Wildlife conservation compatible with local forest uses on Seram Island, eastern Indonesia: Focusing on interrelationships between humans and wildlife through indigenous arboriculture

The 8th IALE World Congress, Beijing, China, August 18-23, 2011

Masatoshi Sasaoka(CIFOR), Ken Sugimura(CIFOR) and Yves Laumonier (CIRAD)
What is arboriculture?

- Arboriculture: Utilization, cultivation, protection of useful arboreal plants

**Useful arboreal plants:**
- Plants used consumptively for food, medicine, construction materials, handicraft materials, etc.
- Plants used non-consumptively for purposes of shading, windbreak, attracting animals (for trapping), etc.

- Subsistence systems in Wallacea and Near Oceania: “Arboreal-based Economy”

**Arboreal-based economy:**
“Subsistence economy whose practitioners meet a majority of their dietary, nutritional and economic needs through the exploitation of arboreal resources including located in or proximate to a forest environment [e.g. forest game animals]” [Latinis 2000:43]
Why focus on arboriculture?

- Growing attention to human-modified landscapes

  - Satoyama initiative [MoE Japan 2010]
    “The Satoyama Initiative is a comprehensive effort to spread awareness that protecting biodiversity entails the protection of both wild and human-influenced natural environments, such as farmland and secondary forest, which have been maintained sustainably over a long time.”

  - Ecoagriculture [McNeely and Scherr 2002]
    “The management of landscapes for both the production and the conservation of ecosystem services, in particular wild biodiversity”

- Need to evaluate conservation values of human-modified landscapes (agroforest etc.)

  - Protected area: only 12% of the terrestrial area of the Earth
  - The large part of the terrestrial area has been affected by agriculture
Why focus on arboriculture?

- Secondary forest in tropics that we can easily imagine: commercially logged; disturbed forest; slash-and-burn fallow forest; Industrial plantation... However, there are many secondary forest patches which are formed and maintained through arboriculture in the tropics.

- Human-modified forests formed and maintained through arboriculture are ‘invisible’ for outsiders. Why?
  - Extensively managed, and tolerate other species (non-crops and wild animals) existing and using the forest
  - Sporadically dispersed in forest area and there are no clear boundaries

For biodiversity conservation, enabling ecosystem service use by local people, it is needed to be clarified:

- How arboricultural practices form and maintain what forests
- What roles and meanings such human-modified forests have for the local livelihood and biodiversity
Outline

- Study area
- Outline of indigenous arboriculture in Seram
- Human-wild animals interrelationships formed and maintained through arboriculture
- Implications
Amani oho

- Population: ±320 (±60 households)
- Subsistence activities: sago-starch extraction, agriculture (vegetable), hunting/trapping, collection of other NTFPs
- Main source of incomes: seasonal migrant work as harvester of clove, selling bush meat, parrot trade, etc.
- Access: to North: 2-3 days on foot, to South: 1 day on foot
- Located in the interior of central Seram nearby National Park

Research

- 2003-2010
- Method: Key informant interviews, one-on-one interviews, group interviews, participatory mapping and participatory observation
Indigenous arboriculture in Seram
## Folk categories of land in Amani oho

<table>
<thead>
<tr>
<th>Land types</th>
<th>Land use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential land and home garden <em>(Amania)</em></td>
<td>Residential land and home garden with coconut palm, betel nut palm, and various herbs.</td>
</tr>
<tr>
<td>Intensive root crop - vegetable garden <em>(Lela)</em></td>
<td>Intensively managed garden, of which main crops are taro, cassava, sweet potato, vegetables, tobacco, sugar cane, etc.</td>
</tr>
<tr>
<td>Extensive banana - taro garden <em>(Lawa)</em></td>
<td>Extensively managed garden with banana and taro.</td>
</tr>
<tr>
<td>Forest garden <em>(Lawa aihua)</em></td>
<td>Mixed tree garden with fruits trees (durian, jackfruits, etc.) and wild trees</td>
</tr>
<tr>
<td>Sago grove <em>(Soma)</em></td>
<td>Sago palm (<em>Metroxylon sago</em>) grove that supply sago starch, staple food for local people.</td>
</tr>
<tr>
<td>Cultivatable land and fallow forest <em>(Lukapi)</em></td>
<td>Cultivatable land where huge roots of trees have decayed and fallow forest that was formed in the ex-lela and ex-lawa.</td>
</tr>
<tr>
<td>Itawa forest <em>(Itawa harie)</em></td>
<td><em>Litsea mappacea</em> - dominated forest that has been made and maintained by local people and used as a trapping ground for edible wild birds.</td>
</tr>
<tr>
<td>Bamboo grove <em>(Awa harie)</em></td>
<td>Bamboo grove made by local people. Several species of Bamboo are used as handicraft materials, fuel wood, etc.</td>
</tr>
<tr>
<td>Damar forest for resin collection <em>(Kahupe harie)</em></td>
<td><em>Agathis damara</em> - dominated forest that has been made and maintained by local people and used for resin (damar) collection.</td>
</tr>
<tr>
<td>Forest for NTFPs collection <em>(Itama harie)</em></td>
<td>Semi-disturbed natural forest used for collecting fuel wood, construction timber, rattan, etc.</td>
</tr>
<tr>
<td>Forest for hunting/trapping <em>(Kaitahu)</em></td>
<td>'Primary' and mature secondary forest situated far from the village settlement and used for hunting/trapping grounds.</td>
</tr>
</tbody>
</table>

Source: Field research.
Cuscus (*Phalanger orientalis*)

The left is of the cuscus, arboreal marsupials. According to my previous study, cuscus account for almost 50% of the wild animal food resources consumed by the villagers in terms of the amount of protein. Villagers sometimes hunt cuscus using bamboo spear, but in many cases, they trap cuscus using a weighted noose made of rattan as shown on the right.
Forest area divided into many forest lots (kaitahu)

This is a map of hunting and trapping grounds in Amani oho. According to group interviews and participatory mapping, the forest area that is used as hunting and trapping grounds is divided into more than 250 forest lots called locally kaitahu. Each dot on the map indicates the location of each kaitahu. Each kaitahu belongs to a certain individual or group, and has a specific name based on its topographic characteristics.

<table>
<thead>
<tr>
<th>Code</th>
<th>Nama kaitahu</th>
<th>Code</th>
<th>Nama kaitahu</th>
<th>Code</th>
<th>Nama kaitahu</th>
<th>Code</th>
<th>Nama kaitahu</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soa E</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E1</td>
<td>Hahulohu</td>
<td>E54</td>
<td>Makalasina</td>
<td>A52</td>
<td>Wasa(2)†</td>
<td>Li13</td>
<td>Lialelo</td>
</tr>
<tr>
<td>E2</td>
<td>Kukutotui</td>
<td>Soa A</td>
<td></td>
<td>A53</td>
<td>Tiapohuhi</td>
<td>Li14</td>
<td>Melute</td>
</tr>
<tr>
<td>E3</td>
<td>Aimusunuhatia</td>
<td>A1</td>
<td>Wasa(1)</td>
<td>A54</td>
<td>Hatuto</td>
<td>Li15</td>
<td>Tuahua</td>
</tr>
<tr>
<td>E4</td>
<td>Kaipu</td>
<td>A2</td>
<td>Soa</td>
<td>A55</td>
<td>Muhua Haha</td>
<td>Li16</td>
<td>Kahiya</td>
</tr>
<tr>
<td>E5</td>
<td>Haluhari</td>
<td>A3</td>
<td>Sewartinueni</td>
<td>A57</td>
<td>Atauhata</td>
<td>My1</td>
<td>Kikuhua</td>
</tr>
<tr>
<td>E6</td>
<td>Liapoto</td>
<td>A4</td>
<td>Hili Kule Kule</td>
<td>A58</td>
<td>Lihalhalari</td>
<td>My2</td>
<td>Tapua</td>
</tr>
<tr>
<td>E7</td>
<td>Sahua</td>
<td>A5</td>
<td>Koaku</td>
<td>A59</td>
<td>Ramauhena†</td>
<td>My3</td>
<td>Atauhua</td>
</tr>
<tr>
<td>E8</td>
<td>Kasife</td>
<td>A6</td>
<td>Pakalula</td>
<td>A60</td>
<td>Nisaisapetia†</td>
<td>My4</td>
<td>Maroh</td>
</tr>
<tr>
<td>E9</td>
<td>Silahata</td>
<td>A7</td>
<td>Sufeli</td>
<td>A61</td>
<td>Waeula†</td>
<td>My5</td>
<td>Maman</td>
</tr>
<tr>
<td>E10</td>
<td>Mapae</td>
<td>A8</td>
<td>Kasisu Haha</td>
<td>A62</td>
<td>Malihukola</td>
<td>My6</td>
<td>Tifu</td>
</tr>
<tr>
<td>E11</td>
<td>Liamumusi</td>
<td>A9</td>
<td>Tomoe†</td>
<td>A63</td>
<td>Suhula Sama Kete Kete†</td>
<td>My7</td>
<td>Lemai</td>
</tr>
<tr>
<td>E12</td>
<td>Liaphitam</td>
<td>A10</td>
<td>Sisoy Hata</td>
<td>A64</td>
<td>Koriwahata†</td>
<td>Soa M</td>
<td></td>
</tr>
<tr>
<td>E13</td>
<td>Salapika</td>
<td>A11</td>
<td>Sesehutu</td>
<td>A65</td>
<td>Hatutuhu†</td>
<td>Ms1</td>
<td>Amani</td>
</tr>
<tr>
<td>E14</td>
<td>Patate</td>
<td>A12</td>
<td>Hanahata</td>
<td>A66</td>
<td>Kohaha†</td>
<td>Ms2</td>
<td>Waese</td>
</tr>
<tr>
<td>E15</td>
<td>Hahulohu Tapu</td>
<td>A13</td>
<td>Ahahae</td>
<td>A67</td>
<td>Matakaitupa†</td>
<td>Ms3</td>
<td>Haimaru</td>
</tr>
<tr>
<td>E16</td>
<td>Liahaulu Ana</td>
<td>A14</td>
<td>Ulaipoto(1)</td>
<td>A68</td>
<td>Lumu Panu Panu†</td>
<td>Ms4</td>
<td>Sotita</td>
</tr>
<tr>
<td>E17</td>
<td>Lehea</td>
<td>A15</td>
<td>Pahita Sia Tue Tue(1)</td>
<td>A69</td>
<td>Kahupe Hatuku‍etu†</td>
<td>Ms5</td>
<td>Ananai</td>
</tr>
<tr>
<td>E18</td>
<td>Halule</td>
<td>A16</td>
<td>Manucale</td>
<td>A70</td>
<td>Uwaela†</td>
<td>Ms6</td>
<td>Masala</td>
</tr>
<tr>
<td>E19</td>
<td>Enamasae</td>
<td>A17</td>
<td>Kopa Hata Hata</td>
<td>A71</td>
<td>Kaulata Rahe Koria†</td>
<td>Ms7</td>
<td>Marilal</td>
</tr>
<tr>
<td>E20</td>
<td>Manusela Ana</td>
<td>A18</td>
<td>Lumah Ulai</td>
<td>A72</td>
<td>Lianahu Hatu†</td>
<td>Ms8</td>
<td>Omako</td>
</tr>
<tr>
<td>E21</td>
<td>Manusela Potoa</td>
<td>A19</td>
<td>Liolepe Hani</td>
<td>A73</td>
<td>Hatusuhu</td>
<td>Ms9</td>
<td>Huthur</td>
</tr>
<tr>
<td>E22</td>
<td>Aitulahara</td>
<td>A20</td>
<td>Kutulisa</td>
<td>A74</td>
<td>Kalae Pola-pola</td>
<td>Ms11</td>
<td>Wekele</td>
</tr>
<tr>
<td>E23</td>
<td>Awoua</td>
<td>A21</td>
<td>Unenehutu</td>
<td>A75</td>
<td>Taumuamune</td>
<td>Ms12</td>
<td>Silahutu</td>
</tr>
<tr>
<td>E24</td>
<td>Hoale Ana†</td>
<td>A22</td>
<td>Lulakala</td>
<td>A76</td>
<td>Korue Waithu</td>
<td>Ms13</td>
<td>Koka</td>
</tr>
<tr>
<td>E25</td>
<td>Pahohi</td>
<td>A23</td>
<td>Sapatue</td>
<td>A77</td>
<td>Aimakasana†</td>
<td>Ms14</td>
<td>Halua</td>
</tr>
<tr>
<td>E26</td>
<td>Totunie Paki-paki</td>
<td>A24</td>
<td>Malihukata</td>
<td>A78</td>
<td>Keilekesana Kete-kete†</td>
<td>Ms15</td>
<td>Atamau</td>
</tr>
<tr>
<td>E27</td>
<td>Makalasina</td>
<td>A25</td>
<td>Aipaki</td>
<td>A79</td>
<td>Wekele(1)</td>
<td>Ms16</td>
<td>Malih Nua</td>
</tr>
<tr>
<td>E28</td>
<td>Lusilala</td>
<td>A26</td>
<td>Tehio</td>
<td>A80</td>
<td>Milekori Tupe</td>
<td>Ms17</td>
<td>Fouthi</td>
</tr>
</tbody>
</table>

Legend
- Opened forests where villagers conducted trapping/hunting
- Closed forests
- Forests which had not been used for more than 20 years
- Kaitahu owned by the Church
- Forests managed by the Church
- Boundary of Petuman (The location of the boundary not well recognized)
- National Park Boundary
- River
- Mountains
Setting traps for cuscus

Natural and artificial gap

Sohe, weighted noose trap

Villagers set nooses called sohe at forest gaps as shown on this slide. Cuscus move along branches and leaves for foraging at nighttime. Villagers cut branches and vines so that only a single branch or vine connecting an adjacent tree remains in the gap. Traps are set on the branch or vine.
Setting traps for cuscus

This is a conceptual map of kaitahu where traps are set. Villagers use natural forest gaps as trapping sites but they also create artificial gaps to set sohe.
Protection of trees used by cuscus

- Cutting vines that are twined around the trunk of those trees
- Cutting down or barking trees covering those cuscus preferred trees

- Trees, fruits of which are eaten by cuscus
  - Atau (*Syzygium luzonense*)
  - Masapa (*Syzygium malaccense*)
  - Haana (*Gordonia excelsa* Blume)
  - Kori (*Lithocarpus celebicusc* (Miq.) Rehder)

- Trees, sap of which are lapped by cuscus
  - Supa (*Ficus* sp)
  - Airula (?)
  - Solaoto (?) etc

Villagers also protect several trees, fruits or sap of which are eaten or lapped by cuscus. They set traps along these trees.
Many human-modified forest patches are scattered in the forest area!

Even though at a glance mature natural forest looks like intact primary forest without human intervention, there are many human-modified forest patches scattered in the forest area.
Importance of edible wild birds in the local diet

The fruits of Itawa are preferred by many wild birds. Itawa forest is an itawa dominated forest that the local people created and maintain for the purpose of attracting edible wild birds, and trapping them. The left shows the proportions of dietary intake of main animal resources. Although wild bird account for only 6% of the wild animal foods consumed by the villagers in terms of the amount of protein. But wild birds are important during certain periods. The right shows the frequency of animal food intake. During this period, the frequency of wild bird intake drastically increased. So wild birds are seasonally important food resources.
Frequently trapped wild birds

Around 50 species trapped for subsistence purposes (food)
Most of them are Columbidae birds

- **Gymnophaps mada** (local name: mavene)
- **Ptilinopus superbus** (ovota)
- **Columba vitiensis** (nieli)
- **Macropygia amboinensis** (pilaka)
- **Aceros plicatus** (ka) etc.

In Amani oho I registered around 50 species of birds trapped for eating. Most of them were Columbidae birds.
Wild birds are trapped using birdlime made from sap of an *Artocarpus* tree. The right shows a villager setting birdlimes on a tree. Birdlime is inside this bamboo cylinder.
### Trees used for catching wild birds and bats

<table>
<thead>
<tr>
<th>Local name</th>
<th>Scientific name</th>
<th>Fruiting season</th>
<th>Wild birds and bats</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Trees which are not felled when clearing land for agriculture</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oma</td>
<td>Artocarpus sp.</td>
<td>Feb-Apr</td>
<td>solo musunu (Pteropus sp), solo puti (Pteropus sp)</td>
</tr>
<tr>
<td>Leha</td>
<td>Symplocos cochinchinesis (Lour.) Moore</td>
<td>Dec-Jan</td>
<td>fufualo(?), makatola(Basilornis corythax), mavene(Gymnophaps mada), ovota (Ptilinopus superbus), uniuni (Zesteropus Kuehni)</td>
</tr>
<tr>
<td>Awou Tuni</td>
<td>Prunus arboreus (Blume) Kalkman</td>
<td>Jan-Feb</td>
<td>fufualo, mavene, ovota</td>
</tr>
<tr>
<td>Awou Lasa</td>
<td>Prunus grisea Kalkman</td>
<td>Jan-Feb</td>
<td>fufualo, mavene, ovota</td>
</tr>
<tr>
<td>Ketapi</td>
<td>Geniostoma sp.</td>
<td>May-Jul</td>
<td>mavene, ovota</td>
</tr>
<tr>
<td><strong>Trees, the growth of which is encouraged through seedling and protection</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Itawa Kopi</td>
<td>Litsea mappacea</td>
<td>Jan-Feb</td>
<td>fufualo, ka (Aceros plicatus), lesoa (Ivos affinis), loe, (Phiemon subcorniculatus), manu putia (Ducula bicolor), makatola, mavene, nieli (Columba vitiensis), ovota, sisai (Alisterus Amboinensis), totoro, ovota, sisai (Alisterus Amboinensis), totoro</td>
</tr>
<tr>
<td>Itawa Tuni</td>
<td>Litsea mappacea</td>
<td>Mar-Apr</td>
<td>fufualo, ka, lesoa, loe, manu putia, makatola, fufualo, ka, lesoa, loe, manu putia, makatola,</td>
</tr>
</tbody>
</table>

Source: Field research
Arboricultural activities to form *Itawa*-dominated forest

**Human interventions:**
- Weeding, clearing underbrush, and cutting vines (Jan.-Apr.)
- Cutting and barking trees covering *Itawa*
- Collecting seeds of *Itawa* and seeding land

**Itawa** forest
- *Itawa* forest patchily distributed in fallow forest
- The largest one: around 1 ha

*Itawa tuni* (*Litsea mappacea*)

This slide indicates arboricultural activities to form *Itawa*-dominated forest. Some villagers encourage the growth of *Itawa* through weeding, clearing underbrush, and cutting vines and felling and barking trees covering *Itawa* and hindering its growth, as well as collecting seeds of *Itawa* and seeding. *Itawa* forests are patchily distributed in fallow forests. I haven’t yet conducted a sufficient survey to measure the sizes of *Itawa* forests, but based on measurements by pacing it off, the size of largest one seemed to be around one ha.
According to villagers accounts, most wild birds attracted by the Itawa do not directly come to the Itawa tree. Before coming to the itawa, they usually perch on trees with a few branches and leaves where the view is not obstructed in order to make sure that there are no predators such as snakes. Therefore villagers set birdlime on the branches of these perching trees. Itawa-dominated forest can also be regarded as human-modified forest formed through arboriculture.
(3) Forest garden

- Mixed fruits tree garden with durian, langsat, jackfruits, water rose apple, etc.
- The formation: planting seedlings or protecting seedlings and young trees growing wild (naturally) – mainly those seeds dispersed by wild bats (*Pteropus sp*)
- Patchily distributed in mostly old secondary forest (old fallow forest), and few in ‘primary’ forest
- Extensively managed: cutting underbrush and vines only when harvesting → non-clear boundary, mixed with many wild plants

Forest garden mixed with many wild plants
(4) Damar Forest

- *Agathis damara* - dominated forest used for resin (damar) collection
- The formation: selective protection of seedlings and young trees which are growing naturally
- Patchily distributed in ‘primary’ and old secondary forest
- Damar is used as a fuel for lamps and kindling; had been an important source of income up to mid 1960’s
- Felling and barking are strictly forbidden
Human-wild animal interrelationships formed through arboriculture
Moluccan cockatoo

- Endemic to Seram
- IUCN Red List: VU (vulnerable)
- Listed at CITES Appendix I
- Protected by existing Indonesian laws:
  - Undang - undang No.5 Tahun 1990 Tentang Konservasi Sumber Daya Alam Hayati dan Ekosistemnya
  - Peraturan Pemerintah No. 7 Tahun 1999 Tentang Pengawetan Jenis Tumbuhan dan Satwa

Moluccan cockatoo (Cacatua moluccensis)
Trap for Moluccan cockatoo

The cockatoo caught by a trap set on Durian tree

Trapped Moluccan cockatoo

However, the local people sometime trap and trade this parrot. In uplands on central Seram, the major source of income is seasonal migrant work harvesting cloves in the southern coastal area. But the income from the migrant work is unstable because of the fluctuation in production and the price. So their dependency on wild parrots is enhanced during times of hardship caused by the decrease of the main source of income. As we can see from this slide, they use traps made of fishing line. They set the traps on fruits tree such as durian and jack fruits during fruiting season because the parrots like to eat those fruits.
A trapper who brought a trapped cockatoo to the south coast to sell it. The cockatoo was put into a bamboo cylinder like this.
Utilization of human-modified forests by Moluccan cockatoo

<table>
<thead>
<tr>
<th>Forest types</th>
<th>Utilization</th>
<th>Season</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forest garden</td>
<td>Eat fruits of durian, langsat, jackfruits</td>
<td>Jan.-May.</td>
</tr>
<tr>
<td>Damar forest</td>
<td>Eat fruits of <em>Agathis damara</em></td>
<td>All the year around</td>
</tr>
<tr>
<td></td>
<td>Nest in tree hollow of large <em>Agathis damara</em></td>
<td></td>
</tr>
</tbody>
</table>

Source: Field research

According to the accounts of villagers, the Moluccan cockatoo does not prefer to live in remote undisturbed forest but prefers to live in forests not so far from villages, because they frequently use forest gardens and damar forests. The cockatoo often comes to forest gardens during the fruiting season to eat durian, langsat, jackfruits etc. It frequently uses damar forests to eat fruits of *Agathis damara* and to nest in tree hollows of large *Agathis damara*.
Sites where Moluccan cockatoos frequently seen or heard

Legend

KH: Damar forest
L: Forest garden
K: Primary/old secondary forest

Boundary of village territory
- National park boundary
- Forest trail
- River
- Mountain

Source: Field research.
Moluccan cockatoos are, to some extent, dependent on human-modified forests (forest garden and damar forest) which are formed and maintained by arboriculture.

Local people occasionally trap the parrots attracted to these human-modified forests to earn some money in times of hardship.

Mildly interdependent relationship (?) between Moluccan cockatoo and human.
## Use of Human modified natural environment by wild animals

<table>
<thead>
<tr>
<th>Species</th>
<th>Type of land</th>
<th>Utilization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Celebes Wild Boar (Sus celebensis)</td>
<td><em>Lukapi</em> (cultivable land and fallow forest), sago groves, bamboo grove</td>
<td>Eating fruits of durian and jackfruits (fruits fallen on the ground), bamboo shoot, etc.</td>
</tr>
<tr>
<td>Grey Cuscus (Phalanger orientalis)</td>
<td><em>Lukapi</em>, sago groves, forest garden, <em>kaitahu</em></td>
<td>Eating leaf stalk of sago palm, fruits of <em>atau, masapa</em> etc.</td>
</tr>
<tr>
<td>Bat (<em>Pteropus sp</em>)</td>
<td>Forest garden, bamboo grove, forest garden, sago grove, <em>lukapi</em></td>
<td>Eating fruits of sugar palm, langsat, jackfruits, oma, guava, water rose apple etc.</td>
</tr>
<tr>
<td>Malayan Civet (<em>Viverra tangalunga</em>)</td>
<td>Forest garden, <em>lukapi</em></td>
<td>Eating banana, fruits of durian, jackfruits, papaya, pineapple, itawa etc.</td>
</tr>
<tr>
<td>Lories (<em>Eos bornea, Alisterusamboinensis etc</em>)</td>
<td>Forest garden</td>
<td>Eating Banana and durian</td>
</tr>
<tr>
<td>Papuan Hornbill (<em>Aceros plicatus</em>)</td>
<td><em>Itawa</em> forest</td>
<td>Eating fruits of Itawa</td>
</tr>
<tr>
<td>Wild birds (<em>Gymnophaps mada, Ptilinopus superbus etc.</em>)</td>
<td><em>Itawa</em> forest, edges of garden</td>
<td>Eating fruits of Itawa, leha (<em>Symplocos cochinchinensis</em>), awou (<em>Prunus grisea</em>), ketapi (<em>Geniostoma sp.</em>) etc.</td>
</tr>
</tbody>
</table>

Source: Field research.
Implications
Implications

- The human-modified forests are extensively /loosely managed → anthropogenic forces to exclude wildlife other than main crops do not work strongly. This enables diverse wildlife to use human-modified forests.

- Various wild animals use human-modified forests as foraging sites, shelters, nesting sites etc. Meanwhile, humans utilize such wild animals as come to the human-modified forests → Human-modified forests secure local livelihood by providing various ecosystem services (mainly NTFPs), and, at the same time, contribute to maintain the relative rich local biodiversity (?)

- Inter-disciplinary studies are needed, in evaluating conservation as well as socio-cultural and economic values of human-modified forests
Future research activities

- Clarify human interventions to form human-modified forests and characteristics of their spatial distribution
- Evaluate quantitatively the importance of forest ecosystem services derived from the human-modified forests
- Evaluate the importance of human-modified forests as habitats for the Moluccan cockatoo by measuring relative abundance

Direction of Discussion

- Do human-modified forests secure local livelihood by providing various ecosystem services (mainly NTFPs) and, at the same time, contribute to maintain the relative rich population of the endangered parrot, the Moluccan cockatoo?
- How extensive indigenous agriculture affects the possibility of the coexistence of human and wildlife.
- Is it appropriate to apply conventional ‘zone-based conservation model’ to the conservation of rare species in the area where local people form and maintain sporadically distributed human-modified forests through extensive arboriculture?
Thank you

This study was made possible by the grant assistance provided for CIFOR by the Ministry of Foreign Affairs, Japan, in 2010, and by the facilitations and support from CoLUPSIA (Collaborative Land Use Planning and Sustainable Institutional Arrangement Project) funded by the EU. We thank these institutions for their assistance and support.