

'Biorights' of commons as an economic opportunity for negating negative link between poverty and nature degradation

Dr. Dipayan Dey

Abstract

Bio-rights are financial mechanism to compensate opportunity costs of local stakeholders and assist commons of global south in reconciling poverty alleviation and sustainable use of natural resources. Bio-rights allow public value of key biodiversity areas to be transferred over time to local stakeholders as a direct economic benefit and turns natural resource management and conservation into development opportunity.

Observations suggest monetary value of nature has not been recognized by world community with existing economic system and its value is marginally present in market. One suggested solutions for poverty is to compensate commons for managing their natural resources. Biorights could contribute to this as direct payments to compensate for poverty related costs and distribution of payments to communities on the basis of nature conservation.

'Community-ecosystem' approach of this study on transformation of nature services to economic opportunities in various peri-urban wetlands of East Kolkata enables all stakeholders to concentrate on one problem at a time and allow rectification through adaptive management practices over time and space. It depicts a mixed financial model of community partnership for sustainability with low investment and high return assurances, affirming women empowerment and social cohesion, catalyzing social changes too. Adaptive management is the key factor for sustainability of this project and it is decentralized to the lowest appropriate level.

Need for a juridical basis and a good monitoring system was stated several times during the study, especially from stakeholders. Perusals of results show local people in developing countries that are dependent on the nature areas actively support the biorights system, which is a precondition for the success of biorights. In order for biorights to be globally successful it should be considered at first to aim at those nature areas which have the highest priority to conserve, in terms of estimated benefits and costs of conservation.

1) INTRODUCTION

Biorights is a concept that tries to protect areas of global biological importance by compensating poor people that live near nature areas and are dependent of these nature areas for cash generating activities. The hypothesis is that in this way a sustainable rural development is possible as the negative link between poverty and nature degradation will disappear. The money that is needed for biorights projects has to come from global stakeholders who have interests, of some sort, to protect these areas of global biological importance. In poverty alleviation the stakeholders need to be found in especially the public sector and

to a lesser extent in the private sector of developed countries. But for the long term, involvement of the private sector, including the financial world, may become essential if biorights is to become successful. Concerned governments in the developing countries may find it as an attractive solution to reach the Millennium Development Goals for 2015 that extreme poverty has to be decreased by 50%.

The monetary value of nature has so far not been recognised by the world community with our current economic system and hence its value is only marginally present in the market. Mostly the costs of nature conservation are visible in the market and only the most obvious benefits, such as tourism revenues, are accounted for in the market. That is why it is not possible at present to make an unbiased cost-benefit analysis of existing nature reserves. Therefore, other tools have to be found that can prioritise nature areas that are the most important to conserve. A cost-effective analysis may be an interesting tool to find what the most important areas of global biological importance are. It became clear that the most cost-effective areas in the world are those that have a high wilderness value and that are low populated and relatively less developed. This would mean that especially the “hotspot” areas in developing countries are the ones that need protection first. Pointing out the most cost-effective areas worldwide is one thing, making nature conservation a sustainable solution for the local people is another. One of the suggested solutions for the poverty problem is to compensate people for managing their natural resources. Biorights could contribute to this by compensating local people in developing countries directly for not degrading the natural environment. The global average compensation cost that is needed to cover the opportunity costs of the local people, lies in the range of US\$13.65/ha/year. And although biorights is not a new concept, it does hold elements that are new and that have potential, such as:

- 1) The direct payments to compensate for poverty related costs. These payments are also for the long term to guarantee a sustainable rural development.
- 2) The distribution of payments to communities and not to individuals on the basis of nature conservation.

In order for biorights to be successful we need cooperation of both the global community (public and private) and local people in developing countries. The local people (mostly poor farmers) need to actively support the idea of biorights as they determine to a large extent what will happen with the nature that surrounds them. And the global community is of course important for the investment. They have to determine if the benefits of participating are greater than the costs.

Considering the biodiversity business, the difficulty so far is that forests are regarded as public goods, which may cause the global community to act as “free riders” anticipating that others will take the lead in conservation efforts. Clear defined private property rights might trigger global investors to start investing in nature conservation. In that sense, a positive trend towards more private owned land is happening at present, as governments in developing countries are giving away state property rights to either individuals or local communities. The role of

private initiators should be much more highlighted in this context, as it takes financial courage to start investing in a new market such as for biorights. Success, by means of the biorights pilot projects, could greatly contribute to the involvement of private initiators and the eventual success of biorights. Combining the findings from the literature-, interview- and model study, it can be concluded that biorights can contribute to a solution for the poverty-environment issue, if the following conditions are met: The public- and also the private sector show sufficient interest for a continuous availability of money for biorights projects. Especially the private sector is at the moment sceptical about biorights, as they state that biorights does not present benefits to their business at present. If the pilot projects prove to be successful, it might trigger private actors to also become more interested in biorights. These private investors can be expected to be only interested when they have direct monetary benefits in nature conservation. The legal setting is clear and transparent. The need for a juridical basis and a good monitoring system was stated several times during the interview study, especially from stakeholders in the private sector. These are necessary as a back-up for private investment and to transfer back the results from the biorights projects to the investors. Local people in developing countries that are dependent on the nature areas for cash generating activities actively support the biorights system. Their active support and involvement is a precondition for the success of biorights. Optimization of the benefits of protecting certain nature areas in relation to its costs is greatly required. In order for biorights to be globally successful it should be considered at first to aim at those nature areas which have the highest priority to conserve, in terms of estimated benefits and costs of conservation.

2) RESEARCH DESIGN

The study was conducted in rural to peri-urban areas of Eastern India, Indo-Nepal border areas, eastern Bhutan and coastal Bangladesh. All these areas are prone to natural disaster and conservation of floodplains, Himalayan terrains, coastal plains and mixed broad leaf forests are vested on the local stakeholders who barely depend on natural resources for livelihood. Sociometric survey was simultaneously done through random sampling with a sample size of two thousand four hundred in six month's time. Attitude scaling was taken upon a six point scale. Data was processed and analysed with <EXCEL> ANOVA. Feedback studies after training and capacity building was done for correlation of results. Cost Benefit Analysis (CBA) of the proposed economic model was calculated on opportunity cost incurred for conservation against the marginal profit earned.

3) STUDY MODEL

A. Success stories

At the COP8 of the Ramsar Convention in Valencia in November 2002, during which the publication on Wise Use of Mires and Peatlands was launched, the Conference of the Parties adopted the draft Resolution COP8 DR11 on Designation of Under-represented Wetland Types, which included reference to

the role of the Global Peatlands Initiative (GPI). As a result in the stakeholder meetings in Central Kalimantan in relation to the Ex-Mega Rice Project which affected over 1.5 million ha of tropical peat swamp forests and caused significant environmental problems as well as increased poverty, the GPI financed the development of the "Biorights" financial system, which provides a basis for addressing poverty-environment issues. During the UNEP-Finance Roundtable in Tokyo in October 2003 in a workshop on Biodiversity and Finance, the innovative Biorights approach was presented by the authorities of Central Kalimantan and representatives of the local Dayak communities.

In phase II of the Global Peatlands Initiative (GPI) the linkage between poverty and peatlands was explored, particularly as a follow-up to previous work in phase 1 that enabled identification and involvement of stakeholders in project planning processes. The occurrence of peatlands in developing countries often coincides with rural poverty, as a consequence of peatlands often being some of the last remaining wilderness and natural resource areas. In many instances they occur at the fringes of development. They provide a buffer for the local communities located far from markets and trapped in systems of poverty and often largely dependent on the productivity of natural ecosystems or the potential offered by conversion of these systems to subsistence agriculture. Under phase 1 of the GPI already some projects worked closely with local communities to explore options for sustainable management and restoration (e.g. Thailand - GPI14, Indonesia - GPI10, China - GPI8). The projects in Indonesia and China received a follow-up in the second phase (China - GPI68, Indonesia - GPI62). The project in Thailand received a further grant from the NC-IUCN Small Wetlands Grants. In GPI Phase 2 several new poverty reduction oriented initiatives were supported; some were developed on the basis of peatland inventories that were done or started in phase 1. An example is the Maputaland project (GPI56) following the initial peatland inventory in southern Africa by the IMPESA network, which focused on one of the poorest regions in South Africa where poverty clearly was a vector in the destruction of the peatswamp forests resource. Another example is incorporated as a component in the Paramos project (GPI71), which included six case studies in critical peatland areas (high biodiversity and poverty indexes) in different countries to enhance the understanding of the relation between high Andean peatlands and rural livelihoods. Other GPI Projects in Indonesia (Kalimantan and Sumatra) focused on community-based peat fire prevention, including capacity building and awareness raising, as well as the extinguishing of fires in critical areas. The peat fires in South-east Asia have a huge impact on the local economy, as a result of resource destruction (e.g. forestry, agriculture, biodiversity), as well as impact on transport. Moreover, these fires and the resulting smog affect the health of hundred thousands of people both in the rural communities as well as cities, with many people being hospitalised or treated as out-patients. Whereas already many projects exist to monitor the occurrence and impacts of these fires, the GPI projects were some of the first to actually set examples on how this major problem can be addressed through bottom-up approaches involving local communities and other stakeholders.

The Global Peatland Initiative has proven to be useful as a public-private partnership. Such partnerships should not be regarded as a magical tool to achieve sustainable development or "wise use" of natural resources such as peatlands. Their value is mainly in providing a platform for a variety of development and conservation sectors and stakeholders to work together constructively towards a better understanding of each other's interests and towards agreements on issues that require inter-sectoral cooperation. In this respect it is important that sustainability or "wise use" is not only an opportunity, but may involve opportunity costs for some of the stakeholders on local and regional levels. For instance, in poverty trapped regions it should be acknowledged that without attempts to solve the economic and social problems one can not expect much attention to environmental problems, while at the same time poverty issues may augment poverty. To solve such discrepancies it can be useful to clearly identify and assess the opportunity costs through such partnerships, enhancing credibility of the fundraising approaches to donor agencies. The paradigm of "wise use" or sustainable development provides the partnership with a tool requiring the industry to internalize environmental and related social issues within their operations, whereas environmental non-governmental organizations are required to internalize economic and related social issues in their environmental objectives. In this respect the partnership could be directed more towards the peat based industry. So far too little emphasis has been given to the initiatives and contributions of the industry with respect to achieving wise use. A case in point are the investments made in rehabilitation of exploited peatlands and the efforts made for instance by the Canadian peat industry to support the science community. Also the options for co-operation with the oil and gas industry need more attention. The GPI could also contribute to the debate of peat as a renewable or non-renewable source of energy. Another most important challenge of the partnership is to contribute to the de-coupling of poverty and degradation of peat resources in the world. To really address environment-poverty issues, generally longer-term programmes are necessary. It is a pity that for bureaucratic reasons the GPI was able to only finance short-term activities. In this light, the achievements of the partnership have been significant, but to achieve sustainable results some of the initiatives started by the GPI will require longer-term follow up funding. In operating along these lines we believe that in the end the GPI partnership can provide added value towards achieving the ultimate goal of its partners: the wise use of peatlands. So far, the GPI partnership has proven its value, and it is clear that without the joint expertise of its partners and their networks it will be much more difficult to positively influence the policy frameworks of the different conventions and governments.

Mali's biorights project in Indonesia helps women's groups and poor people conserve biodiversity, as 80% of the population is farmers and thus dependent on natural resources for their livelihood, financial assistance from international institutions was also requested though, particularly for micro-financing, to alleviate poverty and help reverse the trend of natural resource degradation. The

local government of Central Kalimantan is implementing the biorights project had noted the need of enhancing human resources to manage natural resources. Nazir Foad, Director of the Species Programme at WWF Indonesia, noted the benefits in investing in biodiversity for the financial community and elaborated on a plan being developed for ecologically-friendly investment that contributes to sustainable development and biodiversity. Further, Edwin Cyrus, Director of the Conservation Area Amistad Caribe of Costa Rica's Ministry of Environment and Energy reported that the Ministry has been active in environmental and biodiversity-related projects. Highlighting a 1998 forestry law for an environmental services programme, he noted the need for enhancing funding for biorights initiatives and supported combining private and public funds. Roberto Lopez Chaverri, Sustainable Development Executive of Corporación Andina de Fomento (CAF), in Latin America had highlighted in international forum that inter alia: fostering the creation of such companies; working with local communities; and approaching other financial institutions to leverage resources in financing biodiversity-based programmes. He urged the corporate sector and banks to play a bigger role in creating sustainability products and services for achieving sustainability goals.

B. The East Kolkata Wetland Experiences

Sometimes called the "Kidneys of Kolkata (Calcutta)," the East Kolkata Wetlands (EKWs) are the largest of their kind in the world, covering an area of 12,500 hectares which were designated as a RAMSAR site in 2002. EKW recycles some 680m liters of raw sewage every day. The wetlands' mosaic comprised of ponds, lakes, channels and swamps are the only sewage treatment facility for 12 million people of the city Kolkata.

EKW produces more than 13,000 tones of fish annually, whose yield at 2-4 times higher than average fish ponds, is among the best of any freshwater pisciculture in the country. Some 150 tonnes of vegetables per day are harvested from small-scale plots irrigated with wastewater. The main challenge in saving the wetland is that the livelihood of nearly 1.5 lakh inhabitants is directly or indirectly bestowed on wetland resources. The project undertaken by SAFE aims to conserve the site for long-term sustainable environmental development through community participation and partnership.

The national NGO, South Asian Forum for Environment (SAFE) has inaugurated its "Biorights" pilot project on eco-tourism at the East Kolkata Wetland on 2nd Feb, 2008, The World Wetlands Day. The project is one of its kinds to be launched for the first time in India. This particular project is initiated by Kolkata Urban Services for the Poor, KUSP, under the Ministry of Urban Development, WB and is funded by DFID, UK.

This is indeed a matter of proud for SAFE and the wetland people as this project will benefit the livelihood of about 1200 wetland fishermen who now have a ray of hope that their livelihood will improve and the wetlands can be saved from the hands of forceful encroachers. The pristine water bodies makes wetlands a wonderful site for eco-tourism and this project undertaken by SAFE "*Converting Nature Services into Financial tool, a Biorights model*" will not only create

tremendous awareness among the urban people but also shall develop an appetite for saving the wetlands from further degradation.

4) OBSERVATIONS

A. Primary resources

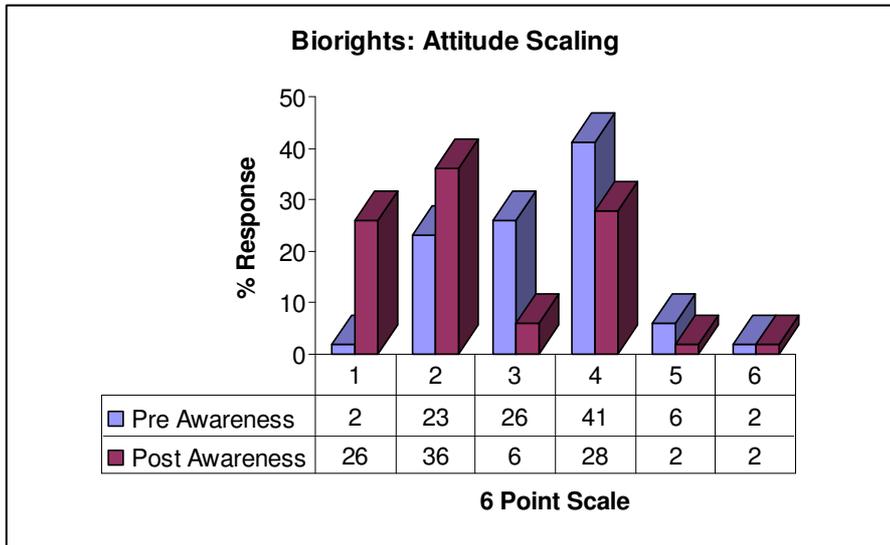


Fig: 1 Biorights Attitude Scaling

The six point scale indicates (1) strongly favour (2) favour (3) somehow favour (4) do not favour (6) strongly reject. A considerable change in attitude was noticed after the awareness campaign and conduction of workshops on alternative economic opportunity and Biorights.

B. Cost Benefit Analysis (CBA)

CBA represent the best practical way to capture and express in a single dimension monetary, many but not all, of the effects and utility changes, therefore, currently the basic idea behind CBA is to measure in monetary terms how social welfare is affected by a particular event or project. The UNIDO approach of 1972 emphasized on distributional matters, which drove the pioneering manual of project appraisal for developing countries written by Little and Mirrlees to a revised version. By the end of the 1980's a more balanced approach to project or event appraisal accepted that CBA of projects is complementary to market liberalization and policy reform, and has a central role in achieving economically efficient investment decisions and a more rapid economic growth in developing countries. Further, examination of the potential of environmental insurance as financial tool for establishing Biorights for per-urban redevelopment was done. Given the preliminary and exploratory findings described here, three aspects of the environmental insurance market warrant immediate research effort:

- (1) The insurance purchase decision processes within municipal governments and economic development organizations to uncover interventions that

- might accelerate the use of specific environmental insurance coverage;
- (2) Developers' and financiers' assessments of the utility of different insurance products, especially as compared to direct cash subsidies for projects at either the short- or long-term lending stage; and,
 - (3) Economic and community development officials' perceptions of environmental insurance and its relevance to their urban redevelopment efforts.

These three types of questions are best examined through structured focus groups. Given regional variation in experience with East Kolkata Wetlands redevelopment, at least few households from each locality should be included in the study sample. Since more will be learned in settings already actively engaged in coastal zone redevelopment, the ideal sample would include localities of different sizes and experiencing different local economic conditions like:

- (1) Public and non-profit sector environmental and economic development decision-makers; and,
- (2) Developers, lenders and others involved in private investment in the local real estate market.

Such a study could produce immediately useful information on local governments' capacities to productively employ insurance products and on federal support, including program guidance documents that could improve insurance utilization. In addition, assuming that the private sector focus groups place a significant value on insurance coverage, the results of the study could provide the foundation for the more comprehensive survey research that would then be justified. This next level of analysis could employ Contingent Valuation Techniques to measure potential urban redevelopment investors' perceptions and valuations of the tradeoffs between environmental insurance coverage and other public sector support such as interest rate subsidies, loan guarantees, tax credits or abatements, or direct cost sharing. This information is essential for developing criteria that can be used by economic development agencies in making decisions about optimal ways to stimulate peri-urban redevelopment within tight budget constraints.

C: Economics of Disaster mitigation

The current trends in disaster control have been relief and mitigation in post disaster periods. The socioeconomic condition is greatly affected with the one time grant or relief funding made available to the commons. Survey studies indicate that sudden inflow of funds are meager to sustain the development process against hazard damage though it has a general acceptance to the below poverty level people for obvious reasons. The surplus fund is often wasted or spent inappropriately and fails to confirm conservation objectives. An average inflow of funds is proportionately shown in Fig 2 below based on survey reports from floodplains of Indo Nepal border areas.

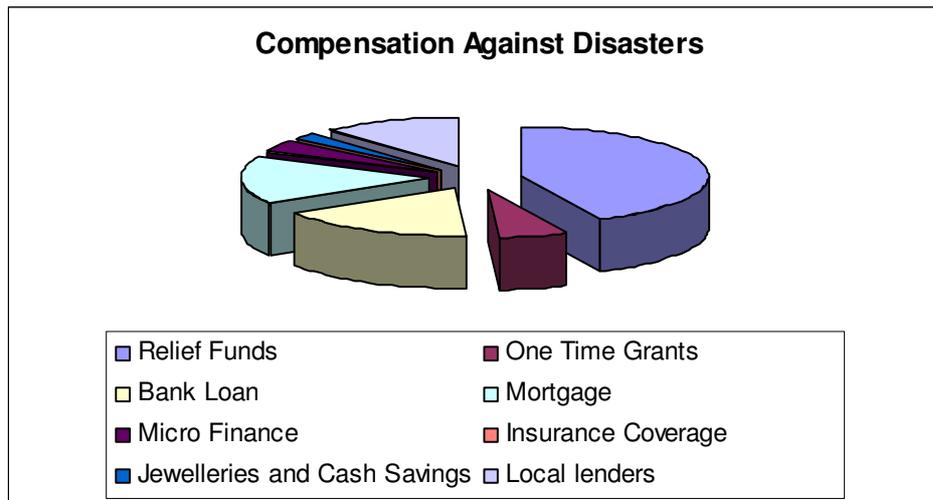


Fig 2: Financial compensation against disasters

B. Secondary resources

i. Case studies

In that light, an interview survey was carried out in the Netherlands covering a number of public- and private bodies that could have an incentive to participate in biorights projects. The result from the study was that almost all respondents found the concept interesting. A slight difference could be noticed however between the opinions of respondents in the public- and private sector. The public organisations that were interviewed were all involved in either the development- or nature conservation issue. Biorights might become part of the policy of these organisations once it proves to contribute to a solution for the poverty- and nature degradation problem. The respondents from the private sector were generally a bit more sceptical as some of them did not see clear benefits that biorights could have for their company. But biorights might become more interesting for the private sector and especially the financial sector: If it succeeds in reducing the availability of “risk-money” that is normally available for these kinds of projects. In the case that fiscal benefits are available. Besides the interview study in the Netherlands, there was also the attendance at the UNEP FI Global Roundtable Conference that was held in Tokyo (2003). A lot of the world leading financial institutions were present at this conference. It became clear that although there was a willingness noticeable to invest in more socially responsible initiatives, there is still a lack of actual investment in them as these projects are obviously regarded as not profitable enough, i.e. return on investment is regarded too low. Besides looking at the “buyers” side of biorights, this study also investigated the expected behaviour towards biorights of the “sellers” side. In order to find out what compensation payment is needed to get local people’s involvement, one of the biorights pilot projects, has been chosen to calculate this. The case study area was the San Juan la Selva region in the north of Costa Rica. It was calculated that the compensation payment in the case region has to lie at least in the range of \$88/ha to be competitive with the timber market. These are simply the opportunity costs of the land, by means of timber revenue. At a market price

for biorights of US\$98/ha, an estimated 80% of the case study region can be conserved. This price is also the estimated monetary global benefits that all the stakeholders combined have in the conservation of the primary forests of Costa Rica. Conservation of the remaining 20% of the area is at high costs and it can be considered whether this is cost-effective. Altogether, this means that in the case study area where 6000 households live, which all have on average 85 ha. Of land, a total amount of \$47 million is needed on an annual basis to compensate all these people to maintain the natural character of the forests. Due to the relative high compensation costs, future trends in timber and beef revenue, which determine the opportunity costs of the land, may also determine the success of biorights in this area. If the opportunity costs of the land will drop due to a considerable drop in timber prices, biorights might become both an economically and at the same time sustainable interesting alternative for farmers.

DISCUSSION

From a research perspective, original and synthesis work is needed to address the problem and as well develop a new modeling and decision support approach that will not only be capable of restoring the ecosystem but also ensure sustainable development throughout the ecoregion. Such models must be fueled by a wide variety of ecological, spatial, and related monitoring data. Implementation of ecological and socioeconomic innovation would open more options for sustainable development through improved and ecofriendly agro-practices. The decision support tools provided here will be helpful to simulate wetland management scenarios and would suggest important methods for development and evaluation of alternatives within the planning process. In addition, the gathering of the monitoring data will provide significant baseline data necessary for other aspects of the planning process. This decision support research is designed to recommend adaptive environmental management that can best contribute in negating the negative link between poverty and conservation objectives at minimum opportunity cost. It would also attempt attitude change among local stakeholders and assure community participation in achieving sustainability in social and environmental development. As evidenced by the study the eagerness to participate is stimulated with awareness of the commons. The overall purpose of this research, therefore, is to provide decision support that will allow conservation ecologists to simulate agro-environmental management and social response to this management to explore the most satisfactory ways of reaching long term sustainability and growth. Positive ecological impacts of eco-restoration would reflect enhanced productivity, better species richness, high yields and lowering in pollution levels. Functional assessment of habitat health should show gradual reversal to natural conditions, normal limits of standard ecological basics, improved regeneration status of endemic and rare species, better seed bank and restoration of faunal niche etc. Attitude change is expected among local inhabitants through community participation. Local stakeholders get trained to sustain the system

while socio-economy revives by opening newer ecofriendly options for livelihood. Conservation awareness restrains people from exploitation of natural resources. One of the greatest challenges lies in the inherent uncertainty of how well the restoration effort will work. The concept of adaptive management has, therefore, been incorporated specifically to provide a framework for decision-making to help reduce uncertainty in the planning phase and design steps to deal with these uncertainties. These measures may include incremental project implementation, experimental studies in sub areas of the restoration site, running parallel projects that differ in one or more conditions, and implementation of continuous functional assessment to evaluate the effectiveness of a restoration technique. Each of these techniques requires that a project be monitored over time. This is done to assess the success or failure of different restoration techniques and determine what remedial action might be required if a restoration effort is not achieving project goals. Need for a juridical basis and a good monitoring system was stated several times during the study, especially from stakeholders. Perusals of results show local people in developing countries that are dependent on the nature areas actively support the biorights system, which is a precondition for the success of biorights. In order for biorights to be globally successful it should be considered at first to aim at those nature areas which have the highest priority to conserve, in terms of estimated benefits and costs of conservation.

5) BIBLIOGRAPHY

- Meyer, P.B. 1997 (forthcoming, 1999). "Appraisers and Contaminated Lands: Valuation and Capital Availability," in C. Bartsch, ed., *Brownfield Financing Papers*. Prepared by the Northeast-Midwest Institute. Washington, DC: U.S. HUD.
- Meyer, P.B., and T.S. Lyons. 1997. *Environmental Merchant Banking: Entrepreneurship and Brownfields Cleanup*. Working Paper 97-7. Louisville, KY: Center for Environmental Management, University of Louisville.
- U.S. EPA. 1996. *Potential Insurance Products for Brownfields*. Washington, DC: USGPO.
- Walker, C, P. Boxall, C. Bartsch, E. Collaton, P.B. Meyer and K.R. Yount. 1997 (forthcoming). *The Impact of Environmental Hazards and Regulations on Urban Redevelopment*. Prepared by the Urban Institute with the Northeast-Midwest Institute, University of Louisville, and Northern Kentucky University. Washington, DC: U.S. HUD.
- Yount, K.R., and P.B. Meyer. 1997 (forthcoming, 1999). *Financing Small-Scale Urban Redevelopment Projects: A Sourcebook for Borrowers Reusing Environmentally Suspect Sites*. Final Report to EPA Urban and

- Economic Development Division prepared by The
- E.P. Systems Group, Inc. Washington, D.C.: U.S. EPA.
 - Bunting et al. "Workshop Proceedings: The East Kolkata Wetlands and Livelihoods." July 2001, www.dfid.stir.ac.uk/dfid/nrsp/downlaod/workshoppdf
 - Ghosh, Dhrubajyoti. "Wastewater-Fed Aquaculture in the Wetlands of Calcutta - an Overview." 1990. www.cepis.ops-ms.org/muwww/fulltext/repind53/calcutta/calcutta.html
 - Ghosh, Dhrubajyoti. "Turning Bad Water into Good." *Changemakers Journal*, October 1998. www.waste.n1/docpdf/OP_calc.pdf
 - Kundu, Nitai. "Planning the Metropolis." *Kolkata Environmental Improvement Project Publication*, 4(2): pp5 to 57.
 - Burbridge, P.R. 1994. Integrated planning and management of freshwater habitats, including wetlands. *Hydrobiologia* 285: 311-322.
 - Cooper, R.C. 1991. Public health concerns in wastewater reuse. *Water, Science and Technology* 24(9): 55-65.
 - de Hann, A. 1999. Livelihoods and poverty: the role of migration - a critical review of the migration literature. *Journal of Development Studies* 36(2): 1-47.
 - Edwards, P. 1997. *Trip Report to Vietnam, 7-15 October*. Bangkok, Thailand: Asian Institute of Technology [unpublished report].
 - Edwards, P., Demaine, H., Innes-Taylor, N. and Turongruang, D. 1996. Sustainable aquaculture for small-scale farmers: need for a balanced model. *Outlook on Agriculture* 25(1): 19-26.
 - Edwards, P., Polprasert, C. and Wee, K.L. 1987. Resource Recovery and Health Aspects of Sanitation. *Research Report 205*. Bangkok, Thailand: Asian Institute of Technology.
 - Ghosh, D. and Sen, S. 1987. Ecological history of Calcutta's wetland conversion. *Environmental Conservation* 14: 219-226.