Fig. 4). The 2002 average show that earnings are slightly skewed with most Cooperative members earning less than the Brazilian Minimum Wage of R\$240 (See Fig. 4). By Feb. 2004 declining sales led to a decrease in the overall earnings (See Fig. 4). The R\$300-400 Feb. 2004 bar contains the asterisk since the four Cooperative members may be earning more than R\$400, and consequently represent an even more skewed distribution of incomes among Cooperative members. (This data was obtained during the periodic Cooperative meeting in which the Forest Foundation was discussing the current problems of the Cooperative and the value earned was likely reported as >R\$300, and not the actual value, to prevent internal strife from having all the Cooperative members know about the concentration of earnings in just a few members. The Forest Foundation researchers told the Cooperative members that the earnings need to be more equally distributed but did not provide a mechanism by which to achieve a more equal distribution of Cooperative salaries.)

The Cooperative members receive twice as much per dozen of oyster from selling to the Cooperative than they do from selling to middlemen. (Cooperative pays on average R\$1.80/dozen and average black market price is R\$1.00/dozen). However, being part of the Cooperative also requires additional time to participate in various, lengthy meetings. Furthermore, due to insufficient sales, the Cooperative cannot buy as many oysters that all the Cooperative members can supply. Consequently, some Cooperative members still continue to sell to black market³ middlemen for half the price obtained from the

³ The selling of oysters without certification from the Federal Inspection Service (SIF certification) is considered to be the black market. SIF certification ensures that oysters are safe from consumption and have been depurated of pathogens such as *E. coli*.

Cooperative to supplement their income. These black market middlemen then undercut the Cooperative's own market, making it difficult for the Cooperative to charge more for its oysters along the Sao Paulo Coast (See Fig. 5).

a. Improvements in community well-being (e.g., access to clean water, new village school, waste management etc.)

Most improvements have been at an individual level. Communal benefits include the construction of the headquarters for the Inhabitants of Bairro Mandira Reserve. Other than facilitating the organization of the Cooperative (i.e. a place to have meetings), the headquarters is also used for social events and other community activities (i.e. capoeira lessons).

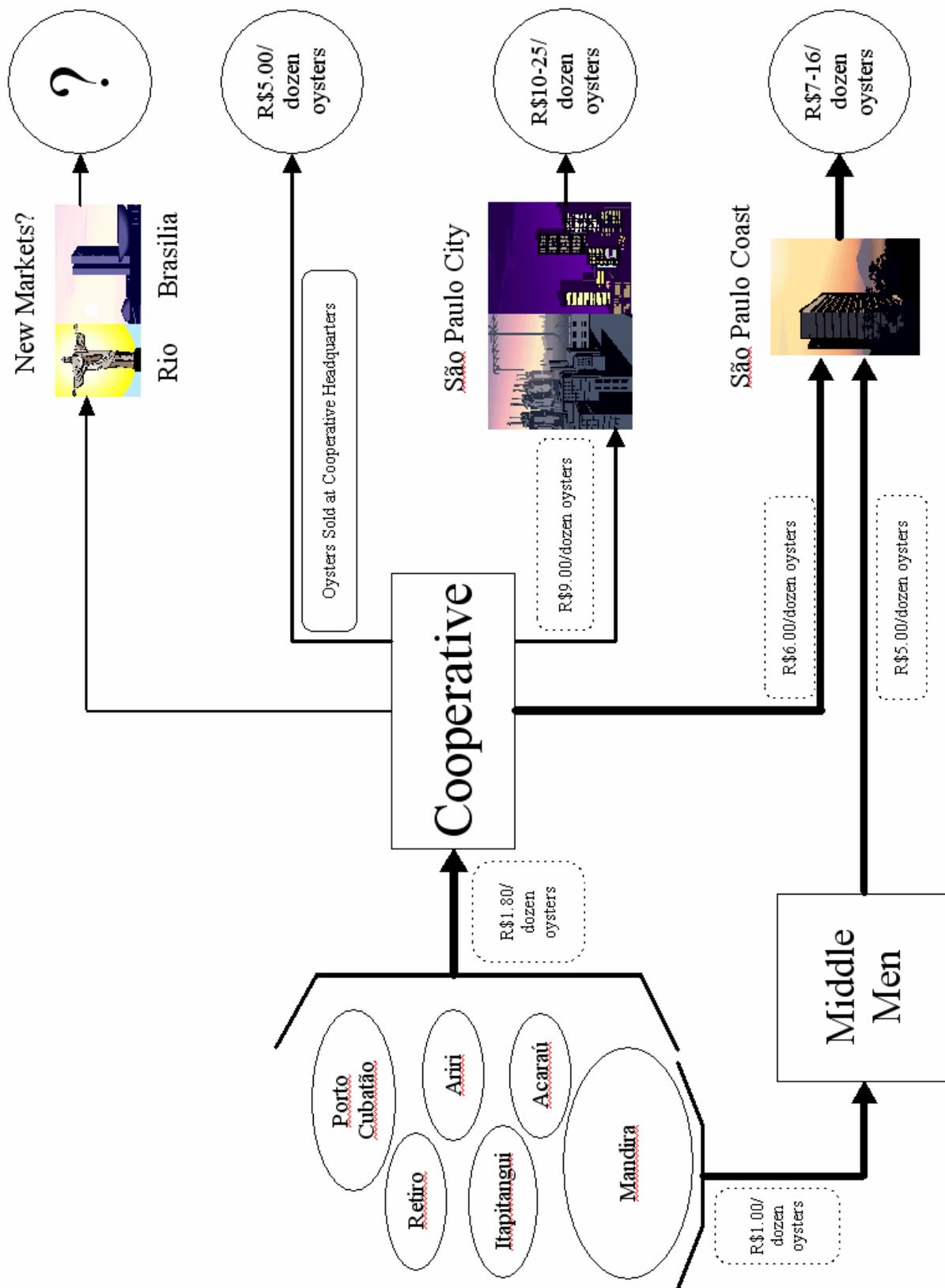


Figure 5. The chain of custody of the oysters from harvest by Cooperative members to final consumers.

3.5 Detailed Analysis of Community-based Conservation (CBC)

- b. *Mechanisms, dynamics, drivers*
 - i. *Analysis of catalytic element that made the initiative work*
 - ii. *Decision-making process (e.g., participatory, transparent, responsible)*

The decision-making for major Cooperative decisions is done through voting by all Cooperative members and greatly influenced by the Forest Foundation, along with input from the Fisheries Institute. Decisions for day-to-day business operations are dependent on the current Cooperative president. Such centralized decision making is a problem since the president is difficult to contact. Firstly, the president is frequently out working in the mangrove and since he lives in Mandira, which is relatively isolated (25km from Cananéia via mostly a dirt road). Furthermore, only one cellular phone may be used as a means of quick contact, which does not work sometimes depending on atmospheric conditions. Responses to critical questions have sometimes been severely delayed since the response from the president could not be obtained.
 - iii. *Conflict-management mechanisms*

Ideally, voting and pressure from other Cooperative members would deal with conflicts. However, the conflict-management of the Cooperative is poorly developed. Recently a Cooperative member betrayed the Cooperative and began to sell black market oysters to the Cooperatives clients. The Cooperative did not take immediate action to expel this member from the Cooperative and shun him. Family ties make it difficult for the Cooperative to take critical action.
 - iv. *What were the roles of horizontal and vertical institutional linkages in the development and success of the project?*

The community did not undergo self-organization themselves, rather it was imposed by outside groups, therefore institutional linkages were and continue to be very important for the Cooperative i.e. for organization and financial support to cover start-up costs and infrastructure development (See 3. Cross-scale Linkages for more information on specific roles).
 - v. *Conflict resolution and enforcement*

There is no standard mechanism for conflict resolution and enforcement. Conflict resolution would be useful to help mediate minor grudges between Mandira and non-Mandira residents.
- c. *Learning and Adaptive Management*
 - i. *How did previous observations lead to project formation and development?* Previous attempts to introduce oyster aquaculture by

the NGO, *SOS Mata Atlantica*, and a former governmental fishery agency, SUDELPA, focused on the complete aquaculture cycle, which takes too long to meet the immediate needs of the aquaculturists. Consequently when this project commenced it only focused on increasing the size and marketability of oysters through the use of rearing beds. It is hoped that one day, the Cooperative will be able to quit extraction and rely solely on culture.

ii. *How was experience incorporated into subsequent steps of the project?*

Processes which yield poor results are systematically modified until significant improvements have been observed and it is believed that further improvements cannot be made. The Cooperative is still trying to optimize its efficiency in its management and sales. The Cooperative has tried three different managers, self-management, and is currently seeking a new management structure. Initially Cooperative members dealt directly with clients, the Cooperative then hired professional sellers to market and sell the oyster but fired them because their fixed wages plus commission were extremely costly. Now marketing firms have been hired to develop a marketing plan, but the Cooperative and Forest Foundation are not satisfied. The Cooperative and Forest Foundation would now like to hire legal middlemen to sell their product to high class restaurants in São Paulo.

iii. *What was the role of experimentation?*

Scientific experimentation was, and still is, crucial for producing high quality oysters (i.e. stocking density, depuration process, construction of rearing beds, etc.). Experimentation is currently being conducted, albeit with limited success, on the collection and rearing of oyster seed. Experimentation is also being done with other valuable aquaculture products such as mussels.

iv. *Role of memory, novelty, innovation*

The opening of new market opportunities is vital for the Cooperative. It is difficult to sell their high quality oysters along the coast since there is very weak enforcement of health regulations and most Brazilians are indifferent to health certification and not willing to pay more for certified oysters. The Cooperative along with the Forest Foundation and Fisheries institute (the *learning network*) are trying to work out new solutions to management and marketing problems. Sometimes external help (outside the learning network) is contacted for help, such as professional marketing firms.

v. *How monitoring (e.g., rare species) informs the project*

Monitoring of rare species has not been used to inform the project. The lack of financial and technical support prevents the scientific

monitoring of oyster stocks however assessment of oyster stocks from the Cooperative members informs the project that the oyster stocks are increasing.

- vi. *Barriers to CBC, and how the barriers were overcome*
The large amount of financing helped overcome the first set of barriers and has led to the development of infrastructure and initial organization of the Cooperative. However, there are still barriers to overcome, i.e. management and marketing problems.
 - vii. *Combining knowledge systems to solve problems*
Fusion knowledge (both local and outsider) are used to solve problems (i.e. dealing with oyster mortality from solar heat stress uses local knowledge [palm fronds to shade] and outsider knowledge [forming tent with top mesh to shade and prevent direct contact with heated mesh]). The use of local knowledge to solve business problems is limited due to the lack of knowledge and experience of the Cooperatives in running a business. Nevertheless, the outsider knowledge to solve business problems is also limited since the head researchers from the Forest Foundation are sociologists and the head researcher from the Fisheries Institute is a veterinarian. Hence there is a need to hire additional outside help from a professional marketing firm.
- d. *Community benefits from biodiversity conservation and environment improvements*
- i. *What direct benefits were observed (e.g., improvement in resource base to be further exploited; alternative income sources (e.g., tourism))*
Community receives higher wages by harvesting much less. Oysters used to be sold de-shelled in bags, containing up to 120 oysters (since there were no size restrictions), for R\$2. Now Cooperative members know they can harvest less and have more time to pursue other activities such as the maintenance of rearing beds. Nevertheless, the benefits from being part of the Cooperative are not evenly distributed. The Cooperative members also realize the importance of maintaining the oyster stocks and benefits of harvesting larger oysters. Informal assessment of the oyster stocks by Cooperative members suggest that the oyster stock has increased greatly and the Fisheries Institute is planning on conducting a “scientific” oyster stock evaluation in the near future. The Cooperative members have also learnt the importance of protecting the mangrove trees and, in that they avoid cutting the mangrove roots as much as possible.
 - ii. *What indirect benefits were observed (e.g., awards and recognition; publicity; increased funding opportunities for conservation)*

- Pride from belonging to the award winning Cooperative is very important to Cooperative members. The first and second time Ministers from the federal government (Minister of Fisheries and Environment) officially visited Cananéia was for the Cooperative. The first time the bank manager in Cananéia dealt directly with an individual was also with the Cooperative. Before Cooperative members used to be embarrassed to say that they collected oysters, it was considered the lowest of all jobs, but now people in the community recognize their efforts and numerous people want to be part of the Cooperative now.
- The money from the Equator Prize also helped to cover some start-up fees, however, these funds have run out and the Cooperative still needs financial assistance while the business continues to learn how to become more efficient and viable.

e. *Livelihood strategies, coping and adapting*

- i. *How did involvement in the project affect other livelihood pursuits, negatively (e.g., time, resources) or positively (e.g., synergies, increased capital)?*

Some Cooperative members are earning more money by selling fewer oysters. Before they would also spend a lot of time de-shelling oysters for sale. Some Cooperative members have invested capital into the creation of concrete oyster rearing beds which have require less maintenance work than bamboo rearing beds. Those Cooperative members have more time to expand their oyster operations or to fish and catch crabs. Cooperative members recognize that they can work less and gain more from being part of the Cooperative. However, they also recognize that they need to spend time participating in the numerous Cooperative meetings. Some Cooperative members also get frustrated when they cannot sell the quantity of oysters they would like to sell and end up selling oysters out of necessity to illegal middlemen.

How did the project affect the ability of households and the community to adapt to changes (e.g., markets)?

The Cooperative is still at the mercy of markets. One barrier the Cooperative has yet to overcome is significantly increasing their sales. With more secure economic situation, the Cooperative members would be inclined to sell their entire yield to the Cooperative and not to illegal middlemen, which pay less and end up undermining the Cooperative's market. Cooperative members still sell to illegal middlemen since they are not confident that the Cooperative will be viable in the future. Cooperative members do not want to lose potential selling networks by completely cutting off the illegal middlemen in case the Cooperative does fail.

Nevertheless, Cooperative members that actively sell to the Cooperative are buffered from markets since the Cooperative itself,

and not the members, is covering the costs from limited profits. Currently, the oysters producers get paid for the oysters they send to the depuration station. However, the prices obtained for oysters along the coast, where the most sales occur and which have low return (sometimes even negative) due to black market competition, are not enough to cover operational and maintenance costs to keep the Cooperative running. This situation has brought about a large debt to the Cooperative. External financing has been used before to cover these costs, but now this outside funding has stopped and the Cooperative is encountering difficulties in becoming a viable business as the debt continues to increase. Consequently, the Cooperative members will not be buffered for much longer if the Cooperative does not attain economic self-sufficiency.

- f. *Resilience of communities, livelihoods and management systems*
- i. *Did the project add options (e.g., livelihoods, alternative management possibilities, new coping and adapting strategies)?*
- For some members, the Cooperative has added substantial options. The higher funds allow some Cooperative members to save up more money, and money provides options. Some Cooperative members can also now afford to send their children to pay for better schooling for their children. Money can also be saved up as an adaptive strategy for times of crisis or need.
 - The creation of the extractive reserve has also helped in developing new management strategies to help secure the oyster stocks. The management system required by IBAMA is a multi-stakeholder body including multiple resource users of the extractive reserve and surrounding area plus NGO's and governmental bodies (co-management) for technical support and guidance. The Mandira community along with help from the Fisheries Institute and Forest Foundation is in the process of creating the multi-stakeholder body and waiting for further direction from IBAMA.
 - The Cooperative, assisted by researchers at the Fisheries Institute and Forest Foundation, is also exploring the sustainable harvest and cultivation of other species, in particular, mussels and crab, but also shrimp. Nevertheless, benefits of capitalization on new market opportunities through diversification need to be weighed against increasing efficiency of current operations.
- ii. *Did the project create learning opportunities (see under learning)?*
- Yes, Cooperative members actively engage in several courses throughout the year on oyster aquaculture and Cooperatives. Although generally geared towards Cooperative members, these courses are generally not limited to only Cooperative members and other

interested parties may attend these free courses. Courses are taught by researchers from the Fisheries Institute and the Forest Foundation.

iii. *Did the project create self-organization opportunities (see under community organization)?*

Yes, the Cooperative has set an example and helped the women of the Mandira community to organize themselves to create a Seamstresses Cooperative (*Corte Costura*), which produces and sells clothing and handicrafts. The Mandira community is also organizing themselves to try to capitalize on eco-tourism within their region. This eco-tourism endeavour is focusing on a waterfall which is located within Mandira property. Steps have been taken to make it more accessible to the public through the clearing of a trail and construction of wooden steps to pass the steep river bank. However, monitoring and capitalizing mechanisms are still being worked out.

g. *Transferability of the lessons from this EI case*

i. *Which lessons were likely transferable? Why?*

1. Time and Commitment:

Simultaneous biodiversity conservation and poverty alleviation requires time and strong commitment of participants. Time and strong levels of commitment, are required throughout successive reiterations of the project; in its planning, implementation, and evaluation. Such successive reiterations of the project will better address issues arising from the complexity of natural and social systems. The complexity and unpredictability of natural and social systems makes it virtually impossible for any project to be perfect. However, with strong commitment and over time problems and challenges encountered by the project may be sequentially overcome.

2. EI Prize increases Pride

International recognition by winning the EI prize greatly increased the pride of the project members and may help other communities/organizations commit to conservation and development goals in the face of adversity.

Other Effects of the EI Prize:

- EI prize brought upon fame and increased number of studies on the project. These studies help inform the project and assist in horizontal learning with other local efforts around the world.
 - However, Cooperative members have expressed that they feel rather annoyed by the consistent amount of studies being conducted, particularly when there is limited or no return for the Cooperative.
- The EI fame also brought about organizations interested in being connected to the fame of the project i.e. the state land institute.

3. Diverse Institutions for Capacity Building:

Cross-scale institutional linkages are vital to achieve simultaneous biodiversity conservation and poverty alleviation. Linkages to diverse institutions were fundamental for capacity building of Cooperostra (i.e. construction of depuration station [See Fig. 5]). Access to diverse institutions, just as access to high levels of biodiversity, confers resilience. The diverse institutions are a safety web which help Cooperostra better adapt to socio-economical changes. This safety web of institutions is crucial in socio-economic climates of developing countries, such as Brazil, which have relatively frequent fluctuations in political organization and economics. Nevertheless, in more stable environments, it might be more efficient and effective to rely on fewer, more secure, organizations.

Another issue to consider with such a diverse array of institutions is the maintenance of consistent tight feedback loops with the resource. However, both the Forest Foundation and Fisheries Institute (both governmental agencies) work simultaneously or in a “tag-team” effort to keep other organizations closely connected to the resource users and resource base. Thus, the combined effort of a principal consortium of organizations is key to help maintain strong feedback loops without compromising flexibility and adaptability.

Empowerment of project members through cross-scale organizational linkages has contributed to the success of the Cooperative. However, it is not realistic to assume that impoverished people with limited educations can be empowered within a few years to deal with all aspects of a business, from supplying quality products to marketing and selling goods. Not only do they not have enough time to partake in complete management of resource, but they have limited capacity to compete in highly competitive markets, such as the restricted oyster consumption market in São Paulo. Development needs to occur in small incremental steps over numerous years, such colossal steps with major changes are prone to numerous setbacks. Simultaneous biodiversity conservation and poverty alleviation needs consistent organizational support for incremental, capacity development. Such projects particularly need vital business capacity development and/or fair business partnerships to attain a competitive advantage in today’s markets and succeed.

Furthermore, middlemen should not be entirely abolished. The role of middle-men as active members of the community and distributors is often overlooked in narrowly focused attempts to quickly increase wages for project/community members. Middle-men possess knowledge and valuable contacts with local markets which could be harnessed to help out with the marketing initiatives. Middlemen could be trained to upsell (i.e. convince current clients into buying certified oysters for health reasons). With some training and provision of materials such as pamphlets, middle-men could help educate their numerous clients on the health risks associated with eating uncertified, non-depurated oysters. Nevertheless, mechanisms need to be set in place to ensure that middlemen are not usurping an unfair proportion of the profits.

4. Improving Livelihoods Critical for Conservation to Work

Project members need consistent organizational support to secure economic futures; secure rights and active control over the oyster resource is not enough. The Forest Foundation and University of São Paulo helped the Cooperative members of Mandira obtain political rights to their resource, by assisting with the designation of the Mandira Extractive Reserve. The Cooperative is also currently working with IBAMA to work on enforcement issues to ensure that active enforcement of resource use laws within the reserve, primarily to prevent outsiders from claiming resources within the reserve. But even though, the project members might be empowered with rights and active control to the resource, they are not economically empowered to commit to long-term conservation goals.

For conservation goals to be an option and continuously met, the basic needs of each Cooperative member need to be sufficiently met. Increasing the financial return for the Cooperative and its members is the main obstacle for continued success of the Cooperative and its members. Nevertheless, the Cooperative still has numerous challenges to face which could be better dealt with or eliminated all together if there was greater demand for the Cooperative's oysters. For example, increased market demand for the Cooperative's oysters would help prevent Cooperative members being forced to sell oysters to middle-men since the Cooperative cannot accept all the oysters its Cooperative members produce.

4A. Market Expansion:

The Cooperative needs to further increase market and extend to buyers all over Brazil. Cultivated, non-native oysters from Santa Catarina State are sold all over Brazil particularly in São Paulo, Rio de Janeiro, and Brasilia. The Cooperative would benefit greatly from expanding to markets all over Brazil. Nevertheless, suitable methods for market expansion are unknown or currently not financially feasible. Marketing firms in São Paulo have been contacted for assistance, but the Cooperative is unsatisfied with the results.

4A.i.) Small Oyster Carts:

The construction and deployment of small oyster carts along coastal beaches may help increase oyster sales and also serve as advertisement for the Cooperative's oysters. Nevertheless, precautions will have to be taken to ensure that sellers are selling only the Cooperative's oysters and not oysters purchased from middlemen. Both punitive and incentive-based tools need to be considered (i.e. severe penalties for selling other oysters and monetary rewards for high sales of Cooperative oysters).

4A.ii.) Oyster Processing:

Processing of oysters to increase the durability of the oyster product would help with market expansion since live oysters must be delivered within only 5 days. Oyster processing methods, such as freezing and canning oysters need to be further explored to facilitate the transportation and sale of larger quantities of oysters.

4B. Certification:

SIF certification has been instrumental for increasing the monetary value of the oyster yield and securing high-end markets. Further certification from the Marine Stewardship Council is currently being explored by the Cooperative.

4C. Benefits must be well distributed:

Mechanisms need to be set in place which ensure that local elites are not claiming disproportionate amounts of benefits, as unfortunately appears to be the case in the Cooperative. For example, each Cooperative member's earnings should be made readily available to the entire Cooperative, so that everyone knows whether they are receiving a fair share of the profits. However, distribution of benefits is always a complicated issue and especially with the Cooperative since the members which, have worked the most for the Cooperative and totally cut ties with middlemen, are the members that usurp most of the profits.

5. Leadership

Strong leaders, both external and local, were critical for the development of the Cooperative. The Cooperative would not have been created without the vision, drive, and determination of key leaders, coupled with their connections to diverse institutions for financial and technical support.

6. Alternative Livelihood Options:

Development projects cannot be too narrowly focused on one sole initiative since socio-economic or ecological changes might compromise the success of one particular activity. Nevertheless, benefits of capitalization on new market opportunities through diversification need to be weighed against increasing efficiency of current operations.

However, in the case of Cooperostra, alternative sustainable livelihood options are important to help supplement incomes from oyster production and provide employment for other community members, especially those living within Mandira Extractive Reserve. Alternative livelihood options also provide a means to earn livelihoods if oyster harvesting must be reduced to help replenish stocks. Alternative species suitable for sustainable, low-impact harvesting and aquaculture are currently being explored such as crabs and mussels. Furthermore, the wives of several Cooperative members within the Mandira Reserve started *Corte Costura*, a seamstress' Cooperative. The Mandira community is also exploring eco-tourism and a handicrafts initiative that is using natural products, such oyster shells, to make souvenirs for tourists.

7. Horizontal Learning:

Horizontal learning has been an important aspect for the project's development. Initially started in Mandira, the oyster rearing process then spread horizontally to individuals of neighbouring communities. If the Cooperative could increase its sales and increase enrollment of Cooperative members, horizontal learning would then be key to train new individuals from other neighbouring communities, which also have access to bountiful

oyster stocks. Horizontal learning was also key in the creation of the Mandira Extractive Reserve, since people living within Amazonian extractive reserves were brought in by IBAMA to help the Mandira residents draft regulations for the extractive reserve. The women of the community were also inspired by the organization of the Oyster Producers' Cooperative to start their own seamstresses' Cooperative, *Corte Costura*.

8. Aquaculture more suitable for agriculturists than small-scale fishermen

With the drastic reduction of current fishing stocks, aquaculture is booming as means to capitalize on non-satiated markets and also serve as an important source of protein for poor rural communities. Emerging aquaculture projects, need to consider the cultural context of potential project members. Preceding the development of Cooperostra, oyster rearing techniques were taught to rural fishermen with limited success. Rural fishermen are not accustomed to waiting months or a year to reap produce. The relatively lengthy oyster rearing process, is better suited culturally for successful adaptation by farmers than fishermen, assuming that the farmers feel comfortable navigating shallow waters. Crop farmers are particularly better suited for aquaculture of filter-feeders such as oysters, mussels, sea cucumbers, as well as photosynthetic symbionts such as coral and *Tridacna* clams. Even though, these organisms are animals they are cultivated similarly to plants, i.e. they do not require regular feedings and they are sedentary (except for sea-cucumbers which have limited motility).

9. Lack of Biodiversity Benchmarks:

There have been limited studies quantifying the actual impact of the project on biodiversity conservation, i.e. the impact of oyster harvesting, rearing beds, and potential aquaculture on the surrounding biodiversity. The impact on biodiversity from such activities needs systematic analysis to confirm whether the impacts on biodiversity are indeed minimal. Unfortunately, such research is lacking and most research centered on development discusses biodiversity in superficial terms, without any actual quantification of a biodiversity measure at either the genetic, species, or landscape level. However, quantification of diverse biodiversity measures in tropical regions is particularly difficult due to the overwhelming diversity of living organisms and lack of taxonomic knowledge to adequately identify all taxa. The identification of taxa requires a large investment of resources, which is often limited in developing countries. Consequently, resource investment in quantification of biodiversity needs to be weighed against resources spent on improving livelihoods through small-scale use of resources, with the assumption that better livelihoods will help achieve better conservation results.

10. Conserving Oyster Stocks in Mangrove Regions

10.A) Designation of Property Rights

Since mangroves are regions which are generally not suitable for construction of homes or agriculture, they are highly undervalued and frequently lack clear property rights. Exclusive property rights need to be designated to help ensure that mangrove resources are not unsustainably exploited. Unsustainable

harvesting may then be prevented since owners will reap the reap benefits of conservation regulations (i.e. such as having quotas, bans, and size restrictions).

10.B) Conservation Laws

Table 7. A summary of laws to help conserve oyster stocks.

Property Rights	Designation of exclusive property rights to local community i.e. as in a Brazilian Extractive Reserve
Size Restrictions	oysters < 5cm not harvested since more profitable at larger sizes oysters >10cm not harvested since high reproductive value
Temporal Ban	No harvesting of oysters during peak reproductive season, (i.e. Dec-Feb in southeast Brazil).
Quotas	Oyster stocks need to be monitored continuously to ensure that current harvest is not exceeding the regenerative capacity (maximum sustainable yield) of the oyster stocks. If oyster stocks decrease, total oyster yield must be reduced.
Minimize Ecosystem Damage	<ul style="list-style-type: none"> ▪ i.e. minimize cuts to mangrove roots while harvesting oysters

10.B.i) Equitable Distribution of Oyster Regulations

Table 8. shows the equitable distribution of oyster regulations among different scales of oyster enterprises (Machado 2003, pers. comm.). Such a distribution of regulations ensures that enterprises usurping greater proportions of the oyster resource have the greatest harvest restrictions and must contribute most to replenishment of stocks.

Table 8. Distribution of conservation regulations for different scales of oyster harvesting enterprises (Machado 2003, pers. comm.)

Scale of Oyster Enterprise	Conservation Regulations
Low-scale	Conservation orientated harvest <ul style="list-style-type: none"> ▪ minimal quota restrictions
Mid-scale	Rearing beds required <ul style="list-style-type: none"> ▪ moderate quota restrictions
Large-scale	Aquaculture required <ul style="list-style-type: none"> ▪ severe quota restrictions

10.C) Enforcement of Conservation Laws for Harvesters

Enforcement of conservation regulations, such as quotas and harvest bans, is particularly difficult within the vast maze of mangroves. Mangroves are difficult to navigate and thus enforcing laws is timely and costly. The extractive reserve residents need reliable government support to effectively deal with individuals

that are engaging in activities that threaten the sustainability of the reserve's mangrove resources.

10.C.i.) Conservation Education

Resource users need to be educated on the value of conserving resources such as oysters and thus abide conservation laws. However, the long-term value of conservation may be overlooked when immediate needs are overwhelming.

10.D) Health Certification Enforcement for Establishments Serving Oysters

Restaurants and supermarkets need to be regularly monitored to ensure that they are only selling oysters which have SIF certification. Heavy fines and other penalties should be set in place to detour enterprises from obtaining cheaper, uncertified oysters. Incentives, such as tax breaks, should also be provided to encourage establishments to continuously sell oysters.

10.D.i.) Educate Consumers on Importance of Certification

General Brazilian public is not willing to spend money on expensive certified oysters since cheaper oysters may be purchased on the black market. Need to educate the public on the hazards of consuming oysters without SIF certification. Consumers may then demand SIF certified oysters from establishments they frequent.

Increasing the total amount of sales of certified oysters is not only beneficial for consumer health. Oyster certification process records the quantity of oysters certified, thereby enabling fisheries scientists to better assess the total yield of harvested oysters.

ii. Which lessons were not transferable? Why?

[I interpreted this question to be virtually exclusive, case-specific recommendations:]

1. Completion of Aquaculture Cycle:

Fisheries Institute and Mandira community experimentation have yielded poor results to date with complete aquaculture of oysters⁴. Some oysters within the oyster rearing enclosures have accelerated growth rates relative to other individuals in the same rearing enclosure. These profound differences in growth rates may be due to physiological differences between at least two and presumably three different oyster species found in the region (Ignacio et al. 2000; Lapègue 2000). Genetic studies need to be conducted to determine whether these different growth rates may be attributed to different species. Furthermore, the potentially faster growing species could be induced to spawn in laboratories as has been accomplished by the Marine Mollusk Cultivation Laboratory at the Federal University of Santa Catarina, in Florianópolis, Brazil. The larvae may then

⁴Complete oyster aquaculture would consist of the acquisition of oyster larvae (seed) with special collectors and rearing the larvae to market size. Currently the Cooperative only gathers oysters larger than 5cm and grows them to larger, more profitable sizes in oyster rearing beds.

be distributed to the Cooperative members. Further technical and financial assistance would be essential to develop the technology and methodology to consistently provide the Cooperative members with the potentially fast-growing, oyster seeds.

2. Decision-Making Process Too Centralized:

The current decision-making process is too centralized since only the Cooperative president can make decisions. Furthermore, the president is difficult to reach since he lives in Mandira (24km from Cananéia) and is usually out harvesting and tending his oysters. Bairro Mandira only has cellular phone access, which is not always reliable due to the remoteness of the location and atmospheric conditions. Decision-making power needs to be spread so that efficient decisions may be made quickly so as not to lose current and potential clients. Furthermore, the position as Cooperative president should be rotated periodically, i.e. every two years, so that presidential power and experience may be distributed amongst different Cooperative members.

3. Inadequate Telephone Service at Cooperative Headquarters:

The Cooperative headquarters is where most of the business transactions are made. Clients e-mail, fax, or call in to place orders or find out more information about the product. The telephone service at the headquarters is not always reliable. The headquarters' telephone service is a "*fixed rural cellular phone service*," which means the Cooperative pays normal phone rates however service is actually via satellites like a cellular phone. Therefore, atmospheric conditions may interrupt with the transmission of signals. During the peak selling season in the summer, intense thunderstorms which disrupt the transmission of signals are common, therefore the Cooperative may be losing out on a lot of business. The Cooperative needs to explore what can be done to improve telephone service for its headquarters, which may only be resolved if the headquarters were moved right into Cananéia city. (The headquarters currently are located 6 km from Cananéia city and thus not close enough to be connected to the cities telephone grid.)

4. Internal Struggles:

There are some grudges and minor conflicts between Cooperative members living in Mandira and members from other communities. Since Mandira residents make up the largest proportion of Cooperative members, some Cooperative members from other locations feel that Mandira residents are favoured. Nevertheless, Mandira residents did significantly help construct the depuration station with bi-lateral funds for Extractive Reserve Association. An external manager that would treat every Cooperative member equally would help alleviate any partiality or suspicions of partiality within the Cooperative. Furthermore, rotation of the Cooperative president to a non-Mandira resident may also help settle any grudges.

5. Lack of Management:

After three managers with limited success, the Cooperative members voted on not to have a manager. However, current operations are not running smoothly. There are some minor problems with the delivery of oysters, quality control, and distribution of oyster

sales among Cooperative members. An external manager would help ensure that Cooperative members treated equally and that everyone has decision making input. The manager would assist in the allocation of fair quantities of oysters each member sells to the Cooperative and help monitor quality control to ensure freeloaders do not supply poor quality oysters. Furthermore, the external manager would also oversee distribution of oyster product and purchasing of goods for the Cooperative. However, one major setback to obtaining an external manager is that the expected minimum wage for a manager in Brazil is much higher than most of the Cooperative member's earnings. Not only is it very costly but it also creates some social tension between the Cooperative members and the manager. Particularly, since the Cooperative members mistrust external managers due to bad experiences with the Cooperative's three managers.

6. High Mortality Rates:

Oysters are placed into large mesh bags for transportation to the depuration station. To save time some Cooperative members clean and place oysters into the bags over several days; i.e. place some oysters in the bags on Sunday, then Monday, and bring in oysters on Tuesday. However, the bags have really small mesh and crowded conditions within the bag do not allow the oysters to feed efficiently, which stresses out the oysters and does not let them eat properly resulting in high mortality rates. The depuration, shipping, and transportation process further stress the oyster and if it is weak it may die and is no longer suitable. The Cooperative pays for the oysters upon arrival at the depuration station, but once the oysters die the Cooperative pays for it, increasing the Cooperative's debt.

Mortality must be reduced. Strict monitoring of oyster mortality rates for each Cooperative member would determine who is supplying poor quality oysters and who is supplying high quality oysters. Members who consistently supply healthy oysters should be rewarded, i.e. lowest mortality rates gain employee of the month award and a small monetary prize. Members supplying poor quality oysters; threaten pay cuts proportional to the mortality rates if oyster condition does not improve and maybe even exclusion from the Cooperative.

iii. Suggestions for the Equator Initiative

- It may be useful for the Equator Initiative application to raise questions about:
 - the equitable distribution of benefits among project members
 - current challenges encountered by the project, in an attempt to obtain a more honest understanding of the project
 - allocation of potential prize money
- Behavioural economics teaches us that people code money they spend through "mental accounting." For example, winning \$500 is coded in the mind as windfall/easy money, which increases the likelihood that this money will be used with less prudence than if it had been earned through employment. Furthermore, mental accounting of the bonus

\$500 may lead to spending in excess of \$500 since the bonus \$500 may validate purchases on several different occasions with the total of these purchases exceeding \$500. Consequently, the US\$30,000 of the Equator Prize should maybe be partitioned so that it is not mentally accounted as free money, which may be spent freely. Perhaps a mechanism can be set up for EI to match every profit obtained by the initiative each month, for up to US\$30,000. This way the money will have to be earned, in a sense, and thus decrease the likelihood of mentally accounting the EI Prize money as windfall money, but rather, money which has been earned through employment and thus should be used with extreme prudence. Nevertheless, bureaucratic implications of such payments may make this suggestion difficult to follow through. [N.B. I'm not questioning the financial management of any EI project nor is this suggestion based on my observations from Cooperostra; it's based solely on human economic psychology.]

- To facilitate horizontal learning it may be useful to devise a classification system to group similar projects (i.e. aquaculture projects) and/or projects with similar needs (i.e. need marketing help). The EI may then unite these similar initiatives and hold workshops to increase horizontal transfer. Cooperostra may benefit greatly from learning marketing strategies and perhaps new aquaculture techniques.

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Appendix: Frequently Used Acronyms

APTA - São Paulo Agency of Technology and Agrobusiness

CNPT - National Center for Sustainable Development of Traditional Communities

IBAMA – Brazilian Institute of Environment and Renewable Natural Resources

MMA – Brazilian Ministry of the Environment

SAA – São Paulo State Secretariat of Agriculture and Supply

SMA – São Paulo State Secretariat of the Environment

NUPAUB – Nucleus of Support for Research on Populations in Brazilian Wetlands

PD/A - Program for Demonstrative Projects – Type A [Fund from MMA]

PED - Program for Projects of Decentralized Execution [Fund from MMA]

SIF – Federal Inspection Service [key institution for oyster consumption certification]