



**ACHIEVING ENVIRONMENTALLY SUSTAINABLE ECONOMIC  
GROWTH IN PNG: ENVIRONMENTAL ECONOMICS TOOLS &  
APPROACHES  
DEC, UNDP/UNEP & EEPSEA**

**WORKSHOP FOR DECISION-MAKERS AND RESEARCHERS  
MONDAY 27 APRIL – FRIDAY 1 MAY 2009**

*Summary*

This workshop for Papua New Guinea's policymakers and researchers was attended by people from the national government agencies, private sector representatives, academic and research institutions and NGOs. The workshop was organized by the Department of Environment and Conservation, United Nations Development Programme (UNDP)/ United Nations Environment Programme (UNEP), and the Economy and Environment Program for South East Asia (EEPSEA). It was designed to improve the awareness and understanding of the role of economic tools and techniques in addressing key policy issues relating to the environment, natural resources and economic development in PNG.

The workshop incorporated two *streams* – one designed for policymakers and the second for researchers. The first two days of the workshop were shared by policymakers and researchers, with up to 80 people participating, to identify key issues relating to environmentally sustainable economic growth in PNG and to gain an understanding of the role that economic analysis can play in policy formulation and implementation. The last three days of the workshop undertook a more technically based training course that explained and demonstrated the models, tools and techniques that economists use to support the planning and management of natural resources and environment, particularly relating to fisheries, water resources, forestry, land and minerals. The technical sessions were attended by up to 45 people.

The workshop presented key tools of environmental economics that were applied to natural resource sectors of importance to the PNG's economy. The workshop reviewed market, policy and institutional failures and how these could be addressed with regard to water, land, minerals, forestry, agriculture and marine resources in PNG. This exercise was conducted through break-out discussion groups. Participants were divided into four groups: 1) water, 2) land and minerals, 3) forestry and agriculture and 4) marine resources based on their professional expertise and interests. They were asked to identify the key market, policy and institutional economic failures of their sectors and the ways to better address these failures.

For water, the group identified under-pricing of urban and industrial water use as a key market failure. Having no national water policy was a key policy failure whilst the weak linkages between the various agencies responsible for water were identified as a key institutional failure. For land and mineral resources, the group highlighted the lack of full valuation of land and a national land-use plan as key policy failures, contributing further to market failure in over/under-

valuing land for investment purposes in PNG. In addition, weakness in environmental regulatory process was also highlighted as a failure in this natural resource group.

For the marine sector, the group underlined weak monitoring and enforcement of marine regulations as a key policy failure and identified weak coordination between stakeholders, particularly in the three levels of government as a key institutional failure. These weaknesses were further reinforced by the fact that PNG lacked a marine policy and legislation.

In the agriculture and forestry sector, the group stressed that a lack of policy directive for downstream processing was a key market and policy failure. Similar to the land and minerals group, the agriculture and forestry sector also identified the lack of a national land-use plan as a policy failure.

As a recommendation, all groups identified the need to improve on the coordination and consultation mechanism amongst key stakeholders as well as to develop an appropriate national land-use plan and land registration system for better management of PNG's natural resources. Other issues such as capacity development, research and development, political will, monitoring and enforcement and baseline data were identified as an important factor to strengthen the market, policy and institutional challenges in PNG.

Workshop participants were also asked to identify research themes for the above four natural resource groups. Some of the identified research themes are as follows: land pricing model (land and agriculture); sustainable inter-generational equitable livelihoods (marine); categories of water uses, review of water quality standard criteria, integrated water catchment study (water); and economics of protected areas in PNG's climate change policy and REDD, economic analysis of protected areas, conduct a cost benefit analysis on oil palm (forest and agriculture).



## ***Background***

1. PNG is a country rich in natural resources that holds a diverse natural environment. It is a country that is experiencing a significant increase in the rate of economic development thanks to its natural resource base such as fisheries, mining, agro-forestry, petroleum and the gas industry. However, it is vital that these resources, both non-renewable and renewable, are managed sustainably for the interests of current and future generations. The well-being of the population depends heavily on these resources, not only because 85% of the population is dependent on the environment for their livelihoods and health, but also in terms of their contribution to the national economic growth, living standards and export earnings. As such, protecting the natural environment is an important part of an effective policy and management regime in PNG. When used properly, economic models and techniques can effectively integrate management of the environment and natural resources within national economic development policies and plans.

## ***Workshop Objectives***

2. The main objective of the workshop was to provide different options and choices facing PNG in terms of their natural resource use – between economic development, poverty reduction and sustaining the resource base for the country – by learning and using economic models and techniques.

The workshop was divided into two *streams* and offered the following:

### Policy Sessions

- Role of economic analysis in policy formulation and implementation;
- Role of renewable and non-renewable resources for economic growth;
- Climate change mitigation and adaptation issues globally and for PNG

### Technical Sessions

- Economics of natural resources, pollution control and climate;
- Economic valuation techniques and cost-benefit analysis;
- Modeling of economy-environment;
- Renewable and non-renewable sectors: forestry, fisheries, agriculture, water resources and minerals
- Process for applying for EEPSEA research grants

## ***Participants and Organizers***

3. The workshop was jointly organized by the Department of Environment and Conservation, United Nations Development Programme (UNDP)/United Nations Environment Programme (UNEP), and Economy and Environment Program for South East Asia (EEPSEA).
4. Key senior policy and technical officers from central and sectoral government agencies, academic and research institutions, private sector members, environmental NGOs and university students attended the workshop.

## ***Agenda***

5. The workshop consisted of nineteen sessions as listed below:
  - Session 1: Economics of Environmentally Sustainable Economic Growth: Introduction
  - Session 2: Causes and Solutions for Environment and Natural Resources Problems: Institutional, Policy and Market Incentives

- Session 3: Economic Valuation of the Environment
- Session 4: Break-out Discussion Groups – Key Institutional, Policy and Market Challenges in PNG and how they can be strengthened (water; marine; land and minerals; agriculture and forestry)
- Session 5A: Economics of Climate Change: Adaptation and Mitigation
- Session 6A: Economic Management of Non-renewable Resources (Land, Minerals, Energy)
- Session 7A: Economic Management of Renewable Resources (Forestry, Agriculture, Water)
- Session 8: Report back of break-out groups of Key Institutional, Policy and Market Challenges in PNG and how they can be strengthened (water; marine; land and minerals; agriculture and forestry)
- Session 9: Policy Conclusions and Recommendations
- Session 10: Applications of Cost Benefit Analysis and Economic Valuation Techniques I
- Session 11: Cost Benefit Analysis and Economic Valuation Techniques II
- Session 12: Macro/Multi-Sectoral/CGE Models for Development Planning I
- Session 13: Macro/Multi-Sectoral/CGE Models for Development Planning II
- Session 14: Economics of Renewable Resources – Modelling Fisheries
- Session 15: Economics of Water Resources
- Session 16: Economics Renewable Resources – Modelling Forestry
- Session 17: Economics of Non-Renewable Resource: Land and Minerals
- Session 18: Capacity-building in Environmental and Resource Economics: Research Opportunities with EEPSEA
- Session 19: Break-out discussion groups: Review of Economic Tools and Techniques and themes for possible EEPSEA research in PNG
- Report back – Themes for possible EEPSEA research projects

### ***Workshop proceedings***

#### **Session 1: Economics of Environmentally Sustainable Economic Growth: Introduction Discussant – Department of Treasury (Andrew Oaeke – General Economic Policy)**

6. A welcome speech was made by Dr. Wari Iamo, Secretary of DEC, followed by Jan-Jilles van der Hoeven, Deputy Resident Representative of UNDP, and David James, Resource Person for EEPSEA. Paul Steele, UNDP-RCB, presented an overview of economic concepts of sustainable development. He emphasized the need to properly manage both social and natural capital to meet the essential needs of today without compromising the needs of the future generations. In addition to safeguarding the capital stock, the same capital should be transformed into human capital in the form of schools and health care to ensure that benefits of natural capital are shared by the larger population. The challenges of MDG7 were also outlined, noting that some countries have identified their own MDG7 targets appropriate for their environment and environmental problems. Also highlighted during this session was the challenges PNG faced in having to make a policy decision on various options for its natural resource use – between economic development, poverty reductions and sustaining its resources base – and how to manage these options. In decision-making options, Paul offered an example of a country with a “resource curse” as opposed to a “resource blessing.” He warned that PNG should avoid the path of resource curse in which countries struggle for control over their abundant natural resources and provide raw natural resources as their majority export product. Instead, PNG needs to emulate countries like Botswana with a resource blessing by reinvesting natural capital back into the economy and into developing the human capital. Infrastructure development such as process plants was also identified as crucial for the economy to reduce dependence on exportation of raw materials. Sustainable Development Programme was provided as an example of reinvestment of natural resource revenues in the real event of revenue/resource depletion of OK Tedi mining.

## **Session 2: Causes and Solutions for Environment and Natural Resources Problems: Institutional, Policy and Market Incentives**

7. David James, Resource Person for EEPSEA, presented Session Two on the causes and solutions for environment and natural resource problems. The three main economic causes of environmental problems presented were market, policy and institutional failures. An example of a cause of environmental degradation is inappropriate pricing of natural resources including the under-valuation of such resources. Environmental externality such as mining contamination of rivers is often overlooked and is not taken into account in the full cost of mining operations. Such an example is regarded as a market failure. Other failures such as inappropriate policy interpretation of national economic accounts and under-valuation of environmental services like clean water and air are considered policy failures that generally would have negative impacts on the environment. Decision-makers need to realize that conventional national accounts do not take into consideration natural resource depletion, degradation and depreciation. This is particularly important to understand in order to avoid perverse incentives that contribute to environmental disaster. Appropriate pricing of natural resources can be effectively made by their access and usage and also by properly internalizing environmental and natural resource values. Regulation and taxation are ways to reduce some of the above-mentioned market failures. Institutional failures in terms of natural resource management occur when conflicting mandates are provided from different government agencies. This is often experienced in places that lack coordination in development planning and resource management while legal/regulatory systems for resource ownership and user rights remain inadequate and/or weak. Given such failures, the integration of environmental and natural resource considerations in economic development planning becomes crucial. Multi-agency coordination and activity is essential, to achieve environmentally sustainable economic growth.

A question was raised as to whether customary ownership of natural resources was considered the best option for natural resource management in PNG. This question was met with a response indicating that in addition to resource ownership and resource management, further examination on benefit sharing is needed to properly assess the most appropriate option for natural resource management in PNG. Also highlighted was the importance of understanding the different ways of assessing priority decisions without only simply applying and using monetary values as a decision-making tool given that the majority of the people depend on subsistence livelihoods as opposed to making monetary or financial transaction in PNG.

## **Session 3 - Economic Valuation of the Environment**

### **Discussant – Department of Environment and Conservation (Kelly Gawi – Deputy Secretary, Environmental Protection)**

8. Billy Manoka, Head of Economics, University of Papua New Guinea, gave a session presentation on economic valuation of the environment. Billy outlined the usefulness of placing monetary values on the environment while making environmental decision-making, cost-benefit analysis of new projects and regulation, natural resource damage assessment (NRDA), pricing assessment of environmental goods and bads and environmental accounting. Tropical rainforest benefits such as carbon sequestration was given as an example of a special valuation techniques where market prices are absent. The objective of an environmental economic valuation is to improve human well-being or welfare through an analysis of the benefit (any action that increases welfare) and cost (any action that decreases welfare) of natural resource use. The three main types of environmental economic valuations are direct use value, indirect use value and non-use value. For instance, forest land contains environmental economic valuations of the following: timber and medicine (direct use value), watershed protection and air pollution reduction (indirect use value) and cultural heritage (existence

value in non-use value). Market-based technique was provided as an example of environmental economic valuation technique to monetize physical impacts to the environment.

Given that PNG's environmental legislation does not fully internalize externalities, it is vital that environmental impact assessments are conducted with accurate science. Having a good baseline data will form the basis of good science and can assist in making future projections of the environment through the *with* and *without* scenarios in projects. For instance, when assessing pollution damage to fisheries, one can estimate in monetary value the cost of damage by using baseline data of the fish stock and estimating the quality and quantity of the fish stock *with* pollution and *without* pollution.

#### **Session 4: Break-out Discussion Groups – Key Institutional, Policy and Market Challenges in PNG and how they can be strengthened (water; marine; land and minerals; agriculture and forestry)**

9. The workshop participants were divided into four groups: water; marine; land and minerals; and agriculture and forestry to discuss the key institutional, policy and market challenges/failures in PNG and how they can be strengthened/solved. The groups reported their findings during Session 8: Report back of back break-out groups of Key Institutional, Policy and Market Challenges in PNG and how they can be strengthened (water; marine; land and minerals; agriculture and forestry). See summary of Session 8.

#### **Session 5A: Economics of Climate Change: Adaptation and Mitigation**

**Discussants – Office of Climate Change and Environmental Sustainability (Daniel Paita – Senior Program Officer, Socio-Economist), PNG Forest Authority (Goodwill Amos – Manager, Planning)**

10. David James, EEPSEA, and Paul Steele, UNDP-RCB, presented Session 5A on climate change. The first presentation made by David James offered explanations of global warming potential and the consequent environmental stressors such as increased drought, floods, soil erosion as well as sea level rise of climate change. Adverse impacts of climate change to health, coastal settlements and water resources were also highlighted. As an economic policy issue, climate change was described, among others, as an environmental externality and a failure of the market system that called for collaborative action and for adaptation and mitigation actions to be considered simultaneously. Prospects for mitigation were outlined, with options of structural economic change, new international trade policies and energy efficiency improvement. Furthermore, natural gas exports, biofuels and carbon sequestration were provided as opportunities for developing countries like PNG to benefit from global climate change mitigation schemes.

The second part of the presentation was on climate change adaptation and REDD options presented by Paul Steele, UNDP-RCB. As an introduction to his presentation, Paul gave details on the current financial crisis and the subsequent reduction of CO<sub>2</sub> emission as outputs are being reduced due to the above crisis. Reduction in CO<sub>2</sub> emissions can consequently have an impact on REDD price as global carbon prices have gone down given that there is less demand from developed countries to off-set their CO<sub>2</sub> emissions. Paul also described of a “Green New Deal” whereby many developed countries’ fiscal stimulus packages have a component of low carbon investment. Given the high coverage of tropical rainforest in the country, Reduced Emissions from Deforestation and Forest Degradation in Developing Countries (REDD) was offered as a cost-effective mitigation option for PNG (and also for the global community). REDD can also offer significant co-benefits such as biodiversity, ecosystem services and rural livelihoods. While potential REDD actions were explained at the local and national levels, barriers for effective REDD implementation such as limited access to markets/information and weak/undefined land tenure were also provided. Following the REDD presentation, climate change adaptation options were provided with an objective to further human and economic development that encompasses a future vision of risk. Both top down and bottom-up

approaches were given as examples to deal with the uncertainties of climate change. Paul warned that with so much focus on REDD in PNG, adaptation issues were not getting the attention that it required as PNG is highly vulnerable to the impacts of climate change.

#### **Session 6A: Economic Management of Non-renewable Resources (Land, Minerals, Energy)**

11. David James, EEPSEA, and Billy Manoka, Head of Economics, University of Papua New Guinea, presented Session Six on economic management of non-renewable resources. David commenced the presentation by sharing some theories of exhaustible resources and evidence of resource depletion that constitutes non-renewable resources. This was followed by examples of economic responses and resource availability of non-renewable resources. For instance, when prices of non-renewable resources rise, quantities demanded of them are reduced and resource substitution is encouraged as well as recovery, recycling and reuse of materials and products of the resources.

Billy presented a brief outline of PNG's mining/petroleum policy and the basic principles outlining the policy along with procedures in mining, government participation in mining and petroleum, fiscal arrangements in mining and distribution of royalties from mining. It was highlighted that some of the arrangements explained may be outdated such as the additional profit tax.

#### **Session 7A: Economic Management of Renewable Resources (Forestry, Fisheries, Agriculture, Water)**

**Discussants – National Fisheries Authority (Augustine Mobiha – Executive Manager, Fisheries Management), PNG Forest Authority (Goodwill Amos – Manager, Planning), Department of Environment and Conservation (Kay Kalim – Deputy Secretary, Environmental Sustainability)**

12. Paul Steele, UNDP-RCB, and Budy Resosudarmo, Australian National University, presented Session Seven on economic management of renewable resources. Paul presented his segment of the presentation on the economics and politics of natural resources and sustaining pro-poor growth for natural resource rich countries. He explained that in order to promote pro-poor growth, countries need to invest in value added industries of the natural resource sector (PNG canneries given as a case in example), limit subsidies on extraction activities, ensure poor themselves are not harmed by extraction activities and tax profits for pro-poor investments. Countries also need to develop the skills of the poor and provide them access to markets as well as rights to their natural resources. Papua New Guinea, like other rich natural resource based countries, is faced by hard choices over their natural resource use – whether to pursue economic growth, poverty reduction and/or sustain the resource base. However, natural growth can be promoted while sustaining the resource base through investment in the reduction of natural resources, diversification from natural resources dependence, finding incentives for sustaining resource base (e.g. REDD) and adopting new regulations and controls to maintain and sustain the resource base.

Budy presented his segment of the presentation on the principles of economic management of renewable resources. Basic resource utilization is categorized into conservation, conversion or production. In an ideal situation where sustainable production of resources take place and natural resources are sustained, protected and conserved, the ecological function is sustained and economic development will likely to occur. However, once over-extraction/illegal extraction, wrong practice and limited resource recovery activities come into the picture, the ecological function is depleted and economies will be faced with over-capacity of resource-based industries. These activities are often driven by a combination of economic, institutional/policy, technological, cultural/socio-political and/or demographic factors. One suggestion pointed out to alleviate this issue was the review of DEC's (and other agencies such as PNGFA and NFA) current user fees and the imposing of more

stringent penalties for pollution which should take account of some Cost Benefit Analysis when determining revised fees.



*Participants during the ESEG workshop.*

**Session 8: Report back of break-out groups of Key Institutional, Policy and Market Challenges in PNG and how they can be strengthened (water; marine; land and minerals; agriculture and forestry)**

**Session 9: Policy Conclusions and Recommendations**

13. Groups were asked to report on the break-out groups of water; marine; land and minerals; and agriculture and forestry. They were asked to present on the key institutional, policy and market challenges/failures and how they can be solved/strengthened in the PNG context. The presentation outcome is tabled below:

**Challenges to key institutional, policy and markets in PNG**

	<b>Water</b>	<b>Marine</b>	<b>Land and Minerals</b>	<b>Agriculture and Forestry</b>
<b>Institutional</b>	<ul style="list-style-type: none"> <li>• Weak institutional arrangements</li> <li>• Unclear water-owners</li> <li>• Constant changes in management and services</li> <li>• Mooting of National Water Authority</li> <li>• Unclear regional set-ups</li> <li>• Unplanned settlements</li> </ul>	<ul style="list-style-type: none"> <li>• Weak coordination between stakeholders, particularly the three levels of government</li> </ul>	<ul style="list-style-type: none"> <li>• No land registration and land ownership</li> <li>• Limited resource and capacity</li> </ul>	<ul style="list-style-type: none"> <li>• Lack of implementation (NADP)</li> <li>• Lack of monitoring of funds</li> <li>• Lack of environmental specialist within the sector (agriculture)</li> <li>• Funding constraints</li> <li>• Lack of coordination and consultation amongst key stakeholders</li> </ul>

<b>Policy</b>	<ul style="list-style-type: none"> <li>No national water policy</li> <li>Weak regulations</li> <li>Unclear environmental flows benefits</li> <li>Unclear regional patterns of seasons (rainfall) and weak catchment management (TCEM)</li> <li>No policy on underground waters</li> </ul>	<ul style="list-style-type: none"> <li>No policy to deal with pollution in major river-system</li> <li>No policy on deep sea mining</li> <li>Lack of baseline information</li> <li>Lack of certain fisheries management plan</li> <li>No marine policy/legislations</li> <li>Weak monitoring and enforcement of regulations</li> <li>Lack of capacity to enforce, develop policy and legislations</li> </ul>	<ul style="list-style-type: none"> <li>Lack of policy on land boundaries – including social mapping</li> <li>Weak benefit sharing agreement</li> <li>Limited resource and capacity</li> <li>Weak enforcement</li> <li>Lack of full valuation of land</li> </ul>	<ul style="list-style-type: none"> <li>No national land-use plan</li> <li>Lack of land utilization data</li> <li>Policy is in place but not fully implemented (forestry)</li> </ul>
<b>Market</b>	<ul style="list-style-type: none"> <li>Under-pricing in urban and industrial areas</li> <li>Poor infrastructure maintenance</li> </ul>	<ul style="list-style-type: none"> <li>Lack of consistency in pricing</li> <li>Stringent external market access requirement</li> <li>Lack of economies of scale</li> </ul>	<ul style="list-style-type: none"> <li>Over/under-valuation of land for investment purpose</li> </ul>	<ul style="list-style-type: none"> <li>No proper market infrastructure</li> <li>Lack of transportation network</li> <li>Limited value added work</li> <li>Under-pricing of ecosystem services</li> </ul>

### Solutions to key institutional, policy and markets in PNG

	<b>Water</b>	<b>Marine</b>	<b>Land and Minerals</b>	<b>Agriculture and Forestry</b>
<b>Solutions (institutional, policy and markets)</b>	<ul style="list-style-type: none"> <li>Increase charges/prices for industrial use to encourage recycling</li> <li>Invest in infrastructure and management</li> <li>Charge effluent</li> </ul>	<ul style="list-style-type: none"> <li>Better coordination in dealing with strategies</li> <li>Capacity development of skills</li> <li>Better access to markets – infrastructure development</li> </ul>	<ul style="list-style-type: none"> <li>Improved implementation, governance and political will</li> <li>Land registration</li> <li>Policy and institutional process to deliberate on land ownership</li> </ul>	<ul style="list-style-type: none"> <li>Develop value addition of natural resource through downstream processing</li> <li>Rehabilitation of transport network</li> <li>Develop better National Land-</li> </ul>

	<ul style="list-style-type: none"> <li>charges</li> <li>• Trade waste charges</li> <li>• Develop National Water Policy</li> <li>• Strengthen existing regulations on charges on water uses</li> <li>• Develop trade waste policy</li> <li>• Develop water quality standards</li> <li>• Strengthen institutional linkages</li> <li>• Establish National Water Authority</li> <li>• Enforce regulations to prosecute</li> <li>• Strengthen toxic waste and effluent discharges</li> <li>• Effective monitoring and enforcement of discharges</li> <li>• Establish national Environmental Protection Agency</li> </ul>	<ul style="list-style-type: none"> <li>• Research and development (scientific, policy and planning)</li> <li>• Political will/support for reversing failures</li> <li>• Address and implement policy, market and institutional failures</li> <li>• Harmonize existing laws concerning marine life</li> </ul>	<ul style="list-style-type: none"> <li>• A national land use plan</li> <li>• Implement environment bond</li> <li>• Effect additional profit tax</li> <li>• Legislate for environmental valuation</li> </ul>	<ul style="list-style-type: none"> <li>Use Plan</li> <li>• Establish better coordinated land utilization database</li> <li>• Improve coordination and consultation amongst stakeholders</li> <li>• Provide capacity development for officers</li> <li>• Develop state marketing agency for marketing logs/timber products</li> <li>• Support funding for PNGFA to implement the Forest Policy</li> </ul>
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## Session 10: Applications of Cost Benefit Analysis and Economic Valuation Techniques I

14. Billy Manoka, Head of Economics, University of Papua New Guinea, presented Session Ten on the applications of cost benefit analysis (CBA) and economic valuation techniques. CBA is a method for organizing information to assist in the decisions of resource allocation. The costs and benefits are expressed in monetary terms – whether financial or economic – and are valued in terms of the claims they make and the gains they provide to the community as a whole. Cost-benefit analysis is a useful tool framework to conduct economic appraisal of proposed projects. Financial analysis evaluates viability or profitability of individual entity or project and is mostly concerned with the financial internal rate of return whereas economic analysis makes adjustments to financial benefits and costs

and is more concerned with the maximization of public benefit. The latter also can integrate environmental valuation in its analysis and can better decide whether national resources will be used efficiently or not in a particular project. As a result, some projects may be financially viable but many not be economically desirable due to perverse environmental damages borne by the project being analyzed. CBA can be conducted before or after projects start. It should also be noted that CBA can be conducted on regulations such as water quality standards. During discussion of this session, problems of public accountability and procedures for conducting environmental impact assessments (EIAs) were highlighted. To improve accountability and transparency of EIAs, not only should EIA auditors and EIA manuals become public, but also suggested was the incorporation of economic analysis into environmental analysis such as the case described in New South Wales.

### **Session 11: Applications of Cost Benefit Analysis and Economic Valuation Techniques II**

15. Billy Manoka, Head of Economics, University of Papua New Guinea, gave a further presentation of the applications of cost benefit analysis in Session Eleven by providing a case study of alternative methods of pig waste disposal in Thailand. CBA was done for biogas, fish feed, fertilizer, deep pond and mixed biogas, fish feed and fertilizer with a consideration for external environmental damage costs such as pollution due to the pig waste and the consequent drop in the property value of the surrounding areas. In addition to CBA, sensitivity analysis was used an important tool for conducting risk analysis. In the above case study, the best case scenario for pig waste disposal was to sale electricity generated from biogas to Electricity Generating Authority of Thailand (EGAT).

When conducting CBA for REDD projects, it was suggested to do an analysis using *with* and *without* scenario method. For example, environmental damage cost avoided through *with* REDD scenario can be part of a REDD CBA study. It was also highlighted that publicly funded projects in PNG are typically required to undergo a CBA, monitored by the Department of National Planning and Monitoring.

### **Session 12: Macro/Multi-Sectoral/CGE Models for Development Planning I**

16. Budy Resosudarmo, Australian National University, presented Session Twelve on macro/multi-sectoral CGE models for development planning. Budy discussed the economic model and simulation model with more focus on the latter and the Input-Output Analysis. There are two simulation models namely the partial equilibrium analysis which looks at only one market ignoring other markets and having less data; and general equilibrium analysis which includes all the market in the economy. On the second part in regards to I-O analysis, even though it is complex and data-hungry it is a popular accounting framework that can be used to predict changes in the overall economic activity as a result of a change in the local economy. The I-O structure is made up of purchasers and suppliers who invariably influence each other.

### **Session 13: Macro/Multi-Sectoral/CGE Models for Development Planning II**

17. Budy Resosudarmo, Australian National University, presented Session Thirteen on macro/multi-sectoral CGE models for development planning with an emphasis on the Social Accounting Matrix (SAM) and Computable General Equilibrium (CGE) models. The SAM is an extension of the Input-Output (I-O) model that incorporates additional factors to the production sectors and presents a complete flow of resources for the whole economy. It is useful as it serves as a good database that shows the socio-economic structure of any economy thus provides a socio-economic structure and is an important and relatively simple application tool to describe economic policy impacts to household income. While CGE model basically incorporates the behavior of the agent in an economy and

profiles the behavior with mathematical equations, some weaknesses include time constraints, availability of good and quality data and that the model is based entirely price driven behavior of agents. Despite these it is based on a well developed theory as well as the effects that drive results are known and suitable for analysis of complex price driven policies.

#### **Session 14: Economics of Renewable Resources – Modelling Fisheries**

18. Budy Resosudarmo, Australian National University, presented Session Fourteen on the economics of fisheries. The importance of fishery was highlighted by its provision of direct and indirect employment to as many as 200 million people over the world and particularly to developing countries, namely in the Pacific. Fishery is a renewable resource with its stock capable of both growth as well as depletion depending on how it is managed. The two types of classification for fishery are capture fisheries and aquaculture/fish farming although capture fisheries are identified as more problematic since it is often seen as an open access resource where system or rules that govern its use are generally lacking. Moreover, due to fish's mobility, complex interactions among species and fragility to environmental shocks, fishery is generally characterized as a difficult sector to manage. The basic concept of fishery management is to see fish as a capital capable of yielding stream of economic return through time. Thus, if as an investment, fishing was sacrificed today fish stock can be expected to increase tomorrow. The goal of fisheries should be to reexamine its open access harvest time path and changing it to maximum economic yield harvest time path whereby input restriction is used in fishing effort to control inefficiency and over-fishing. Although not without problems, total allowable quota (TAC) and individual transferable quota (ITQ) were presented as instruments to control fish harvest. Other instruments are community based fisheries management, fisher cooperative, marine protected areas as well as taxes to control fish harvest. The challenge to taxes is capturing the optimal tax size as low tax would fail to conserve fish stock while high tax may reduce the outputs too much and thereby leading to potential gains from fishery utilization being lost.

#### **Session 15: Economics of Water Resources**

19. Budy Resosudarmo, Australian National University, presented Session Fifteen on the economics of water resources. Similar to fishery, water is a renewable resource that can be reused indefinitely if not severely polluted. Water is replenishable, meaning, it is continually transferred between the atmosphere, rivers, lakes and the oceans in a process known as water recycle. At the same, underground aquifers and fossil water are also considered depletable resources; hence, the analysis of water management should combine both elements of renewable and nonrenewable resource theory. Three major sectors of water use are for agriculture, industry and domestic uses with agriculture currently the biggest consumer although demand for water is also growing with industrialization and urbanization in developing countries. Uneven distribution of natural water supply across regions, water stock depletion as a result of increasing demand, water quality impairment in industries, use of environment as sink for water wastes and the common property problem of water are identified as problems in water management. Developing appropriate policies can contribute to effective water supply and demand management. For instance, public campaign can be an effective tool to conserve water while new technology can increase the supply of water through reduced environmental flows and leakage. It is perhaps important to take note that water industry is predominately run under public ownership as it is widely viewed as a social necessity. Such public ownership of water can at times become economically unviable, limiting new investment and contributing to low maintenance of the water supply. As an alternative, privatization may provide greater incentive to water company to operate efficiently and reduce political interference. However, with privatization of water, there are strong concerns on affordability of water, particularly for the poor, and possibility of key assets falling to foreign ownership.

## **Session 16: Economics of Renewable Resources – Modelling Forestry**

20. David James, EEPSEA, and Billy Manoka, Head of Economics, University of Papua New Guinea, presented Session Sixteen on the economics of forestry. David presented the various economic values of forests – from timber production, recreation, biodiversity conservation, catchment protection to carbon sequestration. Specifically on timber production, costs of land, planning management and harvesting as well as growth characteristics of forest, species selection, distance from markets, government regulations, taxes and/or subsidies, among others, were given as examples of factors affecting economics of forestry. In terms of forest management, options for conservation reserves, production forests, sustained yields, plantations, calculation of stumpage values and royalties, value-adding processes, woodchips/sawlogs, pulpmills/fibre boards as outlets for product and carbon sequestration were identified. Budy presented his segment of the presentation on the economics of forestry in the PNG context. It was noted that the forestry sector in the country has difficulties in effectively managing the forest as funding is too scarce to effectively monitor the industry. David reinforced the importance of having proper baseline data and inventory to conduct economic assessment of virgin rainforests to facilitate decision-making.

## **Session 17: Economics of Non-Renewable Resources: Land and Minerals**

21. David James, EEPSEA, and Billy Manoka, Head of Economics, University of Papua New Guinea, presented Session Seventeen on the economics of land and minerals. David presented a case of the Shoalwater Bay Military Training Area in Australia where assessments of mineral potential and value was conducted. The assessment examined the following four scenario options for the above training area: 1) full and unrestricted use of the total training area by defense (no mining); 2) sand mining; 3) unrestricted mining; or 4) vacate the training area. Economic analysis was conducted in the assessment. Another example offered by David was the Fraser Island where a non-renewable resource base was converted into a sustainable economic resource. Following the mining closure, the Island became a popular tourism area. Billy provided an insight into the mining and petroleum operations in PNG. His presentation focused on the need for furthering land reform in PNG as land is kept underutilized under PNG's customary ownership.

## **Session 18: Capacity-building in Environmental and Resource Economics: Research Opportunities with EEPSEA**

22. David James, EEPSEA, presented Session Eighteen on research opportunities with EEPSEA. David explained the objectives and structure of EEPSEA and the procedures for applying for EEPSEA research grants as well as covering some of the issues/topics commonly studied in EEPSEA projects. An in-depth proposal preparation for EEPSEA was provided by David.

## **Session 19: Break-out discussion groups: Review of Economic Tools and Techniques and themes for possible EEPSEA research in PNG**

23. Workshop participants were asked to get into the four groups that were formed for the earlier break-out discussion groups to identify themes for possible EEPSEA research grants for PNG. The themes are presented below:

<b>Water</b>	<b>Marine</b>	<b>Land and Minerals</b>	<b>Agriculture and Forestry</b>
Categories of water uses • Clearly identifying categories of water	Sustainable inter-generational equitable livelihoods: economic,	Land pricing model	• Economics of protected areas in PNG's climate

<p>uses</p> <ul style="list-style-type: none"> <li>• On-stream and off-stream uses (issues of water pricing)</li> <li>• Monitoring user activities and pollution</li> <li>• Water quality standard criteria needs review</li> <li>• Emphasize policy linkage to water uses</li> <li>• Integrated water catchment study</li> <li>• Social issues: water ownership</li> <li>• Lost opportunities</li> <li>• Economic cost of bottling water</li> <li>• Water transfer (inter-provincial, regional and international)</li> <li>• Biological indicators of water quality</li> </ul>	<p>environment and ethical</p>		<p>change policy and REDD</p> <ul style="list-style-type: none"> <li>• Need for national land use plan in forestry</li> <li>• Case study on logging concession</li> <li>• Economic analysis of protected areas</li> <li>• CBA on oil palm</li> <li>• CBA on reforestation</li> <li>• CBR of REDD with conventional logging</li> </ul>
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*Dr. Billy Manoka of University of Papua New Guinea presented on Economic Valuation of the Environment, Economic Management of Non-Renewable Resources, Applications of Cost Benefit Analysis and Economic Valuation Techniques I and II, Economics of Renewable Resources – Modelling Forestry and Economics of Non-Renewable Resources.*



## Next Steps

24. The organizers agreed to support and follow-up recommended actions through the collaborative efforts of stakeholders especially partnership agencies in specific resource sectors in achieving environmentally sustainable economic growth in Papua New Guinea. Workshop participants were encouraged to contribute ideas and recommendations to support the Department's initiative to move forward its ESEG agenda effectively. Based on the feedback received from the participants, it was apparent that further environmental economics training was needed to effectively inform policymaking on PNG's economy and environmental matters. In light of additional capacity development needs in the field of environmental economics, DEC will identify appropriate training programme and institutions to conduct further training courses on the use of environmental economics tools and methods to inform policymaking.

Workshop organizers and participants agreed there are many common growth and environmental issues and common market, policy and institutional-based problems for which viable recommendations and solutions are available, yet difficult to properly and effectively implement. Solutions include appropriate pricing, raising revenues for the environment and institutional reforms to improve coordination for environmental issues that extend across different agencies. It was emphasized that stronger links between the relevant agencies are vital as most of the objectives of the ESEG initiative are multi-sectoral. Other strategies aimed at adapting to and mitigating climate change mechanisms such as REDD and CDM will require international cooperation. There is also a need to promote partnership and a need to continue dialogue and cooperation between DEC and central government agencies such as Planning, Finance and Treasury regarding environmental fiscal reforms. Workshop participants agreed that economics is an important tool for assessing the current status of the environment in such a way as to advance pro-poor environmental management.

With the momentum gained from this workshop and DEC's desire to promote further use of economics in its policy, it is expected that DEC will be making a cabinet submission of the ESEG framework by third-quarter of 2009. In addition, DEC aims to review and raise license fees and other environmental charges to increase penalties on polluters as well as to improve self-financing of the Department. Nonetheless, DEC's ultimate goal will be to help Papua New Guinea achieve environmentally sustainable economic growth through the use of environmental economics in decision-making.