

CONCEPTUAL FRAMEWORK FOR SUSTAINABLE AQUACULTURE AND COASTAL RESOURCES MANAGEMENT: APPROACH TO THE ADOPTION OF MANGROVE-FRIENDLY AQUACULTURE

Renato F. Agbayani

SEAFDEC Aquaculture Department
Iloilo, Philippines

I. Introduction

Poverty characterizes most fishing communities in the Southeast Asian region. In the Philippines, the socio-economic survey of the National Statistics Office showed that 684,500 or 95.3% of the total 718,267 fishing families belong to the low-income group (Herrin and Racelis, 1992). The poverty of fisherfolk is directly caused by the widespread degradation of marine and coastal resources (Lacanilao, 1989), their low educational attainment, lack of skills for alternative livelihood and non-empowerment in local governance (Agbayani, 1995).

Producing food, generating employment and providing basic social services for the burgeoning population, and earning foreign exchange to fuel economic development, are among the top priorities of the Asian region. The region's vast and rich coastal and inland waters have been a major source of adequate and cheap protein food and livelihood for the people.

In the past, the seas teemed with fish. However, over the years, overfishing, destructive fishing practices, indiscriminate cutting of mangroves, and industrial and human wastes have gradually depleted the rich aquatic resources.

Mangrove forests, aside from seagrass beds and coral reefs, form part of the coastal ecosystems that support coastal resources. Consisting of intertidal flora and fauna, mangrove forests thrive in the tropic and subtropical regions of the world. More than a quarter of this important resource is found in Southeast Asia (Spalding *et al.*, 1997) and have contributed significantly to the socio-economic well-being of the coastal communities (Field, 1995).

Mangrove ecosystems provide the following ecological and economic benefits including the provision of nursery grounds for fish, crustaceans and molluscs that are recruited into the fishery resources; production of leaf litter and detrital matter which are broken down into bacteria, fungi, and other microorganisms which in turn provide valuable source of food for marine animals in estuaries and coastal waters; and protection of lagoons and estuaries from storm and erosion.

The mangrove ecosystems also facilitate the reduction of some organic pollution in nearshore waters by trapping or absorption; provide recreational grounds for bird watching and observation of other wildlife; and provide access to a high diversity of mangrove plants and animals, and their adaptations (Saenger *et al.*, 1983; Hamilton and Sneider, 1984).

Population growth and immense aquaculture development in the region have severely damaged the mangrove area. In Vietnam alone, mangrove forest cover was about 400,000 ha in 1943 but was reduced to 250,000 ha due to cutting primarily for charcoal. In addition, the chemical war in 1962-1971 destroyed about 105,000 ha. Specifically, from 1983 to the present, mangrove forests have been converted into agriculture lands and shrimp ponds.

The areas for shrimp ponds however, are too large with few sluice gates for tide water exchange resulting in the degradation of pond environment. Many people have abandoned their ponds and moved to other areas to destroy other mangrove forests for new shrimp ponds (Hong *et al.*, 1995).

Mangrove cover in the Philippines, on the other hand, had been reduced from 400,000 ha in the 1960s to barely over 100,000 ha in 1994. This has been caused by their conversion to fishponds and recreational facilities as well as due to the indiscriminate cutting of firewood and materials for house construction (Primavera, 1993; Primavera, 1995).

Studies have shown positive correlation between nearshore fish and shrimp yields and mangrove areas in the Philippines (Camacho and Bagariano, 1986) and in Indonesia (Martosubroto and Naamin, 1977). The decline in mangrove areas and production from nearshore fisheries contrasts with the increase in brackishwater pond area and aquaculture production.

The destruction of mangroves and other coastal environments caused by shrimp farming has also led to the deterioration of local livelihoods (Barraclough & Finger-Stich, 1996) due to conversion and privatization of mangroves and other lands, salination of soil and water, impoverishment of local populations, and food insecurity. While aquaculture is considered as a key alternative to meet problems on food security, its development, however, in the Southeast Asian region has always been market driven.

The export demand for shrimp and other high-value species encouraged governments and investors in the region to convert mangrove forests to shrimp ponds. In the Philippines, for example, large scale aquaculture was facilitated by the government with the issuance of P.D. 704 in 1975 with a fisheries decree accelerating fishpond development, and BFAR A.O. 125 in 1979 converting fishpond permits from 10-year lease agreements to 25 years.

Added to this ecological disturbance was the adoption of intensive culture systems to maximize profit, on the part of investors, and provide Southeast Asian economies with the much needed foreign exchange. Thus, the adoption of unsustainable aquaculture technologies and the devastation of mangrove forest became a social problem.

The economic benefits realized in terms of private profits for big-time shrimp investors, taxes paid the government by shrimp growers, foreign exchange inflow earnings, and employment of skilled technicians were all negated by the adverse impacts on mangroves and other coastal resources. All these are however, to the detriment of the impoverished fishing communities.

Moreover, the uncontrolled destruction and exploitation of mangrove resources can be attributed to the lack of property rights regimes and institutional arrangements in managing coastal resources. Mangrove forests are technically government-owned common property where access and use is open to all.

The advent of aqua-silviculture provides options for ensuring food security through the practice of mangrove-friendly aquaculture techniques. Aqua-silviculture involves more traditional, non-destructive aquaculture techniques combined with sustainable forestry techniques, including limited harvest of mangroves (Primavera, 1993).

However, local situations should first be considered before technology interventions are introduced. This will ensure the sustainability of both the resource and the technology.

II. Conceptual Framework

The basic elements considered in the project formulation on sustainable aquaculture and coastal resources management are mainly the people or the socio-economic attributes of the community; the biophysical characteristics of the coastal and land-based resources; the traditional and other existing institutional rules and regulations in the management of resources; and the status of fishing and aquaculture technology in the community (Fig. 1). Market attributes will have to be looked into by project implementors to support the marketing efforts of fish and non-fish products and services from the community.

The integration of the basic elements of the project through an interdisciplinary approach is important in order to understand fully the social dynamics in adopting technologies in order to get economic benefits from the coastal resources. The integration process will lead to two action situations: technology transfer and adoption on one side; and property rights regimes and institutional arrangements on the other side (Fig. 2). The technology transfer and adoption mechanisms will require both research undertaking and development interventions.

Property rights and institutional arrangements is the coastal resource component of the project which will define the rules and rights in the management of common properties such as mangrove forests and other coastal resources. The property rights in mangrove areas is a grant of authority from the state to the users in form of tenurial rights and stewardship agreements.

The effects of the two action situations (technology and resource management) will lead to several patterns of interaction or behavior among the resource and technology users. The behavior could be a "free rider"; reciprocity; and collective action.

The most ideal pattern of interaction is the collective action of the community of resource users. In this behavior, the resource users are interested in attaining a common goal and benefit for all.

Thus, the two behavior may be individualistic or opportunistic. Moreover, the long-term outcomes of the projects will be measured in terms of efficiency, sustainability, and equity.

III. Research and Development Agenda

Using the conceptual framework, a research agenda can be prepared consistent to the interrelationship between and among the basic elements of the projects and the long-term outcomes.

A. Socio-economics

Socio-economic studies will provide base line information on the socio-demographic attributes of the community. Socio-economic impact analysis will be done to evaluate the technical and economic efficiencies of the mangrove-friendly technologies. Resource valuation studies on mangrove and other coastal resources (corals and seagrasses) will be among the components of the analysis.

B. Bio-physical and environmental

Biophysical and environmental studies will assess the mangrove and other coastal resources before, during and after the management and development interventions.

C. Technology transfer

Technology transfer and adoption will include actual field demonstration and verification of mangrove-friendly aquaculture systems. Training and extension services will ensure correct adoption of the technologies and eventual commercialization.

D. Policy

Policy studies will document and analyze the process, formulation, and implementation policies and institutional arrangements, specially issues pertaining to property rights.

IV. Approach

The concept of property rights as a management strategy in stopping further destruction of mangroves and rehabilitating destroyed mangrove forest, requires the collective effort of different users and stakeholders. The property rights in mangroves is a grant of authority from the state to users in the form of tenurial rights and stewardship agreements. These rights are guided by rules on what acts are permitted and forbidden in exercising the authority provided by the right.

Well-specified property rights provide incentives for either individuals or groups to invest in resources and maintain them over time in order to obtain benefits. Property rights are characterized by exclusivity or the right to determine who can use or access the resource; transferability or the right to sell, lease or bequeath the rights; and enforcement or the right to apprehend and penalize violators of the rights (Randall, 1987).

Community-based coastal resource management or CBCRM and co-management strategies have been successfully implemented in the Philippines (Pomeroy and Carlos, 1997; Agbayani and Babol, 1997; Primavera and Agbayani, 1996). The people-centered approach of CBCRM focuses on capacitating the fishing community through training, education and skills development in resource management, enterprise development, training on para-legal issues, gender sensitivity, and lobbying among others.

The people-empowering activities will prepare the community to be effective and active co-managers of coastal resources. Community-initiated institutional arrangements on marine sanctuaries and reserves have also been implemented in various fishing communities in the Philippines. The concept of territorial use-rights in fisheries (TURFs) which grants the organized community property rights over coastal resources has been encouraged and legitimized by the government through existing laws, such as the Philippine Local Government Code of 1991 and the Philippine Fisheries Code of 1998.

In mangrove forests, Administrative Order No. 15 (1990) of the Department of Environment and Natural Resources (DENR) sets aside public forest as "communal mangrove forest" for the exclusive use of residents of the municipality. From such forests, said residents may cut, collect, remove mangrove forest products, such as firewood and mangrove timber for charcoal production for home consumption in accordance with forest laws and regulations.

Community-based strategies are effective in addressing localized problems through localized solutions especially those pertaining to the exploitation of common property resources. External agents, e.g., NGOs, academic and research institutions, government agencies, have predominantly initiated CBCRM activities. The relationship of these external agents to the community, however, should be temporary until the community has developed a sense of preparedness and self-reliance.

Beyond the community-based initiatives, however, will be the bigger issue of legitimizing locally-accepted institutional arrangements by concerned government agencies. This act of delegating authority to the community to use and manage coastal resources is a co-management arrangement between the government and the local community. The process of co-management involves community participation in decision-making, power sharing, and conflict management.

The focus of co-management is the issue of property rights or rights to access and limit other users from the resource. Co-management addresses the issue on ownership of resource and mechanism to allocate use rights through rules and regulations.

However, to date, literature on mangrove utilization in the country has limited, if any, documentation on informal or customary use-rights particularly on the adaptive and evolutionary significance of the systems of appropriation - of their construction, logic, and historical transformation. There is therefore, a need to look into the social circumstances of the sectors because as their circumstances change, so does the organizational structure of the community.

Failure to recognize this aspect would eventually result in resource-use conflict (Cordell, 1992). Considering the multiple-use characteristic of this resource, other effects would be unsustainable practices and inequitable distribution of benefits (Ruddle, 1994).

There is also a need to examine and evaluate property rights and collective action on mangrove ecosystems to provide reliable scientific information for policy formulation. Considering the vast mangrove resources that have been destroyed, and are presently being converted to different uses, there is a need to rationalize development strategies that will ensure efficiency, equity and sustainability.

Poverty and food security are the burning issues confronting developing countries today. There is a need to balance environmental conservation and food security in the management of mangrove resources.

Mangrove-friendly aquaculture technologies are being tested, verified, and transferred for adoption by fishing communities in the Philippines, Vietnam, Indonesia and other Southeast Asian countries. The Workshop on Mangrove-Friendly Aquaculture was convened by the SEAFDEC Aquaculture Department with special fund allocation from the Government of Japan, in Iloilo City, Philippines in January 1999.

The Workshop identified factors that would contribute to the development of a definition of mangrove-friendly aquaculture. Among these factors were benign; harmonious existence between fisheries and mangrove resources; beneficial to the community and economically viable; enhances biodiversity with minimal impact on the environment; and integrates mangrove rehabilitation and protection with food producing activities such as aquaculture.

REFERENCES

- Agbayani, RF and A. Babol. 1997. Institutional arrangements for fishery co-management on Malalison island, Culasi, Antique: a process documentation research methodology. A report submitted to International Center for Living Aquatic Resources Management. Iloilo: Southeast Asian Fisheries Development Center.
- Berkes, F. 1994. Property rights and Coastal Fisheries. In: R.S. Pomeroy (ed.) *Community management and common property of coastal fisheries in Asia and the Pacific; concepts, methods and experiences*. ICLARM Conf. Proc. 45, 189 p.
- Barracough, S. and Finger-Stitch, A. 1996. Some Ecological and Social Implications of commercial shrimp farming in Asia. *UNRISD Discussion Paper*, 74. United Nations Research Institute for Social Development and World Wide Fund for Nature. Switzerland.
- Bromley, D.W. (ed.) 1992. *Making the commons work: theory, practice, and policy*. Institute for Contemporary Studies, San Francisco, California.
- Camacho, A.S. and T.U. Bagarinao. 1986. Impact of fishpond development on the mangrove ecosystem in the Philippines, p.383-405. In: *Mangroves of Asia and the Pacific: status and management*. Tech. Rep. UNDP/UNESCO Research and Training Pilot Programme on Mangrove Ecosystems in Asia and the Pacific. Natural Resources Management Center and National Mangrove Committee, Ministry of Natural Resources, Philippines.
- Cordell, J. (ed.) 1989. *A Sea of Small Boats*. Cambridge: Cultural Survival with UNESCO (COMAR) UNESCO-ROSTSEA.
- Department of Environment and Natural Resources. 1990. *Compilation of Mangrove Regulations*. Coastal Resources Management Committee, Department of Environment and Natural Resources, Quezon City, Philippines.
- Jacinto, E.R. (ed.) 1998. *Community Legal and Institutional Studies*. Quezon City: Tambuyog Development Center.
- Herrin, A.N. and R.H. Racelis. 1992. Monitoring the coverage of public programs on low-income families: Philippines 1992. *Integrated Development Planning (IPDP) Project*. Manila: National Economic Development Authority. 86 p.
- Hong, P.N., H. Thi San, N.H. Tri and T.V. Ba. 1995. *Our Mangroves*, translated by P.N. Anh and P.N. Hong. Publishing House of Education, Hanoi. 43 p.

- Lacanilao, F., 1989. Countryside development through small-scale fisheries. *Diliman Review* 37(1):3-7.
- Mapa-Lacson, B. and H.P. Cruz. (eds), 1998. Community Property Rights (Options and Action Points for Philippine Municipal Waters), Quezon City: Tambuyog Development Center with Philippine Rural Reconstruction Movement and Community Empowerment and Resource Development.
- Martosubroto, P. and N. Naamin. 1977. Relationship between tidal forests (mangroves) and commercial shrimp production in Indonesia. *Mar. res. Indones.* 18:81-86.
- McAllister, D.E. 1988. Environmental, economic and social costs of coral reef destruction in the Philippines. *Galaxea* 7:161-178.
- Nemenzo, F. 1981. Studies on the systematics of scleractinian corals in the Philippines. In: Proc. of the 4th int. coral reef symp., eds. E.D. Gomez, C.E. Birkeland, R.W. Buddemeir, R.E. Johannes, Jr. Marsh, and R.T. Tsuda, 25-32. Manila, Philippines.
- Oakerson, R.J. 1992. Analyzing the commons: a framework, p. 41-59. In: D.W. Bromley (ed.) *Making the Commons Work: theory, practice, and policy*. Institute for Contemporary Studies Press, San Francisco, California.
- Ostrom, E. 1994. Institutional analysis, design principles and threats to sustainable community governance and management of commons. In: *Community Management and Common property of Coastal Fisheries in Asia and the Pacific: Concepts, methods and Experiences*, R.S. Pomeroy (ed.), Manila: International Center for Living Aquatic Resources Management. (ICLARM) Conf. Proc. 189 p.
- _____. 1992. *Crafting Institutions for self-governing irrigation systems*. California: Institute for Contemporary Studies Press. San Francisco, California.
- Paw, J. and C. Thia-Eng., 1991. *An Assessment of the ecological and economic* Pomeroy, R.S. and M.B. Carlos. 1997. Community-based coastal resource management in the Philippines: A review and evaluation of programs and projects, 1984-1994. *Marine Policy* 21(5):445-46
- Primavera, J.H. 1998. Tropical Shrimp Farming and its sustainability. *Tropical Mariculture*.
- _____. 1997. Development and conservation of Philippine mangroves: Institutional Issues. Paper presented during the 4th Workshop of the Global Wetlands Economics Network, Beijer Institute, Stockholm.
- _____ and R.F. Agbayani. 1996. Comparative strategies in Community-Based Mangrove Rehabilitation Programs in the Philippines. Proceedings of the ECOTONE V, 8-12 January 1996. Ho Chi Minh City, Vietnam. Mangrove Ecosystem Research Centre – Vietnam National University, Hanoi. Pp. 229-243.

- _____. 1993. Intensive prawn farming in the Philippines: Ecological, social and economic aspects. *Ambio* 30:28-33.
- Ruddle, K. 1994. A Guide to the literature on traditional community-based fishery management in the Asia-Pacific Tropics. Rome: Food and Agriculture Organization of the United Nations.
- Sale, P.F. 1980. The ecology of fishes on coral reefs. *Oceanogr. Mar. Biol. ANN. Rev.* 18:367-421.

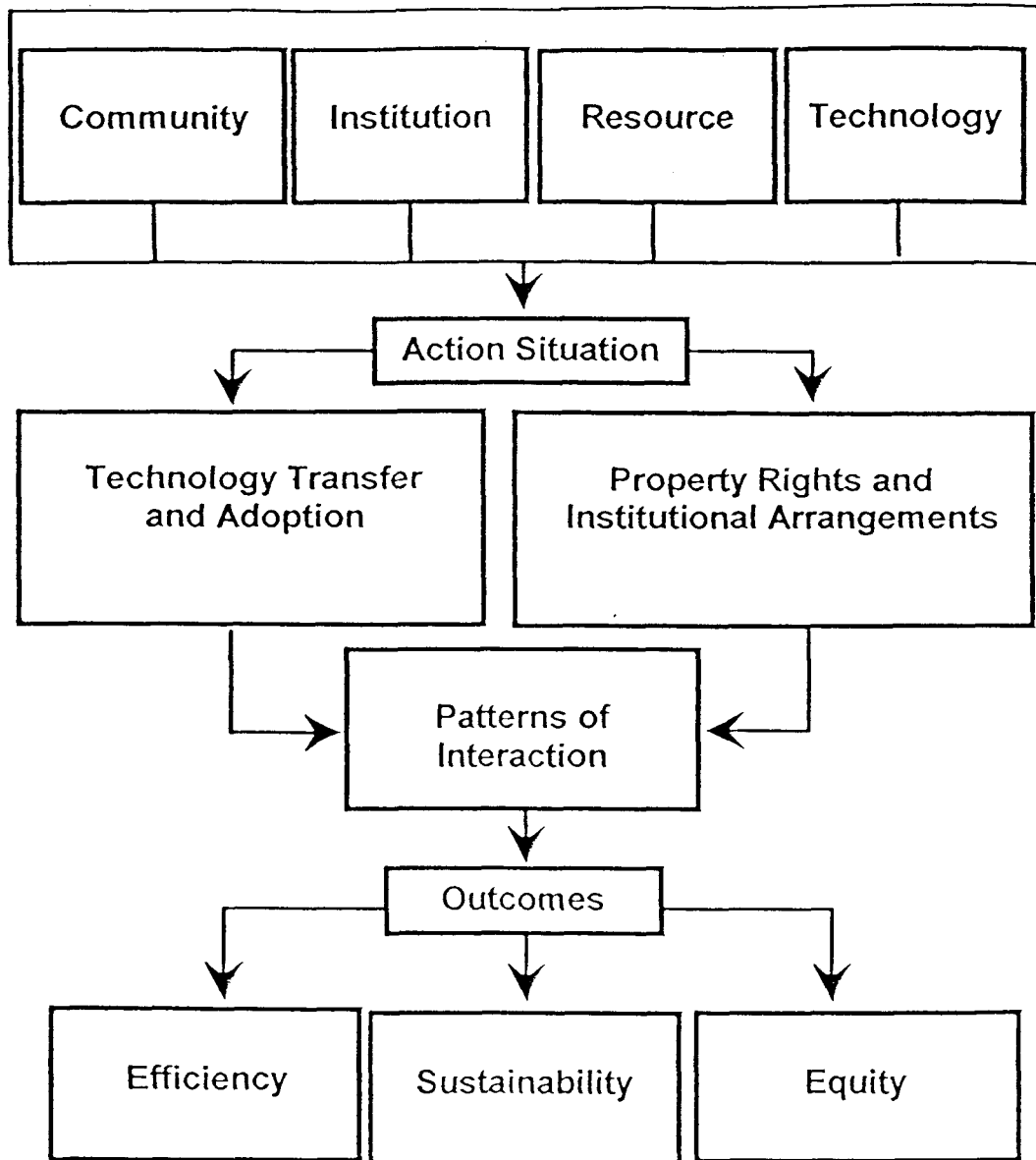


Fig. 1. Framework for sustainable aquaculture and resource management

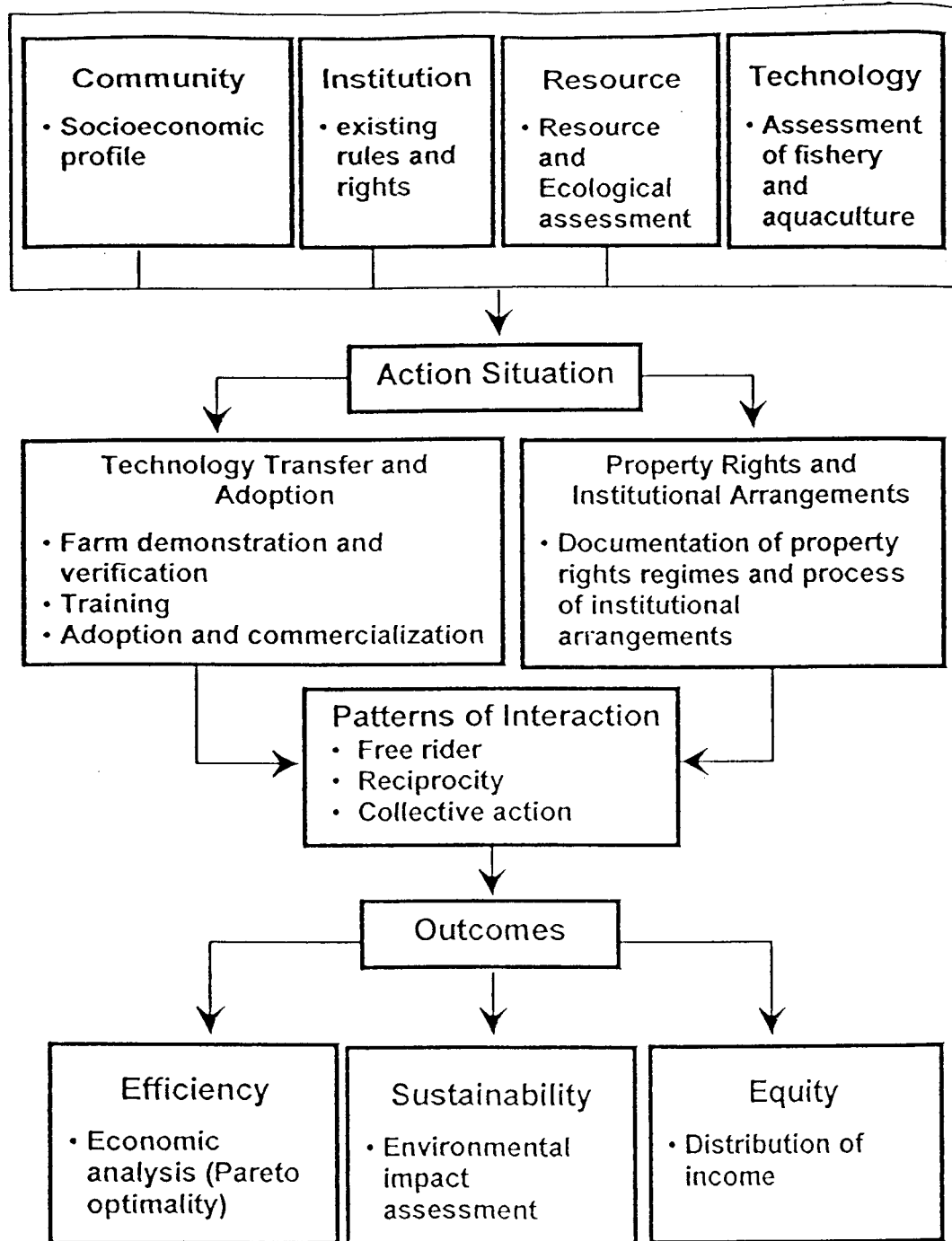


Fig. 2. Research and development agenda for sustainable aquaculture and resource management