• Logging history:
  1) Traditional logging before 1920
  2) Large logging area under Forest Agency
     (Production forest = 25,068 ha (65% of the whole island area))

• Conservation history:
  1) National Park (including in Kirishima National Park) (18,738 ha)
  2) Establishment of Wilderness area (1,219 ha)
  3) World Heritage Site (10,747 ha)

• Number of visitors:
  1970's = 28,000
  1980's = 60,000
  1995 = 157,000 (including climber of mountain = 20,000)

• Sociological issue
  1) Low income of local people comparing with other area
  2) Increase of elder people
  3) Overuse the national park and visitor facilities in peak season

Value as World Heritage Site
• Unique ecosystem of the island (from coast to sub alpine zone in semi tropical area)
• Yakusugi = old big cedar forest
• Diversified plan formation on altitudinal environmental cline
• Landscape of granite raised island

Yakushima Culture Village master plan (1991)
• Concept: Coexistence of human life and nature
• Zoning plan
  1) Conservation zone (core area of the island)
  2) Tourism zone
  3) Village zone (community use area)

Focused value and method applied for environmental valuing
The following methods were applied for environmental valuation of Yakushima.

<table>
<thead>
<tr>
<th>Focused value</th>
<th>Example</th>
<th>Method applied for evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct value</td>
<td>Forest production</td>
<td>Market value (land price)</td>
</tr>
<tr>
<td>Indirect value</td>
<td>Recreation, watershed</td>
<td>Replacement cost method</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Travel cost method CVM</td>
</tr>
<tr>
<td>Option value</td>
<td>Recreation in future</td>
<td>CVM</td>
</tr>
<tr>
<td>Bequest value</td>
<td>Conservation for feature</td>
<td>CVM</td>
</tr>
<tr>
<td></td>
<td>generation</td>
<td></td>
</tr>
<tr>
<td>Existing value</td>
<td>Biodiversity, ecosystem</td>
<td>CVM</td>
</tr>
</tbody>
</table>
These methods are based on two major assumptions for valuing.
Revealed preference: Estimation of environmental value by economic activity
   (Example: travel cost method)
Stated preference: Estimation of environmental value by ‘contingent valuation method’ (CVM)

**Valuing of Yakushima**

Three methods are applied for environmental valuation of Yakushima
1. Market value method (Land value and forest resource value)
2. Travel cost method
3. Contingent valuation method (CVM)

(1) Market value method (Land value and forest resource value)

   Forest Agency estimated the value of forest land and forest resources

   ➢ Forest land value: 45.0 billion yen (RM1.5 billion)
   ➢ Forest resource value: 127.0 billion yen (RM4.2 billion)

(2) Travel cost method = recreation valuation (replacement cost method)

   Valuation by travel cost to recreation site including opportunity cost (estimate from average wages used for travel)
Assumption: Number of visiting are determined by 1) travel cost, 2) tourism resources, and 3) income of travelers. If the travel cost is lower, the number of visiting will increase. There is an inverse relationship between travel cost and number of visiting. Higher tourism value is associated with lower travel cost.

Conclusion of travel cost valuation:

- Annual valuation: 3.68 – 9.92 billion yen/year (RM123 - 331 million/year)
  (24,500 – 66,100 yen/person)
- Current valuation: 92.0 – 248.0 billion yen (RM3.06 – 8.27 billion)

(3) Contingent valuation method (CVM)

Questionnaire (main point) (interview method; N=1200)
- Explain present situation of Yakushima
- Question about conservation policy for Yakushima (Yes/No/Unknown)
- Prepare two scenarios; 1) strong scenario = conservation of core area + buffer zone
  2) weak scenario = conservation of only core area
- Question about payment will for conservation
  Do you agree to pay ----- yen from your family budget for conservation of Yakushima in next year?
- Results

<table>
<thead>
<tr>
<th></th>
<th>Strong scenario</th>
<th>Weak scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Raw data</td>
<td>Revision</td>
</tr>
<tr>
<td></td>
<td>Raw data</td>
<td>Revision</td>
</tr>
<tr>
<td>Median (yen/family)</td>
<td>1,284</td>
<td>1,566</td>
</tr>
<tr>
<td>Average (yen/family)</td>
<td>6,626</td>
<td>5,655</td>
</tr>
</tbody>
</table>

Beneficiary: Whole Japan

Total valuation = average will of payment per family number of family in Japan

<table>
<thead>
<tr>
<th></th>
<th>Strong scenario</th>
<th>Weak scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>66.8 billion yen</td>
<td>29.3 billion yen</td>
</tr>
<tr>
<td>Average</td>
<td>248.3 billion yen</td>
<td>151.1 billion yen</td>
</tr>
</tbody>
</table>
(7) Others

Trading environmental permits (green gas reduction)
Joint implementation for reduction of green house effect gas was proposed in the ‘United Nations Framework Conservation on Climate Change’. Developing countries have many emission sources of the green house gas (GHG) which will be reduced cost-benefit effectively by introducing technology and fund through the joint implementations (JI) of the developing countries and developed countries. Several countries introduce the joint implementation mechanism to reduce the green house effect gases.

Japan Programme for Activities Implemented Jointly (AIJ) Under the Pilot Phase started in 1996 recognizing green house gas emission reduction goal as set out in the 1990 “Action Programme to Arrest Global Warming”.

Objectives of the Japan Programme for AIJ are;
1. to accumulate experience in order to contribute to the deliberative work for the formation of an international framework of JI to be implemented in the future,
2. to establish a methodology for measuring, in a comprehensive manner, net reduction or absorptions in GHG emissions to be achieved by JI,
3. to formulate steps to encourage the private sector to participate in future JI projects.

Eligibility of AIJ Participants are
- Domestic participants; Corporations, National/local governments, other recognized
- Foreign participants; National/local government, Corporations, Others belonging to the above countries

Example of JI
- Introduction of energy save / alternative energy technology
- Collection of methane gas from waste of animal husbandry
- Plantation (absorption of CO2)

Monitoring will be conducted comparing baseline data (not introduced JI) and data after implementing JI (Table 7-2)

<table>
<thead>
<tr>
<th>Item</th>
<th>Target gas</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline data</td>
<td>CO₂</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Joint Implementation</td>
<td>CO₂</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other GHG</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Lifecycle assessment of products

Lifecycle Assessment (LCA) is an all-encompassing appraisal method for determining a product's environmental impact through all phases of production, consumption, and final disposal. LCA provides procedures for critical environmental evaluations of raw material procurement methods, production, transportation, product use, and disposal. (Quality of the Environment in Japan 1994)
Table 7-2 Sample List of Collected Data on lifecycle assessment of products (Source: Environment Agency)

<table>
<thead>
<tr>
<th>Category samples</th>
<th>Process samples</th>
<th>Resource procurement</th>
<th>Raw material production</th>
<th>Production and processing</th>
<th>Distribution and sales</th>
<th>Consumption and use</th>
<th>Recycling</th>
<th>Waste</th>
<th>Transport</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air pollutants</td>
<td>NO₂ g</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SO₂ g</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>CO g</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Particulate g</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water pollutants</td>
<td>BOD g</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>COD g</td>
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<td></td>
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<tr>
<td></td>
<td>SS g</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy</td>
<td>KWh</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resources</td>
<td>Kg</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solid waste</td>
<td>Kg</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Fig. 7-3 Sample Analysis of Collected Data (Source: Environment Agency)

4. Conclusion

- Environmental economics is not a fictional assessment
- Useful tool for decision maker, executives and people
- But, assessment of existence (intrinsic) causes controversy
- Suggestion for Sabah
  1) State green accounting
  2) Environmental report by companies and governmental agencies
  3) Introduction of CVM for test survey of protected areas
  4) Tax system / recycle deposit system for waste control (example; plastic bag tax)
  5) Consideration to activities implemented jointly (FIJ) for green house gas reduction

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Valuing environmental entities and taking into account in development policies

Environmental economics are seeking to expand principal that natural systems are multifunctional assets that environment provides humans economically variable functions and services

1. Natural Resources
2. Waste assimilation capacity
3. Life support system

Accounting and valuing of nature and environment

What is environmental economics?
- Valuing environmental entities and taking into account in development policies
- Environmental economics are seeking to expand principal that natural systems are multifunctional assets that environment provides humans economically variable functions and services

Background and History of EE
- To account natural resource consumption in GDP
- To evaluate monetary value of ‘non-market goods’
- To estimate ‘instinct value’
- To justify conservation

Natural Resource Management and Environmental Economics

Research (Science) Management Plan (Policy / Implementation)

Resource Management

Account / Valuing (Economic method)

Environmental Economics (EE)

Topics
1. Definition and History
2. Methodology
   1) Green accounting (auditing)
   2) Assessment of ecosystem services value
   3) Environmental report of enterprise / company
   4) Polluter Pays Principle and Green tax
   5) CVM (Contingent Value Method)
3. Variation of EE
   1) Joint Implementation for reduction of GHG
   2) Life cycle energy and material consumption
4. Conclusion

Environmental Economics (EE)

Topics
1. Definition and History
2. Methodology
   1) Green accounting (auditing)
   2) Assessment of ecosystem services value
   3) Environmental report of enterprise / company
   4) Polluter Pays Principle and Green tax
   5) CVM (Contingent Value Method)
3. Variation of EE
   1) Joint Implementation for reduction of GHG
   2) Life cycle energy and material consumption
4. Conclusion
1. Green accounting

**Background**
- GDP does not include cost for pollution control and unsustainable resource use (negative account of GDP)
- Why not account?:
  1. Non-ownership property (example: air, water)
  2. Non-market valuing (example: landscape)

**Method**
1. Accounting cost for pollution control / management
2. Energy consumption and greenhouse gas accounting
3. Resource account (forest, minerals, fish, soil)

---

Green accounting (continue 1)

**Example - Netherlands**
Focusing on 1) national account (revenue and expenditure)
2) air pollution (acid rain issue)

<table>
<thead>
<tr>
<th>Sector</th>
<th>National Account</th>
<th>Air Pollution</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Revenue</td>
<td>Expenditure</td>
</tr>
<tr>
<td>Mining</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Agriculture</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>

*12 sectors

---

Green accounting (continue 2)

**Example - Germany**
Focusing on material flow and energy
1) input into production
2) output produced
3) ancillary materials for output
4) hidden flow (soil excavated volume, so on)

<table>
<thead>
<tr>
<th>Sector</th>
<th>Input</th>
<th>Output</th>
<th>Ancillary material</th>
<th>Hidden flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mining</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Agriculture</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Industry</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>

---

Green accounting (continue 3)

**Example - Philippines**
Start: in 1991 by USAID support
Focusing
1) Resource account
   Forest, minerals, fish, oil
2) Cost of pollution control (air and water)

<table>
<thead>
<tr>
<th>Sector</th>
<th>Resource Output (consumption)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Forest</td>
</tr>
<tr>
<td></td>
<td>Minerals</td>
</tr>
<tr>
<td></td>
<td>Fish</td>
</tr>
</tbody>
</table>

---

2. Ecosystem service value

**Methods**
Valuing of ecosystem by
1) material flow and products
2) function evaluation by alternative industrial technology (sewage disposal, so on)

<table>
<thead>
<tr>
<th>Ecosystem</th>
<th>Area (million ha)</th>
<th>Food * Material flow</th>
<th>Purify *</th>
<th>Total value (Trillion$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>332</td>
<td>15</td>
<td>118</td>
<td>unknown</td>
<td>8.38</td>
</tr>
<tr>
<td>1.8</td>
<td>521</td>
<td>21110</td>
<td>unknown</td>
<td>4.11</td>
</tr>
<tr>
<td>19</td>
<td>32</td>
<td>922</td>
<td>87</td>
<td>3.81</td>
</tr>
</tbody>
</table>

* US$ per year per ha (Source: Costanza et al., 1997)
3. Environmental report of enterprise/company

**Objectives of reports**
- to publish environmental management policy
- to inform energy and material flow
- to report environmental management cost and benefit

**Type of reports**

<table>
<thead>
<tr>
<th>Report type</th>
<th>Internal report</th>
<th>Exterior report</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target</td>
<td>Executives</td>
<td>Investors, consumers</td>
</tr>
<tr>
<td>Objectives</td>
<td>Cost-benefit analysis</td>
<td>Publishing environmental measures</td>
</tr>
</tbody>
</table>

---

4. Polluter Pays Principle and Green tax

**PPP (Polluter Pays Principle)**

External cost of environmental management caused by unsuitable activities of enterprises should be changed to interior cost of the enterprises (OECD).

\[ \text{PPT} = \text{Interiorize-able cost caused by specified person / enterprise} \]

\[ \text{External cost caused by unspecified person / enterprise} \rightarrow \text{Need other mechanism} = \text{Green tax} \]

---

5. CVM (Contingent Value Method)

**What is CVM?**

- CVM (Contingent Valuation Method) is a method for valuing non-market goods by WTP (Willingness to Pay)

**WTP and WTA**
- Valuing non-marketing goods can be evaluated by willingness to pay (WTP)
- Demand for loss of non-marketing goods can be measured by compensation for the loss = Willingness to accept (WTA)
CVM (continue)

Methodology =
Questionnaire of WTP

1. Free answer: How much can you pay for conservation of lower Segama?
2. Price offered (bidding game): Will you pay RM50 for conservation of lower Segama? Yes/No; How about RM50 payment? Yes / No (too expensive), Yes/No (annoying)
3. Multiple payment choice: How much you can pay for conservation of...? Please select one: RM20, RM50, RM100
4. Choice between two things (Yes/No) (take-it-or-leave-it approach with follow-up)

CVM: Example - Yakushima Island (1)

Background information
- Yakusima: 54,000 ha island in southern part of Japan
- Population: 1960/24,010, 1990/13,594
- Nature: Granite raised island (summit = 1980 m)
- Lot of rainfall: >7,000mm/year in mountain area
- Biodiversity: Forest cover = 89%, Yakusugi = old aged cedar (oldest tree; >7000 years old)
- Number of visitor: 157,000 (1995)

CVM: Example - Yakushima (2)

Three methods applied for valuing of Yakushima
1. Market value method (land value and forest resources)
2. Travel cost method
3. CVM (Contingent Valuing Method)

Yakushima: Travel cost method

Assumption
- Valuing of target area can be evaluated by travel cost of visitors
- If the target area has high value, the visitor pay more money and more visiting times

Relationship among tourism value, travel cost and number of visitor

CVM: Example - Yakushima (3)

Flowchart of questionnaires for CVM
1. Knowledge on Yakushima
2. Experience in Yakushima
3. Explanation of issue for conservation of Yakushima
4. Explanation of conservation policy
5. Question on WTP (willingness to pay)
6. Understanding of scenario
7. Question on concerning on Yakushima
8. Personal information

1-4: Introduction, 5-7: checking reliability of answer from interviewee

CVM: Example - Yakushima (4)

Design of WTP
- Strong scenario: Conservation plan establishment buffer zone
- Weak scenario: Conservation plan without buffer zone (core zone only)

Conservation level
- Strong scenario
- Weak scenario
Presentation situation = weak scenario
Cost (WTP)
CVM: Example Yakushima (5)

Conclusion of valuing of Yakushima

| Market value | Land value | 45.0 billion yen |
| Travel cost | Annual valuing | 3.7-9.9 billion yen |
| CVM | Strong scenario | 248.3 billion yen |

(WTP=3,441 yen/family)

- CVM: Contingent Value Method
- WTP: Average WTP/family x total number of family in Japan (43.9 million)

Environmental Economics (EE)

Topics

1. Definition and History
2. Methodology
   - 1) Green accounting (auditing)
   - 2) Assessment of ecosystem services value
   - 3) Environmental report of enterprise / company
   - 4) Polluter Pays Principle and Green tax
   - 5) CVM (Contingent Value Method)

3. Variation of EE
   - 1) Joint Implementation for reduction of GHG
   - 2) Life cycle energy and material consumption

4. Conclusion

Variation of Environmental Economics

(1) Joint Implementation for reduction of GHG

Objectives and background
- Reduction of green house gas (GHG) emission is a global issue
- Much source of GHG emission exists in developed countries
- Developing countries have also many emission source of GHG which will be reduced cost-benefit effectively by introducing technology and fund through the joint implementations (JI) with the developed countries

Example of JI for GHG Reduction
- Introduction of energy save / alternative energy technology
- Bio-gas technology (example: methane gas use from waste of animal husbandry)
- Plantation (absorption of CO2)

Monitoring table of JI (Example)

<table>
<thead>
<tr>
<th>Year</th>
<th>Baseline data</th>
<th>CO2</th>
<th>Other GHG</th>
<th>After Joint Implementation</th>
<th>Other GHG</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2003</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2004</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(2) Lifecycle assessment of energy and material consumption

Lifecycle assessment of products

Lifecycle Assessment (LCA) is an all-encompassing method for determining a product’s environmental impact through all phase of production, consumption and final disposal (Quality of Environment in Japan 1994).
Conclusion

1. Environmental economics is not a 'fictional assessment'.
2. Useful tool for decision maker, executives and people.
3. But, assessment of existence (intrinsic) value is not so easy.
4. Suggestion for Sabah:
   1) Start the State green accounting
   2) Environmental report by enterprises / companies
   3) Introduce of CVM for assessment of protected areas
   4) Green tax system / recycle deposit system for waste control.
   5) Consideration to activities implemented jointly (AIJ) for green house gas (GHG)

Thank You
ASSESSING THE POTENTIAL OF NATURE TOURISM AT KLIAS AND BINSULOK, SABAH

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Nature tourism has become the main stream of tourism industry in Sabah. The objectives of this study are to evaluate and assess the products of tourism and the potential negative impacts on environment, study on local communities and relevant agencies perception on nature tourism and purpose a framework for the tourism-environment relationship. Generally, the people of Klias and Binsulok have poor perception on nature tourism due to lack of information of the industry. Therefore, awareness of nature tourism ideas must be generated because it can preserve or improve the quality of life and natural resources. Study component comprises field observations and inventory, interview and survey questionnaires and cost-benefit analyses including carrying capacity measurements. Expected outputs from the study are:

1. Assessment of list of products of nature tourism and facilities available at the study area.
2. Assessment of potential impacts of tourism to environment.
3. Cost and benefit analyses of products and facilities available at the study area.
4. Recommendation on the management of nature tourism in the KPSFR and its surrounding areas based on marketing value and cost-benefit analyses.
5. Publication of research project in related journals and conferences.

Date of Presentation
18th March 2004
ASSESSING THE POTENTIAL OF NATURE TOURISM AT KLIAS AND BINSULOK, SABAH

by

NOORAINI @ SUNARTI BINTI MAKALADIN
ITBC, UMS

INTRODUCTION

- SEA – fastest growing destinations (Wong, 1998)
- Nature tourism – main stream (Maryati et. al., 2000)
- Sustainable development
- Improve management of natural resources

JUSTIFICATION

- Lack of information of tourism industry (Maryati et. al., 2000)
- Create awareness of nature tourism ideas among local communities
- Preserve and improve
- Increased local revenues

OBJECTIVE

- Products of tourism and study on perceptions of nature tourism
- Assess the potential negative impacts
- Propose a framework

STUDY SCOPE

METHODOLOGY

- Field observations and inventory
  Outputs: products and facilities
- Interview and survey questionnaires
  Analyzed – statistical packages
- Carrying capacity measurements (Davison & Regis, 1997)
  Carrying capacity = Area (m²) used by the visitor
  Average visitor
  The total of permissible daily visits:
  Total daily visits = Carrying capacity X Rotation factor
  Rotation factor = Total time area open for visitor
  Average visits time
To measure the impact of tourism:

1. **Flora** (Smith, 1990)
   - Dominancy (coverage) = \( \frac{\text{Number of points with genus } A}{\text{Total number of points}} \times 100 \)
   - Frequency = \( \frac{\text{Number of frames with genus } A}{\text{Total number of frames with any genus}} \times 100 \)

2. **Fauna** (Smith, 1990)
   - Density = \( \frac{N}{2L(D'\sinh)} \)

**Cost-benefit analysis (Bann, 1995)**

<table>
<thead>
<tr>
<th>Cost</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct costs</td>
<td>Direct economic benefits</td>
</tr>
<tr>
<td>External costs</td>
<td>Non-economic benefits</td>
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<td>Opportunity cost</td>
<td>External production benefits</td>
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<tr>
<td>Ecological costs</td>
<td>Provision of educational and scientific opportunities</td>
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<tr>
<td>Social costs</td>
<td>Provision of social values relating to conservation and biological diversity</td>
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<tr>
<td>Congestion costs</td>
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**EXPECTED OUTPUT**

- Report on assessment of the marketing value
- List of tourism products and facilities available
- Locals and relevant agencies perception on nature tourism
- Recommendation on the management
- Publication

**WORK SCHEDULE**

<table>
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<tr>
<th>Month</th>
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**REFERENCES**


FROM $\alpha$-LACTAMS AND CONDUCTING POLYMERS TO ADVANCING BIODIVERSITY

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e-mail: mashitah@ums.edu.my

SYNOPSIS

While $\beta$-lactams were more popular, $\alpha$-lactams nevertheless provided the necessary chemical challenge to countless chemists starting with Sheehan to Talaty, Quast and then Hoffman. Talaty and I later showed that $\alpha$-lactams undergo acyl-nitrogen cleavage with stronger, unhindered nitrogen nucleophiles whereas sterically hindered, weaker ones favor scission of the alkyl-nitrogen bond. Aprotic oxygen and sulfur nucleophiles, however, show exception to the rule with alcohols favoring alkyl-nitrogen cleavage. Similarly in the case of protic, ionic nucleophiles, soft nucleophiles such as iodide attacks the soft alkyl carbon while hard nucleophiles like alkoxides attack the harder acyl carbon. $\alpha$-Lactams were synthesized for the first time at room temperature and conditions in our laboratories.

At around this time, Chu was actively engaged in conducting ceramics, Smalley was synthesizing his soccerball-shaped carbon molecules and Drexler spoke eloquently about self-assembling molecules that could someday conduct repairs to ruptured blood vessels in vivo. It was the dawn of superconductors, buckminsterfullerenes and nanotechnology. My attention turned toward syntheses of systems exhibiting extensive transannular $\pi$-electronic interactions such as the organometallic multidecker ferrocenophane polymers which are semiconducting. Multidecker ferrocenophane polymers were constructed from cyclopentadieno-, furano-, pyrrolo-, and thienophanes.

Then, upon availability of the steroid, androstenedione, my work then shifted to incorporating the cyclophosphamidate into the A ring of the steroid to target estrogenic receptors. Cyclophosphamidate or Cytoxan® was synthesized based on the toxic war gas, nitrogen mustard. It was known then as a non-selective chemotherapy drug and like nitrogen mustard, its action is based on its alkylating property.
In more recent times, my research is centered on advancing biodiversity resources. Through multidisciplinary and multiinstitutional collaboration nationally, for example, biotechnology research on the indigenous medicinal herb, *Labisia pumila* had reached the critical Clinical Trial Phase II. Fundamental researches in gaining greater understanding of co-evolutionary adaptation of species of the tropical rainforest are also accorded emphasis and are on-going.
From $\alpha$-lactams and conducting polymers to advancing biodiversity

AZIRIDINONES OR $\alpha$-LACTAM

Summary of Topics

Previous work (1985-1998)
- Aziridinones
- Cyclophanes
- Cyclophosphamidyl steroid

- Ecological-related projects

All research endeavour found to benefit from rigorous undergraduate training in physical organic chemistry

Synthesis of Substituted Aziridinones

Modes of Nucleophilic Ring Opening

Selectivity in Ring Opening

$\alpha$-Lactams (aziridinones) shown to undergo alkyl-hydrogen cleavage with stronger, unhindered nitrogen nucleophiles whereas sterically hindered, weaker ones favor scission of the alkyl-hydrogen bond.

Aprotic oxygen and sulfur nucleophiles, however, show exception to the rule. The aprotic favor alkyl-nitrogen cleavage.

Similarly in the case of proton, ionic nucleophiles, soft nucleophiles such as iodide attacks the soft allyl carbon. Hard nucleophiles like acetate attack the harder allyl carbon.

Of reports, ionic, aprotic NMe2 favors exclusively alkyl-dihydrogen bond and that nonionic proton nucleophiles rupture the alkyl-nitrogen bond.
- Great synthetic utility!
Cyclophane Chemistry

Sandwich Compounds: The Case of Ferrocene

- Transannular π-electronic interactions between two aromatic layers
- Constructing a system exhibiting even more extensive transannular π-electronic interactions
- Such multinuclear complexes/polymer – "electron reservoirs" – store and transfer electrons stoichiometrically or catalytically

Measure of Conductivity

Excellent Conductors

- zero band gaps

Insulators

- large band gaps

Semiconductors

- energy gap is in between a conductor and an insulator

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>EXAMPLES</th>
<th>CONDUCTIVITY (dimension)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical Conductors</td>
<td>TCNO</td>
<td>103</td>
</tr>
<tr>
<td>Semiconductors</td>
<td>Polyethylene</td>
<td>20,000</td>
</tr>
<tr>
<td>Conductors</td>
<td>Copper</td>
<td>6.000, 500</td>
</tr>
</tbody>
</table>

Proposed multinuclear complex/polymer have a system of extended alternating double bonds

Schemes of Step-by-Step Synthesis of Novel Multidecker Sandwiches
Multidecker sandwich complexes are suitable candidates for molecular switches.

A prelude to what is **NANOTECHNOLOGY**

**RECENT ADVANCES IN PHANE CHEMISTRY**

- Nanotubes
- Self-assembling molecular machines

**CYCLOPHOSPHAMIDE**
Trade Name(s): Cytoxan

Systematic Name: \( \text{N,N-bis(2-chloroethyl)tetrahydro-2m-1,3,2-oxidaphosphorin-2-amine,2-oxide} \)

Type of Drug: Cyclophosphamide belongs to a general group of chemotherapy drugs known as alkylating agents.

Cyclophosphamide is used for the treatment of lymphoma, leukemias, multiple myeloma, mycosis fungoides, neuroblastoma, retinoblastoma, and cancers of the breast and ovary. It is also used to treat some nonmalignant conditions.

How Drug Works: Cyclophosphamide stops the growth of cancer cells, causing them to die.

Hypothesis

- Incorporate cyclophosphamide into steroid skeleton A ring
- Resulting compound to selectively target breast cancer receptors
- Androstenedione \( \rightarrow \) (13 steps)

PRESENT INTEREST

- Activities in advancing biodiversity resources through technological innovations (requires knowledge of physical organic chemistry) and understanding of traditional knowledge
- Priority areas as determined by the Federal and State governments
- Fully funded research through fundamental and top-down grants (e.g. biotechnology research on the indigenous medicinal herb, \textit{Labisia} pumila and biocontrol substances from insects)
- Capacity building
NO INSTANT EXPERTS

...Everything that
...we know and do
...in times gone by
...was wild and new.

DONALD J. CRAM,
NOBEL LAUREATE 1987,
HOST-GUEST CHEMISTRY

to

R.B. Woodward,
whom we all aspire to become.
THE STATE OF PHILIPPINE BIODIVERSITY

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The archipelago of the Philippines comprises of more than 7,100 island estimating to 29.9 million hectares. The archipelagic water covers an approximately 88% of the Philippine territory. The country's complex geological history and long time of isolation from the rest of the world have also led to a complex biodiversity and high level of endemism. Thus, the country is one of the 17 mega diverse countries contributing a relatively large percentage to global diversity.

Philippine biodiversity however, is at stake as the factors that led to its depletion is much stronger than the factors towards its conservation. In fact, the Philippines have lost more than 97% of its original forest cover in the last five hundred years. With the help of different concerned organizations locally and internationally, rehabilitation and conservation projects are implemented throughout the country resulting to discoveries of new species.

According to the Protected Area and Wildlife Bureau the following are the facts and figures on the country's state of biodiversity: a) There are 61 national parks, 2 marine parks, and 8 game refuges and bird sanctuaries, and 10 wilderness areas covering an area of 1.4 million hectares or 4% of the total land area of the Philippines; b) There are about 22 principal species of beach vegetation, 10 of which are considered dominant; c) About 12,000 plant species; d) 960 animal species are found in Philippine forests; about 500 out of it are birds and 167 are mammals; e) About 488 coral species in 78 genera are found in the Philippines out of the 500 known coral species worldwide and at least 2,000 fish.

Thus, this paper is presented to give a profound understanding on the recent status of Philippines biodiversity as well as its strategies towards its conservation and sustainability.
ASEAN

Geography

- Area: 432,100 sq km

- Location: 13°N and 113°E

- Latitude: 11°N and 117°E

- 780 km east of the coast of Australia

- Southeast of New Guinea

- Northwest of the Pacific

- Northeast of the Philippines

- Southwest of the South China Sea

- Total area: 390,494 sq km

- Land area: 317,574 sq km

- Water area: 72,920 sq km

- 4,106 km coastline

- 56 km SE, S of the Pal. Trench or Mindanao Deep – 15,007 m inf; world’s 2nd deepest spot

Cont.

- Lies on the volcanic archipelago of Indo-Australian Plate

- Strong earthquake occurs randomly either caused by tectonic movements or volcanic eruptions

- Most of the mountains are volcanic

- E.g. Mt. Apo, Mt. Pinatubo, Mt. Katling, etc...

- 20 active volcanoes

- Mayon Volcano

- Pinatubo

Climate

- Warm and humid climate all year around

- Prevailing winds govern three pronounced seasons

- Southwest monsoon – rainy season (June to October)

- Northeast monsoon – cool and relatively dry season (November to February)

- Northeast monsoon – hot and dry season (March to May)

- Average temperatures - day time: 27° - 30°C

- Night time: 20° - 27°C

- Relative humidity – 71% to 85%

- Within the typhoon belt – average of 12 typhoons
Capsule History

- First inhabitants around 40,000 B.P. are commonly called Negritos and Asias (Chimpanzees or Black Dwarfs).
- Physically small and unusually short in stature, dark skinned, spiral-haired and broad-nosed.
- Very similar groups of black people in Asia:
  - Andaman Islands in the Bay Bengal in Indian Ocean.
  - Island of Timor.
  - Northern Malaysia (Orang Asli).
  - Southern Thailand (Gadayu).
  - Southern Taiwan (extinct ~100 yr).
- Vietnamese, Japan, Cambodia.
- Spaniards named them Negritos—"little black people".

Pre-Spanish History (1300 – 1521)

- 1300 – Abu Bakar Makhdum an Arab Missionary arrived in Sulu.
- 1450 – Abu Bakar another missionary came and married the daughter of Rajah Bungkul named Putri Parangdul and became the first Sultan and Sultana in the Philippines.
- 1465 – Abu Bakar established the Sultanate of Sulu and Sulun. Datus from Bornie to spread Islam and the religion of the Philippines.
- 14 century – 90% Islam.
- Rajah Soliman/Sultan – became the ruler of the entire nation.

Spanish (1521 – 1946)

- 1565 – Spain colonized the Philippines for 377 years.
- Pop. totally composed the Philippine archipelago and its waters.
- The name Philippines was given to this region by Spanish explorers.
- The Spanish era of colonization was a period of progress for the Philippines.
- American (1898 – 1946)

- 1898 – start of World War II; Filipino and American United against Japanese.
- 1944 – Philippine Independence.

Religion

- 80% Christian
- 10% Protestant
The Philippines: Biodiversity

Conservation Areas
- 5.39 Million hectare - remaining forest
- 2.02% Virgin forest and protected areas (108,878 ha)
- 18 forest protected areas
- 9 marine protected areas

Estimated number of species in the various groups

<table>
<thead>
<tr>
<th>Groups</th>
<th>Number of species</th>
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</thead>
<tbody>
<tr>
<td>Monera</td>
<td></td>
</tr>
<tr>
<td>Protista</td>
<td>1,201</td>
</tr>
<tr>
<td>Fungi and Lichens</td>
<td>2,789</td>
</tr>
<tr>
<td>Plantae</td>
<td>17,730 (6,367 endemic)</td>
</tr>
<tr>
<td>Animalia</td>
<td>37,136 (14,874 endemic)</td>
</tr>
<tr>
<td>Total species</td>
<td>58,856 = 3.8% (world)</td>
</tr>
</tbody>
</table>
Floral Diversity in the Philippine Forest

- 17,000+ species (16,000 species are endemic)
- 5% of the world’s flora - 23rd most diverse species in the world
- A region with the 10th most species

- 1,000 endemic genera

- 191 families

- Examples:
  - Bisporella cinnamomea (1 genus, 10 species)
  - Orchidaceae (7 genera, 270 species)
  - Zingiberaceae (5 genera, 22 species)
  - Arecaceae (6 genera, 84 species)
  - Poaceae (10 genera, 115 species)
  - Rafflesia (1 genus, 3 species)
  - Monocots (750 genera, 778 species, 5% endemic)

Centers of Plant Diversity

- geography and vegetation
- threatened plant units
- endemic species
- species richness
- high endemism
- diversity of range of habitat or ecosystem
- adaptability to special conditions (e.g. ultrasonic lichen)
- centers e.g. Mt. Iraya, Puting, Arayat, Makiling, Apo, Kitanglad, Sierra Madre

Government’s Program

- Fauna and Flora of the Philippine Project
- plant inventory and taxonomy
- collections management
- writing and documentation

Institution Involved

- Philippine National Museum
- Dr. Domingo, Manila
- National Parks of the Philippines: Bicol, Baguio

Faunal Diversity in the Philippines

- 37,136 species (14,874 endemic)
- 7th most animal rich
- mostly dominated by insects 20,131 (13,874 endemic)

Insects

- Crustaceans - 2000+ species
- Spiders - 200+ species
- Centipedes - 34 species
- Millipedes - 54 species
- Insects - 20,131 species
Insects of the Philippines

- Ants (61 genera, >30 endemic genera, >189 species by Alpert, 1988)
- Termites (28 genera, 16 endemic genera, >34 species by Tho, 1972)
- Butterflies (768 endemic species)

Snails in the Philippines

- ~800 species
- >300 endemic species

Mammals

- 204 species – 69 genera
- 111 endemic species – 23 genera

- Tarsius syrichta
- Macaca fuscata
- Macaca nemestrina philippinensis
- Macaca murinus
- Macaca assamensis
- Macaca tonkeana
- Macaca nigra
- Macaca fascicularis
- Macaca nemestrina
- Macaca silenus
- Macaca silenus philippinensis
- Macaca fascicularis nigra
- Macaca fascicularis assamensis
Marine Life

- one of the hotspots of marine biodiversity
- coastal habitats include coral reefs, seagrass beds, soft bottom communities and mangroves
- >500 coral species with 90 genera and 12 genera endemic
- 1,030 species of fish, ranking the region as second in reef diversity next to the Great Barrier Reef of Australia

Centers of Faunal Diversity

- Pleistocene emerged, namely: Greater Luzon, Greater Palawan, Greater Mindanao, Greater Panay-Negros, Greater Sulu and Mindoro by Heaney 1988
- these island groups and their sub-provinces contain unique faunal assemblages
- thus, Philippine Island is the center
Lead Agency, Collaborators and Sources of Funds

- Department of Environment and Natural Resources
- NGOs (Haribon Foundation, Earth Savers Movement etc.)
- Ruhr-University Bochum – Germany
- Frankfurt Zoological Society/Zoologische Gesellschaft Frankfurt – Germany
- Zoological Society for the Conservation of Species and Populations – France

Problems and Threats

- Habitat destruction
  - logging, fires, land conversion, pollution, destructive fishing methods and over-exploitation in coastal areas
- Overexploitation
  - poverty and lack of livelihood opportunities, death of forests, over-exploitation, failure of many resources
- Climate change
- Biological pollution
  - introduction of exotic species, particularly on wetland ecosystems like lakes, seas, and rivers

Strategies and Action

1. Expanding and Improving Knowledge on the Characteristics, Uses and Values of Biodiversity.
2. Enhancing and Integrating Existing and Planned Biodiversity Conservation Efforts with Protection of Wildlife Activities.
4. Strengthening capacities for Integrating and Institutionalizing Biodiversity Conservation and Management.
Laws related to Biodiversity Conservation

- Republic Act No. 9147 - Wildlife Resources Conservation and Protection Act (July 2001)
- Republic Act No. 9072 - National Caves and Cave Resources Management and Protection Act (April 2001)
- Republic Act No. 7586 - National Integrated Protected Areas Law (June 1993)

Gloria under the sea

www.arcbio.org.ph

End
Maraming Salamat!!!