Humans and the Rainforest: Non-timber Forest Products, Medicinal Resources and Bioprospecting
Conservation of Tropical Forests

• One of the many causes of tropical forest loss is poverty. Conservation is often not a high priority for people seeking to meet the most basic of needs.

• Any conservation attempt must take into account local people and their needs in order to be successful.
I. Non-timber Forest Products
   A. Non-plant products
   B. Plant products
   C. Medicinal Plants
   D. Potential Problems

II. Biodiversity Prospecting
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Goals of Sustainable Development

- Economic development
- Conservation
- Distribution of profits to indigenous people
- Survey and description of biodiversity
Non-timber Forest Products

• Anything that can be harvested from a forest in a sustainable manner.
• Provides justification for conservation of biodiversity.
• Use it lose it: In order for conservation attempts to be successful, forested wildlands must be more profitable for local inhabitants and those making land use decisions than other uses of the land such as agriculture.
Non-timber Forest Products

• Art – paintings of medicinal plants in rainforest landscapes from a Brazillian art school are sold as postcards around the world.

• Ecotourism

• Gatherings – a potpourri made from seeds, flowers, leaves, and natural dyes

• Animal products – meat, fish, furs, feathers, live animals, insects
Plant Products That Can Be Extracted From Tropical Forests

• In some study areas, indigenous people have been shown to have a use for every tree species in a one hectare plot.
Food Products

Papaya
(Caricaceae)
Cashews (Anacardiaceae)

- *Anacardium occidentale*
- Multi-use tree native to Brazil.
- Contains compounds that can cause allergic reactions.
Palms (Araceae)

- Leaves used for thatch.
- Fruits can be eaten raw, cooked, or used to make ‘wine.’
- Oil can be extracted from seeds.
- Leaves can be used to make fans, baskets, sieves, mats, garments, toys and hats.
- Stems can be used to make bows, arrows, clubs.
Insect Larvae from Palms

- Insect larvae in seeds or decaying stems are an important source of protein for some groups.
Heart of Palm
Tamarind (Fabaceae)

- Legume
- Native to tropical Africa.
- Sweet, acidic pulp of fruit used to flavor many Asian foods.
Spices – Vanilla (Orchidaceae), Cinnamon (Lauraceae), Cloves (Myrtaceae), Allspice (Myrtaceae)
Brazil Nuts (Lecythidaceae)

- Trees can reach 50m.
- Bear coconut-sized infructescences, each containing around 20 seeds.
- Probably the best known and most widely used product that comes exclusively from wild populations, not plantations.
• Pollinated by Euglossine bees ("orchid bees").
• Dispersed by Agoutis, who eat some seeds and bury others.
• Harvesters allow the seeds to remain on the ground for several months because of the danger of injury from falling infructescences.
Brazil nuts provide more than half of the income for many families in rural areas of the Amazon.
Latex

• Natural Rubber – *Hevea brasiliensis* (Euphorbiaceae).
• Chicle - *Manilkara zapota* (Sapotaceae).
• In both species, latex is extracted by cutting the trunks of trees.
• Chicle was widely used to make chewing gum in the early 1900’s.
Rubber Exploitation

- Chico Mendes – Leader of the seringueiros’ union (harvesters of forest products).
- Brazil established extractive reserves.
- US govt. pressured Brazil to reduce deforestation.
- Blamed Brazilian cattle ranching subsidies for deforestation.
- Brazil slashed subsidies, including one supporting high prices for natural rubber.
- Rubber tapping no longer profitable.
- What will happen to the extractive reserves?
Drugs and Poisons

- Brugmansia (Solanaceae)
- Hallucinogenic properties
- Used in shamanic rituals in the Amazon.
Rotenone

- Extracted from several members of the bean family (Fabaceae).
- A general use pesticide.
- Not toxic to bees.
- Breaks down in sunlight, soil and water.
- Very toxic to fish.
- Safety is questionable.
Fibers

• Kapok (Bombacaceae) – large, buttressed tree
• Buoyant seed fibers used to stuff life vests.
• Fibers are too slippery for weaving.
• Many specialty products are made from the fibers today.
Dyes

- Annato (Bixaceae)
- The red coating on the seeds is used as dye in the cosmetic, food and soap industries.
- Responsible for the orange color of cheddar cheese.
- More environmentally friendly than synthetic dyes.
Wood and Bamboo

• Wood carving provides supplemental income in Zimbabwe.

• Fast growing bamboo (Poaceae) is a strong, versatile material for building and crafts.

• In cloud forests, bamboo forms thick, rapid secondary forests where primary forests have been cut.
Wood as a Non-timber Forest Product

- Single trees or Strips of forest can be harvested in a sustainable manner.
Wicker and Rattan

- Made from vines collected in Oceania.
- Has been shown to be very profitable for gatherers.
- The furniture industry uses approximately $3 billion worth of rattan each year.
• However, rattan is not always harvested in a sustainable fashion and has been eliminated from many areas. May be endangered overall.

• It has been suggested that many rattan-like vines found in the Amazon could be utilized in a similar manner.
Ornamentals
Medicinal Plants

• 25% of prescriptions filled in the US are for drugs containing plant compounds.
• Sales of plant-based compounds are in the billions each year.
• 75-80% of the world’s population includes plants in their health care systems.
• Plants are often the most accessible and affordable medicines available to people in tropical countries.
• Plant products are used to treat a wide variety of health problems including fevers, fungal infections, burns, gastrointestinal problems, pain, respiratory problems, wounds, and are used as antidotes to toxins from organisms such as poisonous snakes.
Methods of Preparing Traditional Medicines

- Aromatic Teas – volatile substances
- Non-aromatic Teas
- Garrafadas – in alcohol
- Baths – absorption through respiratory tract or skin
- Saps – fresh materials are pressed to release sap
- Syrups – plant materials are cooked with sugar
- Exudates – latex from plants
Whole Plant Extracts Vs. Isolated Compounds

• All of these traditional preparations of medicinal plants involve whole plant extracts.
• When looking for new drugs, pharmaceutical companies would like to identify a single active compound that can be easily synthesized.
• However, often synergy between several compounds in a plant extract can be responsible for biological activity.
Cat’s Claw (Rubiaceae)

• Uncaria tomentosa – Una de Gato or Cat's Claw is a large woody vine that is indigenous to the Amazon Rainforest and other tropical areas of South and Central America.

• Has been used by a number of Peruvian tribes for thousands of years.
• Traditional Uses:
Abscesses, Arthritis,
Asthma, Blood Cleanser,
"Bone Pains", Cancer,
Cirrhosis, Contraceptive,
Diabetes, Diarrhea,
Disease Prevention,
Dysentery, Fevers, Gastric
Ulcers, Gastritis,
Gonorrhea, Hemorrhages,
Inflammations, Intestinal
Affections, Kidney
Cleanser, Menstrual
Irregularity, Rheumatism,
Skin Disorders, Stomach,
Urinary Tract Disorders,
Tumors, Wounds.
• Contains at least 57 known phytochemicals, several unique.

• Antibacterial, Antimutagenic, Antioxidant, Anti-inflammatory, Antitumorous, Antiviral, Cytostatic, Depurative, Diuretic, Hypotensive, Immunostimulant, Vermifuge.


Cinchona (Rubiaceae)

- “Quina-Quina” means “bark of barks.” Very effective treatment for malarial fever. Malaria is a global problem today. Quinine.
- Overexploited early-on in the exploration of the neotropics.
- The tree population was saved from near extinction by the establishment of plantations in the old world tropics.
- Demonstrated that the development of natural products from tropical forests can have devastating consequences if not done properly.
Potential Problems With Extraction of Non-timber Forest Products

• Unfortunately, it seems that the more valuable NTFPs are, the less likely they will be harvested in a sustainable manner.

• The methods used in developing tropical forest products must be ecologically, economically and socially sound in order to be sustainable.
Relying on non-timber forest products for income can be difficult for rural people:

- Tropical forests tend to be slow-growing (Crook and Clapp, 1998). Not necessarily true- Some resources are very fast growing. E.g. bamboo.
- Because of the high diversity of these forests, the density of any given useful species may be low (Boot, 1997; Crook and Clapp, 1998). Also not always true.
- Transportation and collection may be expensive.
• There may be a lack of markets for most goods.
• If local people do not have a tradition of using a certain product, they are unlikely to use it. Not necessarily true- People can be taught.
• Supplies of natural products may be unreliable. However, so can supplies of products from monocultures due to pests, water shortages, soil exhaustion.
Long Term Prospects

• For small scale use, extractive products from the forest may actually be more reliable.
Conditions for Non-timber Forest Products to Effectively Contribute to Conservation (Crook and Clapp, 1998):

• The population, community and ecosystem ecology of forest ecosystems must be adequately understood for proper management.

• Harvested resources must have high natural reproduction rates in order to ensure a reliable supply and sustainability of use.

• These resources must be more cheaply and reliably produced in a forest than in an agricultural setting or than by a synthetic substitute.

• The people making decisions about land use must directly benefit from conservation of forests.
Biodiversity Prospecting

• The exploration of biodiversity for commercially valuable genetic and biochemical resources.

• During the 1960’s and 70’s, there was little interest in natural products. Advances in synthetic chemistry enabled chemists to custom design new drugs.

• In spite of many recent pharmaceutical developments, AIDS, malaria, cancer, heart attack aftereffects, blood clots, Alzheimer’s disease and diabetic complications are all unsolved global health problems.
New techniques in screening for potentially useful natural chemicals allows for rapid, relatively inexpensive screening of large numbers of extracts.

Many compounds found in tropical organisms are nonsynthesizable owing to their structures.

More than 21 different organizations are engaging in natural products research, including Merck, US NIH, US National Cancer Institute, SmithKline Beecham, Monsanto, and Glaxo.
Techniques for Screening Chemicals

• Many large organizations use random screenings of thousands of natural extracts.
• However, approximately only 1 in 10,000 chemicals examined could potentially be useful.
• Another method involves targeted collecting of plants in families known to be high in bioactive compounds.
• Smaller pharmaceutical companies use traditional knowledge to improve their chances of finding biologically active compounds.
An Example of A National Program of Conservation and Sustainable Development – Costa Rica’s National Biodiversity Institute (INBio)

INBio is a non-profit, public interest group established by the government of Costa Rica.
INBio-Merck Agreement

1. Costa Rica gets a royalty on any drugs discovered.

2. Merck also has given them 1,135,000 in the first two years of the project.

3. 10% of this budget and 50% of any royalties go to conservation projects such as the National Park Fund.
4. The agreement also involved transfer of technology and knowledge from Merck to INBio so that Costa Rican scientists can begin to exploit their natural resources in a similar manner.

5. In return, Costa Rica provides a limited number of chemical extracts from plants, insects and microorganisms for analysis by Merck.
Why INBio?

1. Great diversity of organisms in Costa Rica
2. Very accessible for study
3. Wide variety of environments – coastal, wet forests, cloud forests
4. Commitment to conservation, education
5. INBio approached Merck
Genetic Resources

• Genetic engineering of crops – biodiversity also has promising implications for agriculture
• Could provide further material for the genetic engineering of crops
Biocontrol

• Bioprospectors are also interested in finding living organisms which can serve as biological control agents for pests and introduced species.

• Parasitoids
Potential Problems With Biodiversity Prospecting
Financial Risks for Investors

1. The market for natural products could quickly be saturated. However, Merck is the world’s largest pharmaceutical company, but only produces 5% of the pharmaceuticals sold globally. Since no one pharmaceutical company dominates the market, competition between companies may result in greater benefits for tropical nations.

2. There is no way to predict future demand for biological samples. Advances in synthetic chemistry, biotechnology or medicine may decrease interest in natural products. However, organisms still provide a source for novel genes.
3. A good chance exists that no drugs will go to market in any one organization’s investigation.

- Only 1 in 10,000 chemicals will be potentially useful.
- Less than ¼ of potential drugs that reach clinical trials will be approved as a new drug.
- On average, it takes $231 million and 12 years to bring a single drug to market.
- So, pharmaceutical companies may not be willing to pay large amounts for the rights to examine plant compounds.
- However, each organism examined may contain 100’s or 1000’s of chemicals, so success rates could be as high as 1 in 1000 organisms examined.
There Are No Established National or International Policies for Bioprospecting

1. No enforcement of agreements and distribution of royalties.

2. No representation of indigenous people in negotiations, who have historically been poorly represented by governments of developing nations (indifference – hostility).

3. No guarantee that bioprospecting results in conservation of forests.
Intellectual Property Rights

• Controversy surrounding application of property rights to natural products.

• Historically, wild, unimproved genetic and biochemical resources have been considered to be common property.

• In the late 1800s in the US, patents began to be applied to organisms.
How can a gene or chemical found in nature be owned by an individual or company?

- Different countries have different rules on intellectual property rights.
- Patents are usually only granted for innovations, not discoveries.
- The US allows patenting of a wide variety of products, while other countries do not patent biological processes and products.
- In fact, many countries have only recently allowed pharmaceuticals to be patented.
Three problems must be overcome if bioprospecting is to contribute to conservation of biodiversity and sustainable development:

1. Biodiversity prospecting could actually speed the destruction of tropical forests. Many companies claim that they are harvesting natural products in a “sustainable nondestructive fashion,” but there is no national or international body enforcing the truth of these claims.
2. There is no guarantee that developing
tropical nations will benefit economically
from bioprospecting.

3. Local as well as national citizens must
benefit from the conservation of forests. In
many cases, it is difficult to support large
local populations on sustainably produced
forest products. Therefore, governments
need to use a portion of national benefits of
bioprospecting to meet the needs of the
people living in intimate contact with the
forests.
Summary

• Need for regulatory action by International Convention on Biodiversity to ensure that the stated goals of forest product extraction and bioprospecting are met.

• Use of non-timber forest products and bioprospecting are only two parts of a larger effort to allow destruction of natural systems.
References


