Notes

Assessing the Economic Value of Traditional Medicines from Tropical Rain Forests

MICHAEL J. BALICK

Institute of Economic Botany
The New York Botanical Garden
Bronx, NY 10458, U.S.A.

ROBERT MENDELSOHN

Yale University
School of Forestry and Environmental Studies
New Haven, CT 06511, U.S.A.

Introduction

In recent years, increasing attention has been given to the value of the tropical rain forest as a source of nontimber market products. Although estimates exist for the value of select forest products (Peters et al. 1989; Tobias and Mendelsohn 1990), many have yet to be quantified. One important class of products that has not yet been valued is tropical pharmaceuticals. Several recent essays have noted that tropical forests are a rich source of unknown chemicals that may eventually prove useful to medicine (Abelson 1990; Oldfield 1989). In addition, traditional medicines are currently the basis for much of the primary health care delivered in tropical nations (Farnsworth et al. 1985). For example, traditional practitioners provide up to 75% of the primary health care needs of rural people in Belize (R. Arvigo, personal communication). Local forests are the source of the plants processed into therapies used in traditional medical systems (Balick 1990). In this paper, we quantify the value of the forests for their therapeutic products, using data from Belize, Central America.

Current methods for the harvest of medicinal plants from forests and fallows involve both destructive and nondestructive practices. For example, destructive methods of harvest include stripping a tree completely of its bark, or cutting it to facilitate harvest. Removing the roots or tubers from a woody or herbaceous plant can also result in its demise. Nondestructive methods include removal of some percentage of the leaves or peeling small strips of bark, to avoid girdling the tree. Based on our observations in Belize, the process of gathering medicinal plants often resembles the harvesting of trees for timber, a more destructive approach. Although this process can be highly destructive for a specific site, provided the harvested area is sufficiently small and that harvests occur over long enough rotations, we suspect that the overall process could be sustainable. It is this approach of long rotations and clearing that we evaluate in this paper. Experiments are underway, however, in Belize to extract medicines more continuously from a plot by removing small amounts of plant material from each tree. As we learn more about the possibilities of this alternative extraction method, it too can be evaluated from both an ecological and an economic viewpoint.

Methods

In order to quantify the value of managing forests as a source of traditional medicines, we began with an inventory of plant material in specific plots. We utilized two sample plots from secondary hardwood forests in the Cayo district of Belize that are representative of the surrounding region. Plot 1 is 0.28 ha in size and plot 2 is 0.25 ha in size. Plot 1 is approximately 30 years old and is located in a valley at about 200 m in elevation. Plot 2 is approximately 50 years old and is located on a

Paper accepted December 4, 1991.

ridge in the foothills of the Maya mountains at about 350 m in elevation. Clearing plot 1, we were able to collect 86.4 kg dry weight of marketable medicinal plant material. The species collected are listed in Table 1. In plot 2, we collected 358.4 kg dry weight of medicine; the composition of which is described in Table 2. Thus, extrapolating on a per hectare basis, we found 308.6 and 1433.6 kg dry weight of medicines on the two plots, respectively.

Results

Local herbal pharmacists and healers purchase unprocessed medicine from small farmers at a rate of $2.80/kg (all values are expressed in U.S. dollars). Multiplying the quantities of medicine found per hectare above by this price suggests that clearing a hectare would yield the farmer between $864 and $4,014 of gross revenue. The farmer, however, has costs he must bear to harvest this material. The collection of plant material required seven man days on plot 1 and 20 man days on plot 2. On a per hectare basis, harvesting required 25 man days on plot 1 and 80 man days on plot 2. Given the local wage rate of $12/day, total harvest costs of the two plots are $300 and $960, respectively. Subtracting these costs from gross revenue, the net revenue from clearing a hectare is consequently $564 and $3,054 on each of the plots.

Not enough information is available to know what rotation age is optimal for collecting medicines. It is not clear how much time should elapse between each harvest on a specific plot. However, assuming that we use the current age of the forest in each plot as a rotation length, we can calculate at least an estimate of the present value of harvesting medicine sustainably into the future. The present value of an infinite stream of harvests every t years (beginning with a standing forest) can be calculated from a standard Faustman formula:

$$V = R/(1 - e^{-rt}),$$

where R is the net revenue from a single harvest and r is the real interest rate. We assume the real interest rate is 5% for this calculation. Given a 30 year rotation in plot 1 and substituting the appropriate values of r and R into the above equation suggests that the present value of medicine in plot 1 is $726/ha. Making a similar calculation for plot 2 but extending the rotation to 50 years yields a present value of $3,327/ha.

Table 1. Medicinal plants harvested from valley forest plot (no. 1) in Cayo, Belize.

Common Name	*Scientific Name*	*Use*[a]
Bejuco Verde	*Agonandra racemosa* (DC.) Standl.	Sedative, laxative, "gastritis," analgesic
Callawalla	*Phlebodium decumanum* (Willd.) J. Smith	Ulcers, pain, "gastritis," chronic indigestion, high blood pressure, "cancer"
China Root	*Smilax lanceolata* L.	Blood tonic, fatigue, "anemia," acid stomach, rheumatism, skin conditions
Cocomecca	*Dioscorea* sp.	Urinary tract ailments, bladder infection, stoppage of urine, kidney sluggishness and malfunction, to loosen mucus in coughs and colds, febrifuge, blood tonic
Contribo	*Aristolochia trilobata* L.	Flu, colds, constipation, fevers, stomach ache, indigestion, "gastritis," parasites

[a] *Uses listed are based on disease concepts recognized in Belize, primarily of Maya origin, that may or may not have equivalent states in Western medicine. For example, kidney sluggishness is not a condition commonly recognized by Western-trained physicians, but is a common complaint among people in this region.*

Table 2. Medicinal plants harvested from ridge forest plot (No. 2) in Cayo, Belize

Common Name	*Scientific Name*	*Use*[a]
Negrito	*Simaruba glauca* DC.	Dysentery & diarrhea, dysmenorrhea, skin conditions, stomach and bowel tonic
Gumbolimbo	*Bursera simaruba* (L.) Sarg.	Antipruritic, stomach cramps, kidney infections, diuretic
China root	*Smilax lanceolata* L.	Blood tonic, fatigue, "anemia," acid stomach, rheumatism, skin conditions
Cocomecca	*Dioscorea* sp.	Urinary tract ailments, bladder infection, stoppage of urine, kidney sluggishness and malfunction, to loosen mucus in coughs and colds, febrifuge, blood tonic

[a] *Uses listed are based on disease concepts recognized in Belize, primarily of Maya origin, that may or may not have equivalent states in Western medicine. For example, kidney sluggishness is not a condition commonly recognized by Western-trained physicians, but is a common complaint among people in this region.*

Discussion

These estimates of the value of using tropical forests for the harvest of medicinal plants compare favorably with alternative land uses in the region. For example, estimates of the value of intensive agriculture in the Brazilian rainforest are $339/ha (Florschutz 1983) and milpa (corn, beans, and squash) in Guatemalan rainforest are $288/ha (Heinzman and Reining 1988). Even the most successful pine plantations proposed for the tropics expect to yield only $3,184/ha (Sedjo 1983). We also identified commercial products such as allspice (*Pimenta*

dioica), copal (*Protium copal*), chicle (*Manilkara zapota*), and construction materials (beams for houses) in the sample plots that could be harvested and added to the total value of the plots. Thus, our data suggest that protection of at least some areas of rainforest as extractive reserves for medicinal plants appears to be economically justified. We feel that a periodic harvest strategy is a realistic and sustainable method of utilizing the forest, based on our evaluation of the flow of medicinal plant materials. For example, within a 50 ha parcel of forest similar to the second plot we analyzed, it would appear that one could harvest and clear one hectare per year indefinitely.

People skeptical of the efficacy of traditional medicine in primary health care delivery systems may argue that these figures overestimate the value of tropical forest medicines because local people should rely on commercial factory-produced pharmaceuticals instead. To substitute Western medicine for traditional healers would require a substantial increase in health expenditures for a country like Belize. Further, there is increasing acceptance that, in primary health care delivery systems, traditional medicines provide effective modalities for many conditions (Farnsworth et al. 1985; Akerele 1988).

The analysis used in this study is based on current market data. The estimates that these forests are worth $726 and $3,327/ha for their medicinal plants could change based on local market forces. For example, if knowledge about tropical herbal medicines becomes even more widespread and their collection increases, prices for specific medicines would fall. Similarly, if more consumers become aware of the potential of some of these medicines or if the cost of commercially produced pharmaceuticals becomes too great, demand for herbal medicines could increase, substantially driving up prices. Finally, destruction of the tropical forest habitats of many of these important plants would increase their scarcity, driving up local prices. We have already observed this scenario in Belize with some species, especially those in primary and secondary forest habitats. We predict that the value of tropical forests for the harvest of nontimber forest products will increase relative to other land uses over time as these forests become more scarce.

Conclusion

We expect that the results of this study will stimulate follow-up studies to quantify the stock and growth of plant medicines in primary and secondary forests. Systems for the sustainable collection of plant medicines and other nontimber products from the tropical forest need to be documented and developed for use on a much broader scale. Tropical forests are a source of medicine for hundreds of millions of people in the developing world. Combining the present value of medicine with that of other sustainable nontimber forest products provides a compelling and quantifiable argument for the conservation and careful management of tropical and subtropical forests.

Acknowledgments

We thank H. Bormann, J. Brown, D. Daly, E. Elisabetsky, J. Gordon, R. Herdt, C. Gyllenhaal, S. Mori, C. Peters, and M. Pinedo for their comments on this manuscript. We are grateful to R. Arvigo and G. Shropshire of the Ix Chel Tropical Research Center, Ltd., Belize for assistance with field logistics, as well as several anonymous informants for sharing with us their knowledge about medicinal plants. This project was supported by grants from the U.S. Agency for International Development, The Metropolitan Life Insurance Foundation, the U.S. National Institutes of Health/National Cancer Institute, The Nathan Cummings Foundation, The Overbrook Foundation, and The Rex Foundation. We also thank the Belize Forestry Department and Belize Environmental Center for their collaboration with this project.

Literature Cited

Abelson, P. H. 1990. Medicine from plants. Science **247**, 513.

Akerle, O. 1988. Medicinal plants and primary health care: an agenda for action. Fitoterapia **59**, 355–363.

Balick, M. J. 1990. Ethnobotany and the identification of therapeutic agents from the rainforest. Pages 21–23 in D. J. Chadwick and J. Marsh, editors. Bioactive compounds from plants, J. Wiley and Sons, Chichester, England.

Farnsworth, N. L., O. Akerele, A. S. Bingel, D. D. Soejarto, and Z. G. Guo. 1985. Medicinal plants in therapy. Bull. WHO **63**:965–981.

Florschutz, G. 1983. Análise economica de estabelecimentos rurais de Municipio de Tome-Açu, Pará: Un estado de caso. Documentos **19** EMBRAPA/CPATU Belem, Brazil.

Heinzman, R., and C. Reining. 1988. Sustained rural development: extractive forest reserves in the northern Peten of Guatemala. A report to U.S. AID/Guatemala, contract number 520-0000-0-00-8532-00.

Oldfield, M. L. 1989. The value of conserving genetic resources. Sinauer Associates, Sunderland, Massachusetts.

Peters, C. P., A. H. Gentry, and R. O. Mendelsohn. 1989. Valuation of an Amazonian rainforest. Nature **339**:655–656.

Sedjo, R. 1983. The comparative economics of plantation forestry: a global assessment. Resources for the Future, John Hopkins Press, Baltimore, Maryland.

Tobias, D., and R. Mendelsohn. 1990. The value of recreation in a tropical rainforest reserve. Ambio **20**:91–93.