MARICULTURE AND ECONOMIC, SOCIAL AND ENVIRONMENTAL BASES THAT DETERMINE DEVELOPMENT AND SUSTAINABILITY[1]

LEANDRO ANGELO PEREIRA[2]
ROSANA MOREIRA DA ROCHA[3]

Mariculture and Economic, Social and Environmental Bases

Mariculture is the branch of agriculture oriented towards cultivation of marine and estuarine organisms (FAO, 2010) and has the potential for including many species of commercially viable and cultivable organisms. This is especially clear in the context of the wide variety of marine environments and organisms found throughout the world (FRANKIC; HERSHNER, 2003) and mariculture is therefore increasing throughout the world.

Mariculture in coastal Brazil is mostly associated with shrimp and shellfish production. Additionally, algae and some fish are becoming more important but remain a small fraction of national mariculture. Ninety percent of shrimp production in Brazil is concentrated in the northeast and mostly of one species (*Litopenaeus vannamei,* ABCC, 2010). This species accounts for 69 thousand tons per year (MPA, 2012). Molluscs, ~5% of the mariculture market (in 2007), mostly comprise the mussel *Perna perna* (89% of shellfish production), followed by oysters (10%, mostly the exotic *Crassostreas gigas*, followed by native *C. brasiliana* and *C. rhizophorae*). Mussel production can reach 30 tons per hectare per year (FURLAN, 2004). Since 1996, shellfish are mostly produced in southern, followed by southeastern, Brazil.

Macroalgae, rather than being cultivated, is mostly harvested and carried out from the Brazilian states of Ceará to Paraíba (OLIVEIRA, 2002). Cultivation of macroalgae is relatively new to Brazil and was originally commercial, but over time it became more common at a smaller, even family, scale because it was fomented by the government and international groups, such as FAO. The main species being cultivated is the red algae in the genera *Gracilaria* and *Hypnea* (CARVALHO FILHO, 2004).

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2. PhD in Ecology and Conservation at the Universidade Federal do Paraná and Professor of Instituto Federal do Paraná – Câmpus Paranaguá; e-mail: leandro.pereira@ifpr.edu.br

3. PhD in Ecology at the Universidade Estadual de Campinas and Professor of Universidade Federal do Paraná; e-mail: rmrocha@ufpr.br

Fish cultivation is also receiving increased attention (but has not yet reached large scale), mostly as a consequence of limited growth of the fisheries industry (FAO, 2009; IUCN, 2010). Fish cultivation is considered to have great potential due to the many areas available for the installation of infrastructure for cultivation throughout the world (BALIAO *et al.*, 2000). From 1970 to 2006 average demand increased 1.2% per year and production remained more or less constant, with a small increase in commercial value of non-cultivated species or fish from small-scale cultivation. Despite the 3% contribution by weight in 2006 (1.85 million tons), pisciculture was responsible for 8% of the total value of mariculture (FAO, 2009).

Mariculture, while often associated with fisheries, has characteristics more similar to that of rural production of goods and therefore should include consideration of natural resource use and conservation as fundamental aspects of its development (DUFUMIER, 1992). Mariculture can be thought of as having three main components: the organism of interest is aquatic, the organism must be manageable, and the mariculture must have an owner, meaning it is not a commons (Rana 1997). Having an owner results in that owner being intimately informed about the activities of the mariculture, with respect to capital, remuneration and private property (individual or collective). Thus, mariculture is a commercial activity and as such, has the multiple objectives of food security as well as profit and economic development. Therefore, mariculture can be analyzed through different aspects of economics.

Classic economics considers the environment to be neutral to human activities and has characteristics that are both predictable and reversible (MUELLER, 1999). In this context, placing a value on natural resources is based on the principle of scarcity, that classifies natural resources that are uncommon or difficult to acquire as economic goods (PEREIRA, 2002). This concept when used with the idea of optimum economic development (YANG, 1995) directly influences management strategies with a tendency towards over-exploitation.

In the neoclassical economic perspective, natural resources can be represented as a simple linear relationship in which raw material is extracted, processed and commercialized, and this also leads to over-exploitation. For example, in oyster cultivation, raw material is often collected directly from mangroves, then processed (management and labor in care and growth of the oysters) and the final product is the commercial grade oyster. Clearly this model is too simplistic because it ignores other environmental services that are involved, such as the microalgae the oysters consume, or water quality in which oysters are cultivated, as well as the social setting in which production occurs.

There is a clear tendency by economists (and economic theory) to reduce the many dimensions of natural resources that are involved in mariculture to a single dimension – the market. With that perspective, environmental problems are considered external to production (externalities) and are not included in the calculations of costs and as such, gives an inflated value for profit. An example is when polluters are private companies, they are often absolved by the system which allows the company to simply pay for the damages, rather than fix the problem, yet the environmental (and associated social) problems remain in the public realm (PEARCE; REDDIFT, 1988; SOUZA-LIMA, 2004).

Shrimp production provides an example of externalities applied to mariculture. In shrimp production, less than 20% of the feed is converted into biomass and illustrates its inefficiency. However, this inefficiency often goes unnoticed because only apparent food conversion is estimated. Thus, more than 80% of the total feed provided to the animals is not consumed and becomes either organic waste or food for non-target animals in the region (BARBIERI; OSTRENSKY, 2002; PEREIRA, 2004; VALENTI, 2008). Not only is this an environmental problem, but it is also wasteful spending of money.

Two points should be addressed when considering economic values of environmental services. The first is the search for solutions to the problem of indiscriminant use of natural stocks without setting limits on how much, or when to harvest (such as in the case of oyster or reproductive fish individuals exploitation). The second is the carrying capacity of the environment such that numbers do not exceed the capability of the region to process wastes generated by production. It is fundamentally important that discussions about mariculture recognize these issues. Only through addressing these factors can a value be placed on the natural resources (AMAZONAS, 2010).

In counterpoint to the above mentioned schools of thought, the Survival Economics school has as a central tenet a concern with patterns of economic growth based on the resilience of the environment or carrying capacity of the environment of interest. A crucial element here is the capacity of the environment to assimilate, recycle or neutralize pollution over time, which are systemic functions that must be viewed as vital and non-substitutable resources for all human activities (REDCLIFT, 1987; SOUZA, 1999; AYRES, 2000). With mariculture, the link between viability of the resource and quality of the environment is extremely important (VALENTI, 2008).

Also, as a productive activity, mariculture should be considered as also potentially having an important impact on the environment (BEVERIDGE, *et al*., 1994; ELER; MILLANI, 2007; OSTRENSKY; BOEGER, 2008) and concern over these impacts and a cost-benefit analysis are essential to evaluate the viability of the activity (VALENTI, 2008). Some undesirable environmental impacts due to mariculture include the introduction of exotic species (VITULE, *et al*., 2009), increasing nutrient and organic compounds concentrations in sediments (PEREIRA, 2002), introduction or facilitation of pathogens and disease transmittance (CAVALLI *et al*., 2010) and direct environmental degradation due to activities and the infrastructure (FREITAS *et al*., 2009; RODRIGUES, 2006). All of these require broader discussion over how mariculture should be carried out (OLSEN, 1996; RIBEIRO, 2009), especially considering the rapid rate of growth, such as in Brazil (8% per annum, since 1981; MPA, 2012). Despite this rapid growth, mariculture in Brazil remains low-tech and small-scale, often family-owned and operated (BORGHETTI; SILVA, 2008).

Because of this small, local, often family scale of mariculture, another important discussion must be about social organization and impact of production. In Santa Catarina (main Brazilian producer of molluscs, with ~ 18 thousand tons, FERREIRA, 2011), only a minority (~7%) of the producers have three or more hired workers. The large majority only occasionally hire day labor, often paid under-the-table (MACHADO, 2002). Nonetheless, these small-scale producers are those that foment mariculture throughout

Brazil (IBAMA, 2007). Justification of this spreading of mariculture is investment in social improvement (IOC/UNESCO, 2011).

Small producers being easily included in the industry means that mariculture, in Brazil, is also growing as a tool for improvement of living conditions at a local scale and, as a consequence, leads to community stability (BRANDINI *et al.*, 2000, OSTRENSKY; BOEGER, 2008). This potential for community stability is dependent upon the programs for incentives to transfer technology and training to the management of cultivation, often not without the associated problems of this transfer (ARANA, 1999). There are many programs that do not consider these communities or the production chain as important (LUTZ, 1980; NEWRICK, 1993) yet these should be fundamental and as such, training should be a basic practice so that mariculture may succeed (BASTOS, *et al.*, 2004; BARENHO, 2008).

Within the requirement of understanding local realities, it is important to remember that coastal communities practicing mariculture are often at odds with one another. There is often have a variety of conflicts within and between communities (MELLINGER, 2013). For example, oyster production in estuaries is directly influenced by family needs and agreements with neighbors, both of which depend upon the size and place of production with respect to the communities. As a consequence, often the less-obvious environmental, technical and sometimes economic concerns take a back-seat to the more immediate social interests in mariculture.

With this in mind, mariculture must be viewed in the context of management by the government of common natural resources. Most mariculture takes place within state-owned, often multiple-use, areas, in which mariculture, fishing, tourism and other activities must all occur simultaneously (VIANNA, *et al.*, 2012). This complex interaction results in management being geared towards resolving conflicts of interest of use of the area rather than that of managing the natural resources of the area (RUFFINO, 2005). Conflict resolution is dynamic and often involves different scales in decision making at family, local, association or even state levels. Forms of space-use management in small communities are often based on mutual respect among the participants and despite there not being explicit and conscious rules for management, they are often the longest-lasting rules (rather than those of governmental organizations, for example; MELLINGER, 2013).

Another social aspect of mariculture is the increasing role of women. In the last 30 years, the number of women involved in mariculture has increased dramatically, especially as family-owned operations, such as in bivalve production. Even though most mariculture is carried out by fishing communities (in which fishing is considered a men-oriented activity, SENA 2001), women are beginning to change the old idea that the sea and boats are male spaces (PELLEGRINI, 2003; PAULILO; BONI, 2009).

Even though mariculture has been considered an alternative to reduce pressure on stocks of marine fish, crustaceans and molluscs (SACHS, 1986; BRANDINI *et al.*, 2000; TURECK; OLIVEIRA, 2003) and incorporating potentially positive ecological characteristics (SUPLICY, 2000; FITZSIMMONS, 2001; SILVA, 2007), it is still necessary to work in an integrated way, bringing together different areas of science and broadening discussions about the economic, technical and socio-economic consequences

of mariculture. Due to both positive and negative aspects of this situation, the different maricultural systems will require monitoring and evaluation in such a way as to favor sustainability (FRANKIC; HERSHNER, 2003). Thus, we need to develop tools for evaluating mariculture over the medium and long-term and to do so, one proposal is to use sustainability indicators (VALENTI, 2008; PEREIRA, 2012). An advantage of these indicators is due to the fact that they summarize and simplify relevant information, thereby permitting complex interactions become understandable and visible to those involved. Ideally, monitoring would be concurrent with research (biological and technological) to improve mariculture (BORN, *et al.,* 1994).

Sustainability and mariculture concept

The varying definitions of sustainability are based on several pillars of sustainable development. Thus, it is difficult to determine a concept of sustainability for mariculture because of the wide variety of activities under the rubric of "mariculture." Sustainability is a multifaceted concept and often its ambiguity is exploited (O'RIORDAN, 1988) and so it is difficult to find a common ground when each area, including actors, institutions, governments and so on, interprets sustainability to its own advantage (BRUNDTLAND, 1991; RATNER, 2004; AFONSO, 2006; VEIGA 2006). Apparently, environmentalists want environmental sustainability, consumers want sustainable consumption, workers want sustainable employment. As this concept means something different for everybody, the attempt to define sustainable development generates discordance (Norgaard 1988, p.618).

Despite this diversity of interpretations of "sustainability," there are common grounds in five lines of reasoning (ACSELRAD, 1999). First, efficiency, that fights waste of both raw and manufactured materials. Second, scale, in which it is proposed that economic growth and pressures are inherently limited by scale. Third, equitability, in which it is accepted that all people have the right to live in a healthy environment. Fourth, self-sufficiency, that attempts to separate local and traditional from global economies to help guarantee local regulation of resource use. Fifth, ethics, which strives to treat all communities fairly. With these five lines of reasoning, we may recall that basic principles of sustainability were stated as follows: satisfying basic needs, solidarity with future generations, community participation, natural resource conservation, social structure to guarantee employment, social security and respect for other cultures, development of educational programs (Sachs, 1986).

To complete this discussion, we must remember that we are at a point between the past and the future. With the situation as it now stands, the search for sustainability requires long-term planning strategies along with the difficult task of making short-term and local political goals compatible with those strategies. In Brazil, long-term planning for the environment often takes the back seat to short-term politics (AFONSO, 2006).

We can say that sustainability is a process of change inspired by new structural values that require the participation of different sectors of society in applying practical actions that consider different time-scales, ecological and environmental (and physical)

limits, social and cultural requirements that together search for sustainable economical development. With that in mind, the idea of sustainable mariculture implies the profitable production of marine organisms while maintaining an ecological setting in which cultivation may endure with intact local ecosystems and communities (VALENTI, 2008; VINATEA, 1999). In other words, sustainable mariculture implies profit and wages, generating jobs and improving the quality of life at the local community level, with respect for local cultures, and with rational and planned use of local resources so that future generations may also use them (SPRECKLEY, 1981; TURECK; OLIVEIRA, 2003).

Clearly, sustainable mariculture has not yet been achieved in Brazil. The question remains, is sustainable mariculture possible? Conceptually, it should be. However, to achieve sustainability, focus needs to change to include social and environmental issues to find a common, stable base. Also, the above described definition of sustainability must be applied. The Brazilian situation currently recognizes the fragility of the system in terms of organization of production which needs to be better planned with the goal of minimizing conflict (e.g., between large and small producers), fairly reconcile space-use among all parties, and establish production profiles for each region (OSTRENSKY; BOEGER, 2008). It is imperative that we discuss the current fragility of the more traditional socio-economic models, social aspects of mariculture, and new proposals for more productive and efficient small-scale systems.

References

ABCC, 2010. Associação Brasileira dos Criadores de Camarão. **Histórico da carcinicultura no Brasil.** Disponível em http://www.abccam.com.br/historico2.html. Acessado em 12/07/2013.

ACSELRAD, H. Discurso da Sustentabilidade Urbana. **Revista Brasileira de Estudos Urbanos e Regionais**, v. 1, p. 79-90, 1999.

AFONSO, C. M. **Sustentabilidade: caminho ou utopia?** São Paulo: Annablume, 2006.

AMAZONAS, M. C. **Economia Ambiental Neoclássica e Desenvolvimento Sustentável**. 2010. Disponível em: <http://wwwsr.unijui.tche.br/ambienteinteiro/econo-amb.pdf>. Acesso em: 03 mar. 2013.

ARANA, L. V. **Aqüicultura e desenvolvimento sustentável**. Florianópolis: Editora da UFSC, 1999.

AYRES, R. U. Commentary on the utility of the ecological footprint concept. **Ecological Economics**, v. 32, p. 347-349, 2000.

BALIAO, D.D.; DE LOS SANTOS, M.A.; RODRIGUEZ, E.M.; TICAR, E.M. Grouper culture in floating net cages. **Aquaculture Extension**, EAFDEC/Aquaculture Department. Tigbauan; Iloilo; Philippines, 2000.

BARBIERI JUNIOR, R.C.; OSTRENSKI Neto, A. **Camarões marinhos: engorda.** Viçosa: Aprenda Fácil, 2002.

BASTOS, M.; MELLO, S.; SAAD, A.; MOSCHEN, F.; COSTA, A. **Desenvolvimento e Apoio de Atividades de Maricultura Sustentáveis no Estado do Rio de Janeiro**. Disponível em: < https://www.ufmg.br/congrext/Meio/Meio54.pdf>. Acesso em: 03 set. 2013.

BARENHO, C. P. **Saber local e Educação Ambiental: parcerias necessárias no processo de inserção da maricultura familiar na Ilha dos Marinheiros - Rio Grande/RS**. Dissertação Mestrado. Pós-graduação em Educação Ambiental, Universidade Federal do Rio Grande, 2008.

BEVERIDGE, M. C. M.; ROSS, L. G.; KELLY, L. A. Aquaculture and biodiversity. **Ambio**, v. 23, n. 8, p. 497-502, 1994.

BORGHETTI, J. R.; SILVA, U. A. T. Principais Sistemas produtivos empregados comercialmente. In: OSTRENSKY, A.; BORGHETTI, J. R.; SOTO, D. (Eds.). **Aqüicultura no Brasil: O Desafio é Crescer**. p. 73-94. Brasília: FAO, 2008.

BORN, A. F.; VERDEGEM, M. C. J.; HUISMAN, E. A. Macroeconomic factors influencing world aquaculture production. **Aquaculture Research**, v. 25, n. 5, p. 519-536, 1994.

BRANDINI, F. P.; SILVA, A. S.; PROENÇA, L. A. Oceanografia e Aquicultura. In: VALENTI, W. C.; POLI, C. R.; PEREIRA, J. A.; BORGHETTI, J. R. (Eds.). **Aquicultura para o desenvolvimento sustentável**. Brasília: CNPq e Ministério da Ciência e Tecnologia, 2000.

BRUNDTLAND, G. H. **Nosso Futuro Comum**. CMMAD ed. Rio de Janeiro: Fundação Getúlio Vargas, 1991.

CARVALHO FILHO, J. Algas uma alternativa para as comunidades costeiras? **Panorama da Aquicultura** v. 14, n.84, p.53-56, 2004.

CAVALLI, L.S.; NORNBERG, B.F.S.; NETTO, S.A.; POERSCH, L.; ROMANO, L.A.; MARINS, L.F.; ABREU, P.C. White spot syndrome virus in wild penaeid shrimp caught in coastal and offshore waters in the southern Atlantic Ocean. **Journal of Fish Diseases.** v. 33, n. 6, p. 533–536, 2010

DUFUMIER, M. Environnement et devéloppement rural. **Révue Tiers Monde**, v. 33, n. 130, p. 295-310, 1992.

ELER, M. N.; MILLANI, T. J. Métodos de estudos de sustentabilidade aplicados a aquicultura. **Revista Brasileira de Zootecnia**, v. 36, n. Suplemento Especial, p. 33-44, 2007.

FAO. **O peixe, fonte de alimentação, meio de subsistência e de comércio**. 2009 Disponível em: <http://www.fao.org/docrep/012/i0765pt/i0765pt09.pdf>. Acesso em: 03 mar. 2013.

FAO. **The state of world fisheries and aquaculture**. Roma: Food and Agriculture Organization of the United Nations, 2010.

FERREIRA; J. F.; SILVA, F. C.; GOMES, C. H. A. M.; FERREIRA, F. M. Produção programada e rastreabilidade de larvas e sementes de moluscos em Santa Catarina. **Revista Brasileira de Reprodução Animal**, v.35, n.2, p.192-197, 2011.

FITZSIMMONS, K. Polyculture of tilapia and penaeid shrimp. **Global Aquaculture Advocate**. v. 4, n.3, p. 43-44, 2001

FRANKIC, A.; HERSHNER, C. Sustainable aquaculture: developing the promise of aquaculture. **Aquaculture International** v. 11, p. 517–530, 2003.

FREITAS, R. R.; COSTA, K. G.; SILVESTRI, F. Maricultura e Meio Ambiente: tecnologias, impactos e sustentabilidade. **Revista Brasileira de Agroecologia**. v. 4, n.3, p.107-113, 2009.

FURLAN, E. F. **Vida útil dos mexilhões *Perna perna* cultivados no litoral norte de São Paulo: Aferição dos parâmetros físico-químicos e microbiológicos.** Dissertação de Mestrado, Ciência e Tecnologia de Alimentos, Universidade de São Paulo. São Paulo, 2004

IBAMA. **Estatística da Pesca 2007 - Brasil, Grandes Regiões e Unidades da Federação**. Disponível em: <http://www.ibama.gov.br>. Acesso em: 03 mar. 2013.

IOC/UNESCO, IMO, FAO, UNDP. **A Blueprint for Ocean and Coastal Sustainability**. Paris: IOC/UNESCO, 2011.

IUCN, 2010. INTERNATIONAL UNION FOR CONSERVATION OF NATURE, **The IUCN Red List of Threatened Species.** Disponível em: http://www.iucnredlist.org/details/12416/0. Acesso em: 30 de junho de 2010.

LUTZ, R. A Mussel Culture and Harvest: A North American Perspective. **Developments in Aquaculture and Fisheries Science**. Vol. 7, New York: Elsevier, 1980.

MACHADO, M. **Maricultura como base produtiva geradora de emprego e renda: estudo de caso para o distrito de Ribeirão da Ilha no município de Florianópolis.** Tese de Doutorado, Departamento de Engenharia de Produção e Sistemas, Universidade Federal de Santa Catarina. Florianópolis, 2002.

MELLINGER, L. **Processos Decisórios na Gestão dos Bens Naturais Comuns: Participação Democrática, Hibridismos e Invisibilidades.** Tese de Doutorado, Programa de Pós-Graduação em Sociologia. Universidade Federal do Paraná. 2013.

MPA. **Boletim Estatístico da Pesca E Aquicultura 2010**. Disponível em: < http://www.mpa.gov.br/images/Docs/Informacoes_e_Estatisticas/Boletim%20MPA%202011FINAL2.pdf>. Acesso em: 20 set. 2013.

MUELLER, C. C. Economia , Entropia e Sustentabilidade: Abordagem e Visões de Futuro da Economia da Sobrevivência. **Estudos Econômicos**, v. 29, n. 4, p. 513-550, 1999.

NEWRICK, G. F. Do Aquaculture Projects Fail by Desing?. **World Aquaculture**, vol. 24 n.3, pp 12-18,1993.

NORGAARD, R. B. Sustainable development: A co-evolutionary view. **Futures**, v. 20, n. 6, p. 606-620, 1988.

OLIVEIRA, E. C., 2002. Macroalgas Marinhas da Costa Brasileira - Estado do Conhecimento, Uso e Conservacao Biologica. In: ARAUJO, E. L. et al. **Biodiversidade, Conservação e Uso Sustentável da Flora do Brasil**. Recife: Universidade Federal Rural de Pernambuco, p. 122-126.

OLSEN, J. H. T. Developing sustainable aquaculture. **World Aquaculture**, v. 27, n. 2, p. 16-17, 1996.

OSTRENSKY, A.; BOEGER, W. A. P. Principais problemas enfrentados atualmente pela aqüicultura brasileira. In: OSTRENSKY, A.; BORGHETTI, J. R.; SOTO, D. (Eds.). **Aqüicultura no Brasil: O Desafio é Crescer.** p. 135-158. SEAP/FAO, 2008.

O'RIORDAN, T. The Politics of Sustainability. In: TURNER, R. K. (Ed.). **Sustainable Environmental Management: Principles and Practice**. London: Belhaven Press, 1988.

PAULILO, M. I. S; BONI, V. **Agricultura e maricultura familiares: um recorte de gênero.** I Jornadas CINIG de Estudios de Género y Feminismos - Teorías y políticas: desde el Segundo Sexo hasta los debates actuales, 2009.

PEARCE, D.; REDDIFT, M. Sustainable development. **Futures**, v. 20, special issue, 1988.

PELLEGRINI, E. **Trabalho feminino na Maricultura de Florianópolis / SC.** 2003. Disponível em: <https://www.google.com.br/url?sa=t&rct=j&q=&esrc=s&source=web&cd=3&ved=0CDcQFjAC&url=http%3A%2F%2Fwww.sbsociologia.com.br%2Fportal%2Findex.php%3Foption%3Dcom_docman%26task%3Ddoc_download%26gid%3D974%26Itemid%3D171&ei=6mE8UsCwOZDPigKS_4HYCg&usg=AFQjCNFHs9z0bE4dEdCqOVCXXUoHn0tnAQ&bvm=bv.52434380,d.cGE&cad=rja>. Acesso em: 10 set. 2013.

PEREIRA, J. S. **A cobrança pelo uso da água como instrumento de gestão dos recursos hídricos: da experiência francesa à prática brasileira**. Tese de Doutorado, Departamento de Engenharia de Recursos Hídricos e Saneamento Ambiental. Universidade Federal do Rio Grande do Sul, 2002.

PEREIRA, L. A. **Cultivo do camarão branco do pacífico, *Litopenaeus vannamei* (BOONE, 1931), em tanques-rede no litoral paranaense: estudo de caso.** Dissertação de Mestrado, Departamento de Medicina Veterinária. Universidade Federal do Paraná. 2004.

PEREIRA, L. A. **Indicadores de sustentabilidade para a maricultura de pequena escala: conceitos, metodologia e usos.** Tese de Doutorado, Pós-graduação em Ecologia e Conservação. Universidade Federal do Paraná. 2012.

RANA, K. J. Trends in global prodution 1894-1995. **Review of the state of world aquaculture. FAO Fisheries Circular**, v. 886, n. 1, p. 3-6, 1997.

RATNER, B. D. "Sustainability" as a Dialogue of Values : Challenges to the Sociology of Development. **Sociological iIquiry**, v. 74, n. 1, p. 50-69, 2004.

REDCLIFT, M. **Sustainable Development: Exploring the Contradictions**. New York: Routledge, 1987.

RIBEIRO, C. A. C. **Desigualdade de oportunidades no Brasil**. Argvmentvm ed. Belo Horizonte. 2009.

RODRIGUES, M. A. A Presunção Constitucional de Degradação do Meio Ambiente pelas Atividades Econômicas. **Revista de Direitos Difusos**, v. 35, p. 107-111, 2006.

SACHS, I. **Ecodesenvolvimento – Crescer sem Destruir**. São Paulo: Vértice, 1986.

SENA, M. G. C. **Onde o paraíso mostra o seu avesso: cenas de trabalhadoras nas matas e mangues de Taperoá**. Tese de Doutorado, Pós-graduação em Sociologia, Universidade Estadual Paulista, São Paulo, 2001.

SILVA, U. A. T. **Recuperação populacional de caranguejo-uçá, *Ucides cordatus* (LINNAEUS, 1763), através da liberação de formas imaturas em áreas antropicamente pressionadas**. Tese Doutorado, Pós-graduação em Zoologia. Universidade Federal do Paraná, Curitiba, 2007.

SOUZA, J. M. Mar territorial, zona econômica exclusiva ou plataforma continental? **Revista Brasileira de Geofísica**, v. 17, n. 1, p. 79–82, 1999.

SOUZA-LIMA, J. E. Economia ambiental, ecológica e marxista versus recursos naturais. **Revista da FAE**, v. 7, n. 1, p. 119-127, 2004.

SPRECKLEY, F. **Social Audit - A Management Tool for Co-operative Working**. Published by Beechwood College, 1981.

SUPLICY, F. A. Capacidade de suporte nos cultivos de moluscos. **Panorama da Aqüicultura**. v.10, n. 57, p. 21-24, 2000.

TURECK, C. R.; DE OLIVEIRA, T. N. Sustentabilidade ambiental e maricultura. **Revista Saúde e Ambiente**, v. 4, n. 2, p. 22-26, 2003.

VALENTI, W. C. **Aqüicultura Sustentável.** 2002. Disponível em: <http://www.caunesp.unesp.br/publicacoes/artigos/valenti/CPIL_VALENTI_Aquicultura%20sustentavel.pdf >. Acesso em: 03 de mar. 2013.

VALENTI, W. C. **A aqüicultura Brasileira é sustentável? Aqüicultura e Pesca**. 2008. Disponível em: <http://www.caunesp.unesp.br/eventos/Seminario_Aquicultura_Sustentavel_ago_2008/Sustentabilidade_da_Aquicultura_Brasileira_Aquafair_2008.pdf>. Acesso em: 03 mar. 2013.

VEIGA, J. E. Neodesenvolvimentismo: quinze anos de gestação. **São Paulo em Perspectiva**, v. 20, n. 3, p. 83-94, 2006.

VIANNA, L. F. N.; BONETTI, J.; POLETTE, M. Integrated coastal zone management: a compatibility review between a public policy for the mariculture development and a coastal zone management plan in Brazil **Journal of Integrated Coastal Zone Management**, vol. 12, n. 3, p. 357-372, 2012.

VINATEA, L. **Aqüicultura e desenvolvimento sustentável: subsídios para a formulação de políticas de desenvolvimento da aqüicultura brasileira**. 1. ed. Florianópolis: Editora da UFSC, 1999.

VITULE, J. R. S.; FREIRE, C. A.; SIMBERLOFF, D. Introduction of non-native freshwater fish can certainly be bad. **Fish and Fisheries** v.10, n.1, p. 98–108, 2009.

YANG, Z. Optimal exporting of exhaustible resources with endogenous trade revenue: The case of a resource-scarce and capital-short economy. **Resource and energy economics**, v. 17, n. 4, p. 379–404, 1995.

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MARICULTURE AND ECONOMIC, SOCIAL AND ENVIRONMENTAL BASES THAT DETERMINE DEVELOPMENT AND SUSTAINABILITY

LEANDRO ANGELO PEREIRA
ROSANA MOREIRA DA ROCHA

***Resumo*:** A maricultura, ramo específico da aquicultura que engloba a produção de organismos marinhos e estuarinos, possui como componentes principais o manejo da produção, a relação direta com o ambiente e seu proprietário. Essas características fazem com que a atividade possa ser analisada pelas Ciências Econômicas, Sociais e Ambientais. Assim, surge como uma alternativa importante no desenvolvimento econômico e pode ser uma atividade para as comunidades litorâneas, interagindo diretamente com o meio ambiente onde está inserida. Nessa perspectiva, pode ser analisada sob o conceito da sustentabilidade. O presente trabalho discorre sobre essa temática, apontando aspectos da maricultura sustentável, considerando características de uma produção lucrativa, conexão com a conservação de sistemas naturais e importantes aspectos sociais, como possibilidade de integração com práticas locais.

***Palavras chave*:** produção animal – desenvolvimento sustentável – gestão costeira.

***Abstract*:** Mariculture (marine agriculture) comprises an owner, production management and a direct relationship with the environment. Thus, mariculture may be examined by economic, social and environmental sciences. Mariculture is an important alternative form of economic development in coastal communities in which there is an immediate interaction between environment and community. Here we discuss aspects of a sustainable mariculture, examining characteristics of profitable production in connection with conservation of natural systems and the possibility of integrating local practices, conservation and profit.

***Key-words*:** Livestock - sustainable development - coastal management.

***Resumen*:** La acuicultura marina, industria que abarca la producción de organismos marinos, tiene como componentes principales el propietario, la gestión de la producción y la relación directa con el medio ambiente. Por lo tanto la actividad puede ser analizada por sus aspectos económicos, sociales y ambientales. Esta actividad emerge como una alternativa importante en el desarrollo económico para las comunidades costeras e interactúa directamente con el medio ambiente en el que opera. En este trabajo se discute este tema,

señalando los aspectos de la maricultura sostenible, teniendo en cuenta las características de la producción rentable, relación con la conservación de importantes sistemas naturales y los aspectos sociales, como la posibilidad de integración con las prácticas locales.

***Palabras clave*:** producción de animales - Desarrollo sostenible - gestión costera.