FORESTS IN BALANCE – LINKING TRADITION AND TECHNOLOGY [XII IUFRO WORLD CONGRESS]

NON-TIMBER FOREST PRODUCTS --- TRADITIONAL PRODUCTS AND TECHNOLOGIES

Proceedings of the IUFRO Division 5 Research Group 5.11 Technical Sessions

8-13 August 2005, Brisbane Australia

Cover photo: A pygmy boy stands in front of a mature *Baillonella taxosperma*, used for timber, edible oil and fruit, as well as the medicinal qualities of its bark. Image taken by Gilbert Abanda

For more information regarding IUFRO Research Group 5.11, or to request additional copies of this proceeding contact:

Jim Chamberlain, Ph.D.,CF
Research Scientist, Non-Timber Forest Products
Coordinator, Research Group 5.11 (Non-Wood Forest Products), IUFRO
U.S. Forest Service, SRS-4352, National Agroforestry Center
1650 Ramble Road
Blacksburg, VA 24060

Tel: 540-231-3611
Fax: 540-231-1383
Email: jachambe@vt.edu
Email: jchamberlain@fs.fed.us
URL: http://www.sfp.forprod.vt.edu
URL: http://www.srs4702.forprod.vt.edu/
URL: http://iufro.boku.ac.at/iufro/iufronet/d5/hp51100.htm

NON-TIMBER FOREST PRODUCTS -- TRADITIONAL PRODUCTS AND TECHNOLOGIES

Proceedings of the IUFRO Division 5 Research Group 5.11 Technical Sessions of the XII IUFRO World Congress

Brisbane, Australia, 8-13 August 2005

James L. Chamberlain, Technical Coordinator and Editor

Published by:

Asia Pacific Association of Forestry Research Institutions
c/o FRIM, Kepong
52109 Kuala Lumpur Malaysia
October 2007-09-10

APAFRI

With:

IUFRO

International Union of Forest Research Organizations

ABSTRACT

Chamberlain, J.L., tech. coord. and editor. 2007. Non-timber Forest Products: Traditional Products and Technologies: Proceedings of the IUFRO Division 5 Research Group 5.11 technical sessions, Brisbane, Australia, 8-13 August 2005. Asia Pacific Association of Forestry Research Institutions, FRIM, Kepong, Kuala Lumpur, Malaysia. 118 p.

This proceeding is a collection of 7 papers and more than 45 abstracts that were submitted for presentation at the World Congress of the International Union of Forest Research Organizations (IUFRO). This august gathering occurs every 5 years and strives to present research on current and visionary topics. The emphasis of the 2005 meeting was the link between tradition and technology and the role that forest products play in this quest. The papers address many aspects of non-timber forest products including management practices, community forestry, sustainable production, and indigenous knowledge.

KEY WORDS: Indigenous knowledge, management practices, livelihood, non-timber forest products, non-wood products, sustainability

TABLE OF CONTENTS

INTRODUCTION

James L. Chamberlain, Editor & Technical Coordinator

In 2005 the International Union of Forest Research Organizations (IUFRO) organized the 22nd World Congress in Brisbane, Australia, The theme of this august meeting was "Forests in the Balance: Linking Tradition and Technology. A major concept behind the Congress was to kindle interest among scientist and the range of stakeholders in the significance of forests and process technologies. The program was designed to reflect the importance of tradition and technology, including indigenous knowledge. It recognized the role that indigenous people have as residence in forests and as future forest managers. To this end, the IUFRO Research Group 5.11 (Non-Wood Forest Products) organized two technical sessions that explored these traditional products in a global society.

Research Group 5.11 (Non-Wood Forest Products) focuses on the discovery, development and wise use of products that come from forests but are not timber-based. This group conducts research on medicinal and aromatic plants, edible plants products, forest fungi, resins and gums, and many other non-timber forest products (NTFPs). These products have been important to indigenous people longer than the technology needed to cut timber has been around. Research focuses on a variety of topics, including harvesting techniques and effects on ecological integrity, techniques for extracting and synthesizing compounds, traditional and not-so-traditional uses of these products, and well as commercial development opportunities.

Since the 2000 IUFRO World Congress a great deal has happened to advance the knowledge concerning non-timber forest products. One of the more prominent and influential activities was a collaborative effort by IUFRO, the UN Food and Agriculture Organization (FAO) and the Center For International Research on Forestry (CIFOR) to organize a side event at the 2003 World Forestry Congress on non-timber forest products. A major issue uncovered through that effort was that "there is a profound lack of information…" Participants of the side event recommended actions to 'generate, compile, and disseminate information to key stakeholders."

Building on this need, the organizers of the NTFP technical sessions for the 2005 World Congress worked to present a synopsis of the state of scientific knowledge for the main non-timber forest products groups. The sessions were aligned with the IUFRO 2005 World Congress sub-theme: "Increasing the value of forests through innovative products and technologies." Presentations focused on communicating the current knowledge concerning major product lines (e.g., medicinals, edibles, etc.) and identifying gaps in the knowledge where more research is needed.

At the business meeting, during the 2005 World Congress, more than thirty people committed to preparing papers for this proceeding. In the end, seven authors persisted through the peer review process to have their papers published. The papers address a variety of issues, cover a broad geographic area and represent the state of knowledge in many areas. Management actions to increase yields are addressed for fuelwood, fodder, as well as rattan. The role of communities

and indigenous knowledge to assess and monitor harvest activities are examined for two African countries. The state of knowledge concerning edible forests products is presented

To expand topical coverage and to provide more comprehensive examination of the issues, I included the abstracts that were submitted for consideration. These appear as they were received with no editing or formatting. These, too, cover a diversity of issues and geography. The abstracts address issues such as sustainable harvesting, inventory and monitoring, livelihood, and domestication.

ACKNOWLEDGMENTS: All papers published herewith went through a double-blind peer reviewed process. My deepest and most sincere appreciation goes out to the reviewers, who will remain anonymous. Without their dedication this process would not have worked. I encourage readers to contact authors for more information. The contact information worked when the papers and abstracts were prepared. I also extend my thanks to the authors for their patience while I struggled to get this completed. I hope that it will be useful to the NTFP community and will inspire communications and collaboration.

EFFECT OF STEM CUTTING HEIGHTS ON FODDER AND FUELWOOD YIELD IN *MORUS INDICA* IN GARHWAL HIMALAYAS

S. K. LAVANIA[1] and VIRENDRA SINGH[1]

Abstract-- *Morus indica* is a moderate size multipurpose tree. The leaf fodder quality of this tree species is reported to be of good quality and can also be profitability utilized as a supplement to poor quality roughages. The study was conducted to determine the optimum stem cutting height of *Morus indica* to obtain maximum leaf fodder and fuel wood. The different treatments included cutting of plant stem at 10 cm (T_1), 50 cm (T_2), 100 cm (T_3), 150 cm (T_4) and 200 cm (T_5) heights. The results indicated that the maximum fresh and dry weight of leaf fodder and fuel wood and total biomass were obtained from plants whose stems were cut at a height of 100 cm. However, maximum number of branches/plant was obtained from 150 cm stem cutting height. Minimum leaf: branch wood ratio was recorded 0.56 from treatment T_1 (10 cm cutting height) while maximum 1.30 was recorded from treatment T_5 (200 cm). It is, therefore, suggested that the stem cutting height of plants from the ground level should be kept at 100 cm (1.0 m) in order to get maximum biomass in terms of leaf fodder and fuel wood.

INTRODUCTION

Morus indica is a moderate size multipurpose tree and cultivated in the state of Jammu and Kashmir, Haryana, Punjab, Uttar Pradesh, Karnataka, Tamilnadu, Kerala and West Bengal in India (Ghosh 1977). It is a deciduous tree and leaves are shed in November and December. The new leaves appear in March-April. The fodder quality of leaves is reported to be good (Mahendra 1937) and can be profitability utilized as a supplement to poor quality roughages. The leaves contain approximately 12.20 per cent crude protein on dry matter basis with *in vitro* dry matter digestibility (IVDMD) of 41.70 per cent (Chaturvedi and others 1995). The shade dried leaves can be used as poultry ration to enhance egg production (Narayana and Setty 1977). In hilly areas, trees are the major source of fodder for livestock and management practices like coppicing and pollarding at variable heights in different tree species influence the biomass production capacity (Chand and Mishra 2001). Hence, the present study was undertaken to find out the optimum height for heading back *Morus indica* for maximising leaf fodder and branch wood (fuel wood) production.

MATERIALS AND METHODS

The present study was carried out at experimental block of Department of Forestry, Hill Campus, Ranichauri, Tehri Garhwal, Uttaranchal (India) situated between 30°15'N latitude and 78°5'E longitude at an altitude of 1800 m during 2001 to 2003. One year old plants of Karnataka provenance raised in the nursery from cuttings were planted at a distance of 1.5 x 1.5 m in July 1999. Weeding and hoeing were done when necessary. After one year of establishment period, the main stem were cut in October at five heights viz., T_1 = 10 cm, T_2 = 50 cm, T_3 = 100 cm, T_4 =

[1] Department of Forestry, College of Forestry & Hill Agriculture, GBPUA&T, Hill Campus, Ranichauri – 249 199 Tehri Garhwal, Uttaranchal (India)

150 cm and T_5 = 200 cm. Each treatment having 3 plants was replicated four times in randomized block design, thus each treatment contained 12 plants.

The leaf fodder and branch wood were harvested every year in October. Number of branches, fresh weight of leaves and branch wood were recorded. The samples of leaf fodder and branches were dried separately at 85^{o}C in an oven until constant weight to record dry weight of leaves and branch wood. The sum of both components (weight of leaves and branch wood) give total biomass. The leaf: branch wood ratio was calculated by dividing the dry weight of leaves (grams) with dry weight of branch wood (grams). Three years data was pooled and analyzed statistically (Snedecor and Cochran 1989).

RESULTS AND DISCUSSION

The data pertinent to number of branches per plant, fresh and dry weight of leaves, branch wood, total biomass and leaf: branch wood ratio as influenced by different cutting heights has been presented in table 1. The number of branches per plant increased as the stem cutting height increased from treatment T_1 to T_4 (up to 150 cm). The maximum number of branches per plant (20.95) in treatment T_4 were significantly higher compared to other treatments, except T_5 at P=0.05. The increase in number of branches per plant with corresponding increase in cutting height may be due to enlarged surface area for branch sprouts. Similar results have also been reported in *Leucaena leucocephala* and *Sesbania sesban* (Misra and others 1995) and in *Morus alba* (Chand and Mishra 2001).

The maximum fresh weight of leaves varied between 127.26 to 611.99 grams per plant. The fresh weight increased from treatment T_1 to T_3. The results were similar for dry weight of leaves. The maximum fresh as well as dry weight of leaves obtained in treatment T_3 (1.00 m) differed significantly with other treatments. It has been reported that 100 cm cutting height gave maximum leafy biomass in *Chamaecytisus palmensis* and *Mimosa scabrella* (Niang and others 1995). Several other workers also have reported that cutting height influenced the leaf yield in different tree species (Krecik and others 1993; Fotadar and others 1995; Deshmukh 1998; Chand and Mishra 2001). Maximum fresh (709.37 grams per plant) and dry weight (354.33 grams per plant) of branch wood was recorded in treatment T_3 and it showed superiority over others stem cutting heights. These results are in consonance with the findings of Chand and Mishra (2001) for *Morus alba*. The total biomass per plant (branch wood and leaves) increased as the cutting height increased up to treatment T_3 (100 cm) and then tended to decline with increase in cutting heights. Thus, maximum fresh and dry weight of total biomass was recorded in 100 cm cutting height treatment. The difference in biomass was statistically significant as compared to other cutting heights at 5 per cent level of significance. Thakur (2002) also reported maximum biomass (foliage and branchwood) at 1.0 m cutting height in *Celtis australis*.

The minimum leaf: branch wood ratio was 0.56 recorded from treatment T_1 (10 cm cutting height) while maximum of 1.30 was recorded from treatment T_5 (200 cm) that differed significantly with each other (P=0.05). The highest leaf: branch wood ratio from highest cutting height may be due to the reason that thicker and heavier branches remained in the lower portion of the stem and were not removed in this treatment. Similar results have been reported in

Leucaena leucocephala (Karim and others 1991) and in *Acacia mearnsii, Chamaecytisus palmensis* and *Mimosa scabrella* (Niang and others. 1995).

The aim of present investigation was to optimise stem cutting height to get maximum biomass in terms of leaf fodder and fuel wood. The findings of the present study clearly indicated that the *Morus indica* plant should be cut at 1.0 m height above the ground level to get maximum leaf fodder and fuel wood production. However, to get more leaf yield in relation to only branch wood (leaf: branch wood ratio), stem cutting can be carried out at 2.0 m height.

LITERATURE CITED

Chand, K. and Mishra, V.K. 2001. Effect of cutting height on growth, development and biomass productivity in four multipurpose tree species of N-W Himalaya. Indian Journal of Forestry. 24 (2): 214-219.

Chaturvedi, O.H., Karim, S.A. and Mishra, A.K. 1995. In vitro dry matter digestibility (IVDMD) of roughages and tree leaves. Indian Journal of Small Ruminants. 1 (1): 50-51.

Deshmukh, H.K. 1998. Studies on the performance of wheat and soybean as intercrop with *Grewia optiva* pollarded at different heights. M.Sc. Thesis, Dr. Y.S. Parmar University of Horticulture and Forestry, Solan (H.P.), 90 p.

Fotadar, R.K., Dhar, A., Dhar, S. and Mukherjee, P. 1995. Effect of different pruning height on the mulberry yield and silkworm rearing. Indian Journal of Sericulture. 34 (2): 105-109.

Ghosh, R.C. 1977. Hand book of afforestation techniques. Controller of Publications, Delhi, 411 p.

Karim, A.B., Rhodes, E.R. and Savill, P.S. 1991. Effect of cutting height and cutting interval on dry matter yield of *Leucaena leucocephala* (Lam.) de Wit. Agroforestry Systems. 16: 129-137.

Krecik, S.G., Lantagne, D.D., Gold, M.A. and Roshetko, I.M. 1993. Cutting management of *Leucaena leucocephala, Calliandra calothyrsus* and *Gliricidia sepium* for fodder production. Nitrogen Fixing Tree Research Reports. 11: 18-21.

Mahendra, I. D. 1937. The *Morus indica* in Punjab. Forest Record: 1(2), Supt. Govt. Printing, Lahore, Punjab, 39 p.

Misra, P.N., Tewari, S.K., Singh, D., Katiyar, R.S. and Singh, D. 1995. Effect of coppicing height on the regeneration and productivity of certain firewood shrubs in alkaline soils of north Indian plains. Biomass and Bioenergy. 9 (6): 459-463.

Narayana, H. and Setty, S.V.S. 1977. Studies on the micropropagation of *Morus indica* leaves in layers mash on health, production and egg quality. Indian Journal of Animal Science. 47 (4): 212-215.

Niang, A.I., Styger, E., Gahamanyi, A. and Ugeziwe, J. 1995. Comparative growth of 15 exotic species and provenances in high elevation acid soils of Rwanda. (eds D.O. Evans and L.T. Scott). Nitrogen Fixing Trees for Acid Soils. Nitrogen Fixing Tree Research Report (Special issue). Winrock International and NFTA, Morrilton, Arkansas, U.S.A.: 207-215.

Snedecor, G.W. and Cochran, W.G. 1989. Statistical method. 8th Ed. East-West Press Pvt. Ltd, New Delhi, 503 p.

Thakur, P.S. 2002. Effect of canopy management on vigour and biomass production potential in four agroforestry tree species from temperate region. Indian Forester. 128 (5): 493-501.

Table1. Effect of stem cutting heights on leaf and branch wood yield in *Morus indica*

Treatments	Number of branches/plant	Fresh weight of leaves (g/plant)	Dry weight of leaves (g/plant)	Fresh weight of branch wood (g/plant)	Dry weight of branch wood (g/plant)	Fresh weight of total biomass (g/plant)	Dry weight of total biomass (g/plant)	Leaf: branch wood ratio on dry weight basis
T_1	8.89	127.26±38.05 (36.82)	67.93±9.41 (36.02)	218.41±13.52 (63.18)	120.66±7.45 (63.98)	345.67±35.04	188.59±5.86	0.56±0.11
T_2	11.26	166.18±21.03 (44.46)	101.93±24.33 (45.11)	207.63±11.53 (55.54)	124.02±17.33 (54.89)	373.81±25.52	225.95±13.60	0.82±0.33
T_3	13.48	611.99±188.73 (46.32)	261.40±119.83 (42.45)	709.37±210.36 (53.68)	354.33±108.35 (57.55)	1321.36±385.85	615.73±128.17	0.74±0.16
T_4	20.95	291.00±61.63 (47.96)	146.72±20.42 (45.32)	315.75±12.86 (52.04)	177.00±14.70 (54.68)	606.75±45.90	323.72±8.16	0.83±0.18
T_5	19.40	220.29±45.91 (57.67)	111.50±6.84 (56.54)	161.70±10.98 (42.33)	85.72±13.14 (43.46)	381.99±41.85	197.22±18.65	1.30±0.16
P=0.05	3.80	195.98	84.56	279.88	142.18	471.81	224.57	0.28

Values in parentheses indicate the per cent contribution of leaf and branch wood in total biomass

COMMUNITY-BASED STOCK ASSESSMENT AND MONITORING SYSTEM (CB-SAMS) FOR NON-WOOD FOREST PRODUCTS IN COMMUNITY FORESTS IN CAMEROON: A methodological guide.

MBILE, P.[1], P. PA'AH[2], L. POPOOLA[3], Z. TCHOUNDJEU[4], J. NCHOUTMBOUBE[5], G. NDZOMO-ABANDA[6]

Abstract -- In 1995, the Government of Cameroon enacted an innovative policy to decentralize the management of its forests, and promote greater participation by local communities and indigenous groups. The purpose of the policy was to improve community livelihoods through increased access to, and benefits from, greater and more systematic use of a diverse range of forest resources besides timber. Since introduction of this policy, mechanisms proposed and used in community forests, added no value either to indigenous practices seeking to build local capacity or to the natural asset base in long-term forest management for multiple objectives. In order to support government policy and develop an agroforestry strategy for protected areas in which communities can adapt the management of non-wood forest products (NWFPs) to their livelihoods, the World Agroforestry Centre embarked on a low-cost, process-driven assessment and monitoring system for non-wood forest products. The process is built on indigenous knowledge, capacities, and practices that empower local users in resource accountability. It solicits very wide local participation and facilitates integration of scientific and local knowledge and methods. This paper presents that methodology, its development, structure, application, some sample results, perspectives and draw-backs.

INTRODUCTION

A legislative framework for forest decentralization

In 1994, the Government of Cameroon enacted its watershed [i]Forestry and Wildlife Laws, to amongst other things, decentralize forest management and increase the participation of local communities in their management (Brown 1999). Some of the strengths and weaknesses of these acts have been discussed in detail by Ekoko (1998) and Egbe (1997). These laws, which ushered in the 'Community Forest' politic, can be considered more or less, to be one of the most important post independence policy actions in relation to local access rights to forest resources, always a burning issue since independence (Oyono 2003; Bigombe 2003).

Although the laws re-enforce common knowledge that the state is the principal owner of all forest domains (Barume 2004; Diaw and Njomkap 1998), it also sets a legal precedent however theoretically, for communities to exercise traditional control over forest resource use and by implication re-kindling notions of traditional ownership (Bigombé 1996; Bomba 2004). With the authority largely in favour of the state 'Community Forests' thus became a meeting point of

[1] World Agroforestry Centre, BP 2067, Messa, Yaoundé, Cameroon; Email: p.mbile@cgiar.org
[2] Chairman, Board of Directors, Agroforestry Cooperative of the Tri-National, Cameroon, caft_cameroun@yahoo.fr
[3] Professor, Forest Resources Management, Dean of Postgraduate Studies, University of Ibadan, Nigeria; Email:labopopoola@yahoo.com
[4] Principal Scientist, ICRAF WCA HT regional representative. Email: z.tchoundjeu@cgiar.org
[5] Student Intern with World Agroforestry Center
[6] Student Intern with World Agroforestry Center

policies put in place by the state, aimed at 'legitimizing' community access and user-ship. Ironically, in this new dispensation, communities are expected to 'manage' these community forests and derive livelihood from them[ii] with the State retaining the right to break that agreement and reduce community freedoms in the use of the forest, if it feels that prevailing management practices are un-systematic and disorderly.

Cutting the rhetoric and adding value to the policy

The more rapid advance of policy, institutional and social analyses of forestry decentralization in Cameroon needs no emphasis. That these aspects have received extensive reviews (Oyono and others, 2003; Oyono, 2004a, 2004b, 2005; CARPE 2000; Brown and Schreckenberg 2001; Etoungou 2003) at the expense of technical accompanying aspects for forest management is perhaps one reason why the contribution embodied in this paper should be valued.

Need for a Community driven approach to forest management

However valuable issues of governance, institutional reform and transparency, local empowerment remain key to the up-take of the process by local communities. To add value to the process by supporting policies with accompanying technical measures is to help develop the management process to frame the philosophical, methodological and practical challenges associated with on-going use and 'management' of natural resources (Gunderson 1999). On such basis the management premise becomes very simple: policies, even by Governments, are experiments within the local socio-cultural and economic context. In truth all stakeholders are expected to learn from them. Even where there is supposed incompatibilities between community realities and the early results of policies, we realize increasingly that, these are often the result of the absence of a system of valorization, integration of local knowledge and their adaptation to solving common problems.

Examples (Abbot and others 2000; Hackel 1999; Wild and Mutebi 1996) exist to support the notion that communities are more likely to meet goals for which forestry policies are intended if technical partnerships, collaborative approaches and capacity development in sustainable and collaborative management methods are re-enforced.

It is only under such conditions of partnership that the hypothesis, that forest management by local communities can increase equity, enhance resource sustainability and empower communities technically and materially to become better partners in sustainable forest management can be attained. One important domain that requires strengthening has thus been the Non Wood Forest Product management sector.

Many tropical non-wood forest products existing in these community forests have been documented regarding the roles they play as food, medicine and in terms of other services they provide to indigenous peoples (Okafor 1991; Falconer 1990; Leakey and Newton 1994). The exploitation, uses and commercialization of these tree products constitute important subsistence activities of farmers living around and in these forests (Ndoye and others 1998). For some of these species, existing markets have expanded within and outside their wide ecological range (Cunningham and others 1997; Tabuna 1999). In addition, great potentials for their further development at industrial level exists (Leakey 1999).

Although it has been recognized that market expansion for these products would increase the value of the community forest and benefits for forest dwellers (Peters and others 1989), growing poverty and insufficiently developed technical skills at community levels hinder their full development. Therefore, the sustainable development of these trees and their products will depend very strongly on both the recognition by local populations of the relationship between conserving their genetic diversity and ensuring their fullest use (Paludosi and others 1999), as well as developing techniques for their scientific and sustained management.

One of the most viable approaches that reconcile both improvement in welfare of local populations and forest products conservation can be to increase aggregate forest products supply through the productive and dynamic management of NWFPs using Agroforestry approaches (Leakey and Newton 1994; Sanchez and Leakey 1997).

Agroforestry: An integrated natural resources management approach

Today, a number of agroforestry-related scientists are offering new strategies that promote agroforestry as a means of improving local livelihoods while conserving important plant species and ensuring essential environmental functions. Brossius and Russell (2003) propose to "reinvent" community-based conservation by suggesting the principle of "building natural, social and economic assets across generations". Leakey and Tchoundjeu (2001) have made first rate progress in concepts and practices of domestication and marketing of indigenous fruit trees in the humid tropics of West and Central Africa, thus supporting conservation through use. Schroth and colleagues (2004) recently authored a synthesis of the benefits that agroforestry can offer biodiversity conservation in tropical landscapes. They identified three hypotheses on how agroforestry can contribute to conservation: (1) agroforestry can protect nature by reducing pressure to deforest land, (2) agroforestry can provide habitat for native plant and animal species, (3) agroforestry can serve as a benign matrix land use for fragmented landscapes. However they all agree that, integrating agroforestry into conservation is a major policy, institutional and technical challenge.

When in 1994/5 the Cameroon Government through its Forestry and Wildlife Laws provided a policy framework supporting community forestry and explicitly creating agroforestry zones within protected area landscape, it became obvious that ways and means needed to be developed to add value to NWFPS and modernize this traditionally subsistence practice, such that it can better support livelihoods, lead to economic growth and be better integrated into regional and international economic activities. The technical challenge of the dynamic management of NWFPs through agroforestry approaches within community zones of forested landscapes is thus the subject of this paper.

Community Based Stock Assessment and Monitoring Systems – the CB-SAMS concept

Considering that following many years of traditional use of forests, local people have accumulated profound technical and spatial knowledge about their forests; and considering that, the ultimate goal of community forestry is the wellbeing of local people, through the systematic use of the wide range of forest products, it became logical that , a system was needed which combined local knowledge systems, as well as their needs, if forests management was going to be optimized and local people empowered.

In 2004 therefore, researchers at the world Agroforestry Center started developing CB-SAMS which is a Non-wood Forest Products management tool developed and being tested as part of the Centre agroforestry strategy being developed for Protected Areas landscapes and as an accompanying measure to support the community forestry politic. For CB SAMS to be effective however, it must be able to address key knowledge questions regarding NWFPs in agroforestry zones.

Key research questions for NWFP management in Agroforestry zones

To ensure the dynamic management of NWFPs within agro-forestry mosaics some key questions need to be answered. These include amongst others, the following:

- What is the existing stock of relevant species which can be managed?
- How is this stock distributed in relation to its gene flow, other land use practices or use types?
- What information already exists about the agriculture-forest mosaic, what is the legal status? What are the management objectives and who owns the process?
- What is the level of biometric rigour required in assessing the stocks?
- Who is being empowered in the assessment process?
- How can Indigenous Spatial & Technical knowledge (ISTK) be best used in the process?
- How can the widest local participation & involvement be achieved?
- How can the results be translated into productive and sustainable agroforest management?

While this paper aims to demonstrate how we have been able to address some of the questions above, gaps still exist regarding responses to equally pertinent questions below, such as:

- What is the productivity per unit time and area?
- What is the quantity or amount of sustainable yield that can be prescribed for harvesting?
- What specific sustainable harvesting techniques in term of season, methods, tools, are appropriate for the products?

These gaps highlight the importance of further development of quantitative assessment methods to support the community forestry policy, without which the process will be incomplete.

Quantitative assessment methods and their appropriation by community stakeholders remain a critical issue to local empowerment of the community forestry development process. Although crucial in managing NWFPs quantitative assessment methods to date remain inadequate in dealing with local community needs in forest management.

Current levels of scholarly knowledge

Assessment of NWFPs is a rapidly growing field of considerable interest to people working across a wide range of disciplines and varied contexts. Works carried out in Cameroon like Sunderland eand others (2003) and LBZG (2002) modelled after previous approaches by Sunderland and Tchouto (1999) on NWFP assessments in Cameroon are worthy of being cited. These transect-based approaches are often carried out as one-off activities, with local people being used mainly as guides and labourers, not as participants. Despite these draw-backs in terms of community empowerment, use of local technical and spatial knowledge, and of new

information and communications technologies, these transect-based methods are still widely practiced.

However, within or without Cameroon, few reviews of the current state of NWFPs assessment in terms of the major difficulties encountered, as well as the main research needs, can equal the exhaustive works published by Wong (2000). This review concisely summarises the current state of research in NWFPs assessments. Wong's work was the product of a workshop organized by the European Tropical Forest Research Network in the spring of 2000, to review the biometric quality of NWFP assessments. The presentations reveal that despite the focus on more 'scientific' approaches as opposed to 'local knowledge-based' ones there was a disturbing lack of statistical rigour in many studies already carried out.

Wong (2000) reviewed close to 400 references of which 97 described quantitative assessments. Of these, only 38% were considered to have used biometrically sound methods. The review thus concluded the main difficulties encountered in this field amongst others to be that, traditional inventories cannot be easily adapted to NWFPs as these would require separately researched and adapted sampling designs, mensuration and monitoring techniques, including theoretical models, if sustainability issues are to be adequately addressed. The review also stressed the need for novel sampling designs and cross-disciplinary efforts, extensive use of local technical knowledge and an emphasis on the empowerment of local resource users.

The review thereafter went on to make certain recommendations amongst which are the need to always consider sound assessment of NWFPs populations and dynamics when considering utilisation of these resources. In addition, there is a clearly expressed need from field workers for NWFPs inventory methods that are simple and easy to use but at the same time are adequate for the determination of stocks and harvest levels. Finally, Walker, and others (1999) observes that local ecological knowledge has been shown to provide important insights into sustainable harvesting practices and there is therefore a need to evaluate and use this sets of information. Methods need to be identified and developed to better represent local knowledge so they can be systematically compared with, and linked to scientific knowledge. For instance, in dealing with the multiplicity of life forms always encountered in NWFP assessments, proposes that it may be more efficient to provide advice based on local indigenous knowledge and in a form that assists the practitioner to design a protocol that fits the peculiarities of a particular species, product, local capacity, objectives and even the land use mosaic as they may occur in the field.

METHODOLOGY

Main Features and Application in Cameroon

CBSAMS is a progressive methodology that seeks to achieve total monitoring of NTFPs resource species and 'effective quantification' of marketable products from community forests under a common property regime as it would exist within a Community Forest (CF) setting.

To proceed, the CF is clearly identified with determined limits using the approved map that is part of the Management Agreement for the CF with the State. A number of sensitization meetings are held to discuss the objectives, methodology and justification of activities, especially with the main user groups (women and Pygmies) as well as with the Community Forest

Management Committee (CFMC), charged with overseeing the management of the CF. Participatory mapping of the forest is carried-out with emphasis on bringing out its different land use types with the aim of designating fairly homogenous monitoring strata in terms of land use types or management objective. The limits of these land use types or strata are then clearly marked-out and annotated on the participatory map as blocks. The description of the different strata in the participatory mapping process is carried-out according to community perceptions, priorities and criteria, to ensure that the local community completely owns the legend developed for the participatory map.

A local mental assessment of the relative proportions of the different Strata is then carried-out with the communities with the aim of putting percentages (%) to the different Strata represented in the legend. This is developed by the communities in terms of the different land use types or Strata (e.g. fallow forest -X%, habitation zones-Y%, logged and un-logged area-Z%). Though these proportions are based on perceptions and therefore, only approximated proportions, they need to be confirmed during field studies using Global Positioning Systems and where affordable through the use of sattelite imagery such as the high resolution Quickbird. Such participatory exercises have been found very useful later-on in improving the [7]accuracy of land use maps.

The participatory map and the legend are then manually copied on to ordinary brown paper and on A4 format while still in the field with the Strata clearly indicated. A base-map of scale 1:200 000 (which should be identical in scale with the map used in the approved CF dossier) and covering the research site is scanned into a Geographic Information System as a JPEG image geo-referenced into real-world coordinates and saved at a scale of between 1:25000 and 1:50000. Print-outs at the same scale are then produced for field use. The participatory map of the forest and its strata are then 'integrated' by on-screen digitizing into the GIS and a graduated coloured legend is created for its different strata (the Arcview extension Xtools may be required to do this).

In Cameroon, the maximum surface area of a CF is 5000 hectares (ha). The community forest used in developing this methodology is 4590 hectares (CODEVIR,). From our pilot activities a team of two tree spotters (one from a local NGO and the other from the local community) working on a tree species spotting survey can cover a Task Area (TA) of 700 ha in 60 days working 4-5 hours a day during NTFP resource species (NTFPrs) reconnaisance surveys. The spotters work on the basis of their knowledge of the forest, driven by the need for such information in the management process and with the aim of covering every part of the TA and not just a sample as would be the case in statutory inventories.

A stratum of more than 700 ha can have more than one TAs, just as more than one stratum with a surface area less than 700 ha can constitute a single TA. The GIS-based participatory map will thus be divided-up into Task Areas (TA) and each TA given out to a 2-person team of resource species spotters drawn from the local NGO and from the community. Although GPS-aided navigation to TAs is possible, the local spotters know the forest very intimately so it is not often necessary to use the GOTO function of the GPS in order to Navigate to the center of the TA

[7] Note that 'accuracy' in CBSAMS refers to harmonizing technical outputs (maps) and community perceptions of their space and has nothing to do with statistical precision

while in the field. In case of doubt and having been previously trained in two operations (GOTO and taking WAYPOINTS using a Global Positioning System - GPS) the spotters go into the forest and take the readings within 20 meters of all the NTFPrs encountered in the TAs. Note that this can be done simulatneously with inventorying for Exploitable Timber (ET) trees or separately.

Several other tasks are required. A second data collection task carried-out by the tree spotters is labeling of the appropriate NTFPrs with pre-prepared aluminum tags with the species' Latin initials and an identifying number imprinted on it. A third action carried-out by the tree-spotters is a detailed description of the area around the tree, in terms of use type (farmland, forest, swamp, bushhut, etc). This information is used to improve the accuracy of the participatory map, develop a monitoring database and derive a more accurate description of the different strata. A fourth action taken with the encounter of a NTFPrs is the measurement of diameter at breast height (dbh) for all high value timber and NTFP resource species above 1 m in height. The expression $C= \pi d$. Where C is the circumference, π =3.14. d= Diameter, thus $D= C/ \pi$, will be used to determine tree diameter.

The total numbers of seedlings (to monitor natural regeneration) 1m and above per NTFPrs identified are thus counted and their dbh taken. Special care is taken here because the resting place of germinated fruits is often determined by the slope of the land and thickness of the undergrowth if not eaten or transported by animals. All observations and readings are simultaneously entered into a pre-prepared log-book, with unique sheets for each individual tree.

The GPS locations of the resource species, the identification number, species name, the description of the habitat, the diameter of the tree and the number of naturally regenerating seedlings are then integrated into the Participatory GIS (PGIS) spatial database. With the recording of the species location and the description of their habitat the participatory map can then be re-adjusted so the strata dimensions previously developed in the village participatory map more accurately reflecting the situation as encoutered in the field and integrated into a GIS (Mbile and others 2003).

Then at the start of each production season the tree spotters then go out regularly to all the Strata in which the species (now labeled and referenced) have been identified to verify if the trees have flowered and thereafter, to monitor them until they bear fruits. Once fruits are spotted on the trees, it is first verified that the trees were positively identified previously and that their references are already taken and stored. If not, this is done (identification number, species, diameter, stratum, and regeneration, land use system, etc).

At this stage the entire Community Forests sampled is said to have a Monitoring Framework (MF) in place and which is maintained in a computer database in CAFT offices. With the number of fruiting trees spotted and registered (not flowering trees, as storms can cause trees to lose flowers) it should in principle be posible to compute expected production and communicate the information to potential buyers so they may prepare or even pay in advance. However it still remains to be determined what quantities are expected during the season. At this stage CBSAMS asumes a more social character and differs from other attempts to research insitu methods for assesing NTFP Stocks.

CBSAMS is a community-based NTFP assessment methodology designed to link closely to other socio-economic constraints like culture, labour, technology and especially the market. NTFP production is generally a compicated affair. Studies on *Baillonella toxisperma* for instance report production once in three years (Mpeck 2006; Plenderleith and Brown 2004) and *Irvingia spp* also showing irregular production with different trees having different production cycles. Only *Ricinodendron heudelotii* has been reported in most areas to produce abundantly year in year out in the CAFT Community forests. In our previous research work in the DJA, while there was successive production for all three species in 2004 and 2005, there was little production in 2006. Hence the difficulties in carrying out medium-term quantification studies for these species. It is largely for these irregularities that it is important for tree spotters to ascertain each year that particular trees whose histories are known have borne fruit prior to carrying out forecasting to meet buyers' needs. Therefore equipment like binoculars as well as GPSs are critical tools for tree spotters.

NTFPs are collected from open access sources and sometimes under permission from License Concessions. These means that for each village-based Community-Forest Management Committee, populations compete with neighbouring villagers and with animals for products and thus not all the 'production' will ever reach the village depots. Meaning that, actual production figures for NTFP year by year as a direct result of these ecological and anthropogenic constraints can only be assessed by measuring products that actually reach the village depots, and not estimates from what different trees produce while in the forest.

This means mathematically that although the potential production can be Q^0, due to factors like accessibility problems, labour shortages, fluctuating market demand (price and Willingness To Pay) for NTFPs, off-takes by animals, or even cultural factors, the actual quantity collected/harvested and processed within the demand-based system could be $Q^1 - Q^0 . = Q$ and thus Q becomes the real quantity marketed by the community.

By working these factors into the methodology, predictive assessments according to the CBSAMS methodology become increasingly accurate with time and are always based on retrospective data (i.e., based on the cumulation of the previous seasons' harvests). This apparent constraint in CBSAMS should be viewed as a part of its realism because expected financial estimates and projections are based on actual measures of NTFP production entering the market. Thus although all the trees are monitored in the forest, only products that are recorded at the village depot are actually computed as part of the expecetd Cost-benefits ratios for that season. Therefore one immediately sees the critical value of CBSAMS as an effective monitoring system.

Thus production information from CBSAMS is based more on a comparaison with retrospective data than on the season's data alone. CBSAMS is an on-going methodology being tested. However, a presentation of some of early features for illustrative pruposes follows this section.

SOME EARLY APPLICATIONS OF CB SAMS and DISCUSSIONS

Linking biometrics and indigenous knowledge

The differentiation of the forest during the participatory mapping process using indigenous knowledge of the forest resource is the first stage of stratification. The hypothesis behind this stratification is that the growth, development, and even occurrence of resource species within different blocks is different and is determined by block characteristics such as whether that block has been logged, if it is a swamp, or whether it has been farmed or is yet untouched.

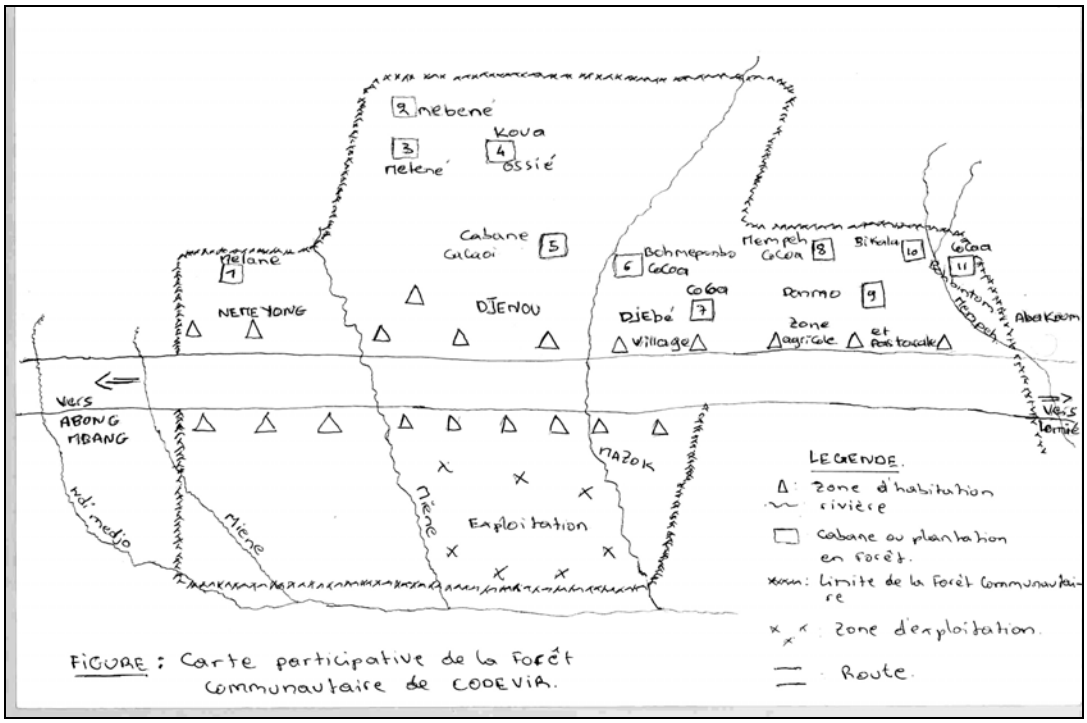

Figure 1. Results of Participatory resource map of the community forest.

This is the first stage of zoning of the community forest into fairly homogenous blocks or strata, within which targeted reconnaissance surveys and resource species sampling will be carried-out later. During the species reconnaissance survey, carried-out on a transect charted to traverse all the different strata, the position of resource species are taken using a Geographic Positioning System (GPS) device and the surrounding area described in great detail in terms of logged forest, swamp, etc. This 'ground-truthing' of species location data is later-on fed into the GIS to further improve the 'accuracy' of the otherwise, qualitative participatory, spatial analysis and zoning of the community forest. Table 1 is an example of integrating the cognitive spatial quantification exercise and GPS ground-truthing during species reconnaissance to produce a relationship between community perception of proportions (quantities) and the estimates carried-out using GPS in the field to map the different blocks.

Figure 2, the finished GIS product, shows the different land use strata, the results of reconnaissance survey showing the representation of the resource species in the different forest strata. Table 1 is thus a presentation of the 'best' cognitive estimates of the proportions of the different strata and area estimates achieved in Arcview GIS 3.2a.

Table 1. Quantitative output, based on cognitive, spatial analyses by community

Community Land use specification, blocks, strata or task areas	Approximate Area estimated after the integration of the participatory map into Arcview GIS 3.2a including modifications after reconnaissance (hectares)	Proportion (%) of different land use types according to community perception	Converting 'spatial' perception to actual Areas: surface area according to local perception based on 'proportions' allocated (ha)
Habitation, farms and, fallows	247	15	249.75
Logged primary forest	94	5	83.25
Secondary forest	688	40	666
Unlogged primary forest	636	40	666
	1665	100	

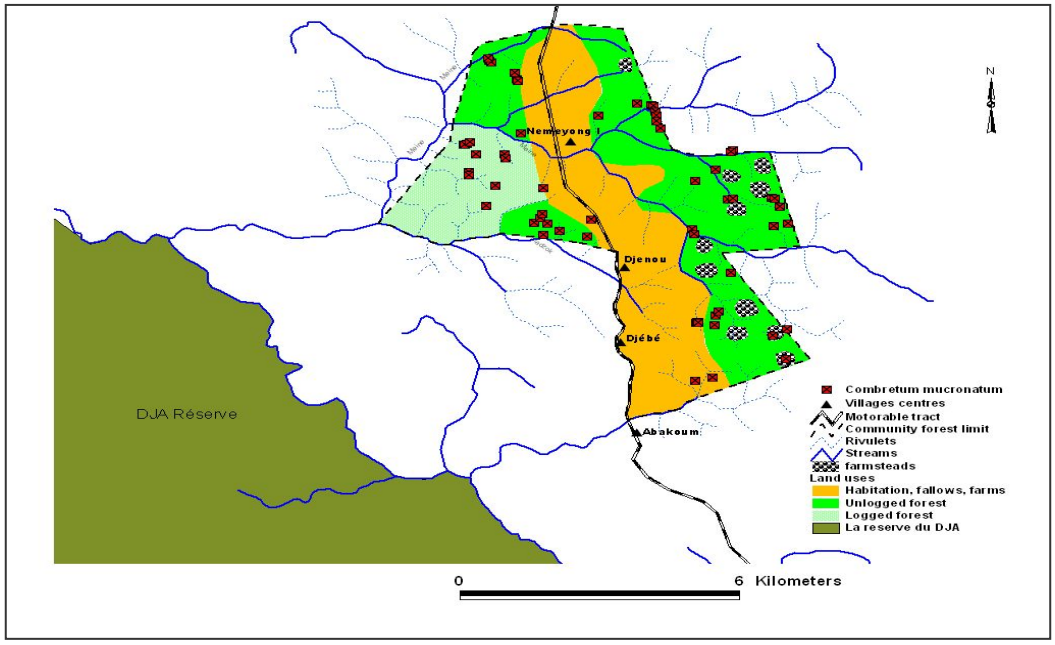

Figure 2. Results of zoning and species reconnaissance as it would be stored in a GIS by local NGOs.

CB-SAMS and local participation at village level

CB-SAMS is aimed at empowering local people in the practice of a quantitative methodology for NWFP assessment. Therefore, its application is deliberately tied to the collection of the resource by all members of the population. In addition to this the methodology is deliberately designed not to be used by 'outsiders' unfamiliar with the local technical and spatial features of the locality.

This has always been a draw-back in many traditional methods of NWFP assessments in which their application is hijacked by 'outsiders' and implementation goes on with local people participating only as guides, bag-packers or, worse, observers.

The roles of local NGOs who have more education, and linked to the community are crucial in the use of GIS and the maintenance of the computer-based information system. Local NGOs also maintain better and more regular relations with policy-makers and are therefore in a better position to bring the policy-makers to appreciate the value of such information generated at local levels.

CB-SAMS has been useful in developing land use planning at local level as well as serving as a powerful advocacy tool for increased planned access to forest resources for local communities. Figure 4 below, for instance, shows the repartition of three high-value species in two main land use systems within a community forests. This natural repartition of the species within fallows and the forest has implications for their management in the sense that, increased numbers of valuable trees in crop fields may work against farmer objectives for the farm as well as some-what weaken her/his arguments for increased access to mature forests. Likewise, the incidence of high numbers of very high-value species within the forest gives an indication of the importance of that forest resource to the farmer and in the light of the forest concession threat, for instance, such information is used by local NGOs to argue for more forest land allocation to local communities to support their dependence on especially NWFP for their livelihood.

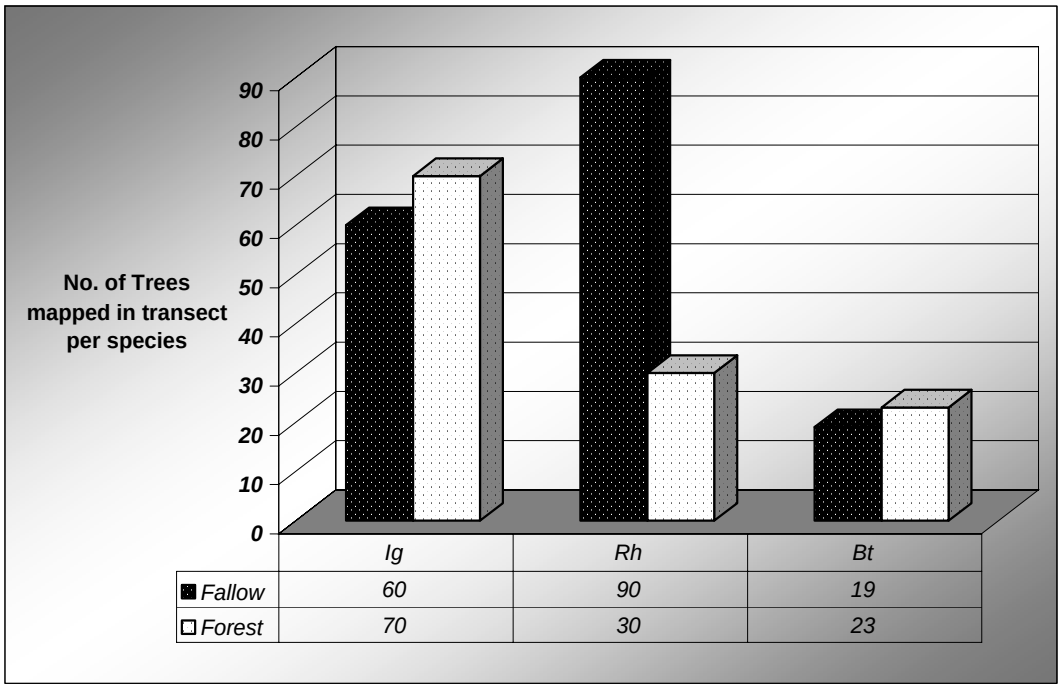

Figure 4. Repartition of species in different land use types. *Ig - Irvingia gabonensis; Rh – Ricinodendron heudelotii; Bt – Baillonella toxisperma*

Another element of CB-SAMS not necessarily unique but equally complementary is that it permits its main users, who are the community to directly link market value to land use in terms

of spatial options[8]. This has both positive and negative effects in that it is hypothesized that land use systems, from which less valuable products are derived, would tend to be 'less valued' in the perception of the local users and vice-versa for systems from which 'more valuable' products are harvested. In extreme cases, where land becomes scarce, conversion of land use into more 'profitable' uses will become an option.

However, as these perceptions depend on market factors like tastes, prices etc., and sometime on social infrastructure like roads, they can be transient, but nevertheless accords us an insight on how the value of natural resources and their relationship to spatial elements can be modeled to ensure maintenance of value and better environmental management. Figure 5 below is the result of structured information collected from local people on sales of three high-value indigenous species: *Irvingia gabonensis*, *Ig, Baillonella toxisperma*, *Bt, and Ricinodendron heudelotii – Rh*.

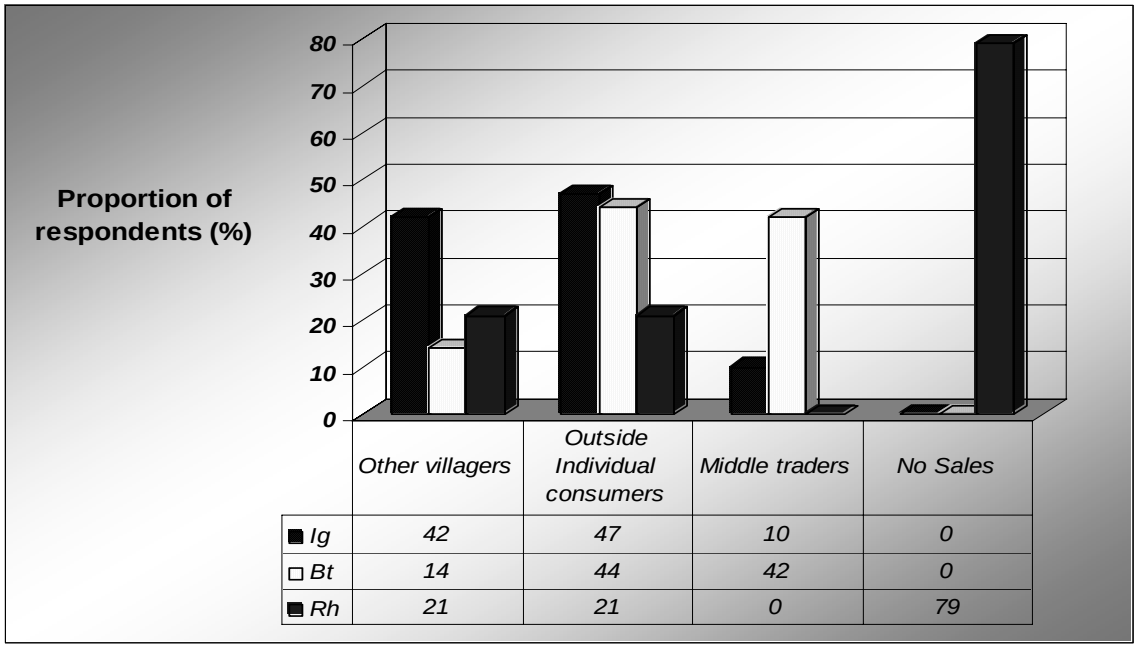

Figure 5. Comparative current market value of forest resources according to local perceptions. *Ig -- Irvingia gabonensis, Bt -- Baillonella toxisperma*, *and Rh -- Ricinodendron heudelotii*

The involvement of middle traders is the strongest indication of market value of the species. Save for cases of no sales, other villagers is the weakest indication of market value with outside individual consumers being indicative of moderate market potential.

By integrating the results on Figure 4 and that in Figure 5 we deduce that although *Ricinodendron heudelotii* is very present in fallows, its current market value is very low. Farmers take few risks and would not often put a high premium on speculation. Thus save for the fact that *Irvingia gabonensis,* of much higher value also occurs in fallows, farming practices such as burning generally deleterious to trees would have been practiced in the fallows to prepare them for crops (a more valuable option that *Ricinodendron heudelotii*). This brings out the importance

[8] The spatial dimension of this methodology is what sets it apart from other NWFP assessments methods.

of maintaining a diversity of species when dealing with indigenous trees. The main point here that resource managers need to note is that a relationship exists between the value that local people attach to land and what grows on it. And that the careful management of this relationship can influence the protection of important ecological functions in such systems. That, in order, theoretical models can be developed to better manipulate the management of certain types of land to ensure the survival of other incidental functions (such as environmental functions and not just livelihood ones) not directly linked to the short-term interests of farmers. That way, value should be added to such lands quickly enough and in ways that encourage the farmers who are after all the local 'land managers' to take an interest in their protection.

CB-SAMS can be used as an effective monitoring and resource accounting tool important for the management and for facilitating the generation of both qualitative and quantitative data on the productive characteristics of resource species which can be stored by the local NGO in a spatial database (sdb) or a GIS.

In the progressive implementation of this methodology local community enumerators progressively identify resource species within the forest which they plan to label with Aluminum plaques. These Aluminum plaques carry unique identification numbers fir the resource specie. In this way information on the species, geographical location, dbh, maturity, regeneration and health status of the tree is recorded on datasheets and entered into an NGO database. Communities can thus monitor the species' productivity, link it to the geographical/land use location and also circumvent illegal exploitation for species with multiple purposes.

CB-SAMS has been developed to be used by communities to collect production data on the resource itself (not the resource species) in the field directly empowering them in communication with potential markets in term of the actual available level of resource. This aspect of the methodology is crucial because many NWFP resource species are solicited for specific products that could be oil from seeds, resin from stems, gum from the bark, etc. A mere statement of occurrence of species is hardly indicative of economic potential and few investors would be encouraged to invest without clear and accurate knowledge of reliable approximate, available quantity of the actual product in the site.

Box 1: Financial Potential of *Baillonella toxisperma* (MOABI)

A 13-litre basket of un-cracked Moabi seeds produced 4 litres of oil kernel.
155 13-litre baskets averaged out from 8 trees produced (155 x 4) 620 litres of oil kernel.
At a ratio of 2 liters of oil kernel to 1 litre of oil as is feasible using hand pressing methods locally, 620 liters of oil kernels thus yield (620/2) 310 litres of oil. 1 litre of oil sells for 1500 FCFA or 3 USD in the village, thus under our 2004/2005 estimates, monitored production had an estimated gross total revenue of (310 x 1500) or 465 000 FCFA or approx. 900 USD
Based on a 75% fruiting rate, 71 mature trees, sampled as 53 fruiting trees, are thus capable of producing ([53/8] x 465 000) or 3,080,625 FCFA, or 6000 USD
This is part of the revenue that in principle should accrue mainly to women and girls

Box 1 presents the results of NTFP quantification within the village using data collected by the community over a period of four months. The methodology develops simple methods for measurements using the products themselves as units of measurement to facilitate data capture and understanding by all members of the community who are by default potential enumerators.

The unique aspect with CB-SAMS is that whereas an externally led survey would have had a higher figure, because perhaps the entire forest would have been evaluated, under current labour conditions, such a figure could be misleading to an external investor as local people only collect from trees whose location is known to them and whose distance from the village is not prohibitive. Therefore the data collected by the users demonstrates the 'actual situation' based on local balance between 'effort' and potential 'benefits'. And as resource accounting continues, the communities 'discover' new trees and the efforts required to harvest from them against the 'expected benefits' are thus 'traded-off' against other livelihood activities.

Some draw-backs of CB-SAMS

Despite the strengths of CB-SAMS, some of its limitations have been identified that come about as a result of its design. As explained in resource collection, monitoring and accounting B-SAMS may not be effective for species not currently considered to be of high value to local communities as the communities. This is so because the application of the methodology is linked very closely to resource used by the main users of the methodology. However, it is hoped that by accounting for most used species awareness may be raised progressively about the value of other species and the processes extended.

CB-SAMS always depend on very wide mobilization of many resource users within a community, training in adapted data collection, methods using local products, involvement of local NGOs who are the main data managers, progressive, depending on the time schedule of the community who has to progressively cover the entire forest. It can therefore be time consuming to organize and implement. Nevertheless, the flip-side of this draw-back which is wider impact, greater ownership and participation, more than compensates for the time taken to get results from using the methodology.

Because is depends on wide participation, trust and participation at local level it is likely to be most effective within fairly homogenous social contexts. Therefore it application in heterogenous social contexts would require some level of social stratification.

The statistical rigour of CB-SAMS depends on the willingness, skills and capacities of very often semi-literate people who may not be motivated at the on-set. To circumvent this otherwise catastrophic draw-back additional academic-style research at thesis level is being developed to improve statistical rigour of the entire process as well as to adapt the methodology to other life-forms and widen the usefulness of the process. However, currently random errors have been minimized by vastly increasing the sample size of all observations. Stratification of forest systems have also been used to increase homogeneity and make generalizations more relevant. As such results can only be extrapolated within strata or blocks. This need for rigorous stratification is further accentuated as different life-forms, irregularities or 'non-ordered' nature of distribution patterns means that generalizations are difficult.

CB-SAMS as Communications and negotiating tool

Finally, even at this early stage, CB-SAMS is rapidly demonstrating its role as a facilitation tool for communications and negotiations between semi-literate forest dependent communities on the one hand and policymakers on the other. CB-SAMS as an information generation tool, provides measurable content to community messages. It provides a visual and quantitative means of encoding local knowledge (though not intentions).

The choice of communication channels for community intentions is a matter of means, collaboration and external support via local NGOs who are an essential part of the process. Decoding can be facilitated by the fact that policymakers are interested in substantive outputs in sustainable forest management by local communities, and are likely to be interested in quantities, spatial relations of data and the implications, and especially, benefits accruing to the local community as what is at stake is the credibility of government policy on forest management.

Feedback, like communications channels is a matter of commitment which should also be made easy because policy-makers are the originators of the sustainable forest management intent, and thus interested in its development and success.

CB-SAMS is potentially promising as a platform for negotiation,. It should enable communities to strengthen their position with verifiable and biometrically sound data. Such data can serve as basis for the development of indicators of sustainable forest management. Negotiation between communities and policy makers can also be enhanced as mutual interest in sustainable forest management will encourage mutual movement. The ultimate goal of methodologies such as CB-SAMS is that they serve as a negotiation tool for the empowerment of forest dependent people. A tool that does not only look at 2 or 3 species but which looks at the whole range of forest products in a systematic and scientific way that adds value to local livelihood strategies.

CONCLUSIONS

The management regimes for forest resources within sub-saharan countries have been characterized during the past decades by policy directives with little or no adaptable technical packages that recognize the knowledge and potentials within the beneficiary communities. Outcomes for sustainable management of forests and of NWFPs in particular have thus experienced a dichotomy wherein on the one hand, the powers that be at both professional and policy levels have required scientifically sound methods for forerst products assesments, and on the other, very little recogition and support regarding how local knowledge systems could be incorported into the process to both enrich it and facilitate up-take and empowerment of local populations. The results have therefore been a forest products management sector characterized by two separate realities: one serving the States, donor and scientific communities, and the other still characterized by subsistence and marginalization of local populations.

By mainstreaming methods and approaches such as CB-SAMS the expectation is that local capacities in terms of knowledge in both technical and spatial domains of forest management can be successfully linked to scientific ones for evaluating and quantifying NWFPs. This way local knowledge is recognized, local populations empowered and science can be better validated against local realities and thus legitimized.

However, in the application of processes such as CB-SAMS sentivity to local cultures and capacities is a pre-requisite and the need for highly trained and motivated practitioners cannot be over emphasized. The application of this method continues however within the remit of research activities carried-out within the World Agroforestry Centre.

LITERATURE CITED

Abbot, J., F.G. Ananze, N. Barning, P. Burnham, E. de Merode, A Dunn, E. Fuchi, E. Hakizumwami, C. Hesse, R. Mwinyihali, M. Sani, D. Thomas, S.P.Trench and R. Tsombe. 2000. Promoting Partnerships: Managing wildlife Resources in central and west Africa. Evaluating Eden Series No. 3. London: International Institute for Environment and Development. 194 pp

Barume, A.K. 2004. *La Loi Forestier de 1994 et les droits des habitants des forêts au Cameroun* (The 1994 Forestry Laws and the Rights of Forest people in Cameroon). *Terroirs, 1-2, 107-119*

Bigombé Logo, P. 1996. *Contestation de l'etat et attestation d'une identité spatiale au Cameroun Méridional Forestier* [Protest against State and attestation of spatial identities in the forested southern Cameroon] *Polis 1, No. special, pp 3-12.*

Bigombe, P. 2003. "The Decentralized Forestry Taxation System in Cameroon: Local Management and State Logic". Working Paper, Washington, DC:WRI

Bomba, C. M. 2004. Législation forestière et protection des droits des populations locales au Cameroun [The forestry legislation and the protection of rights of local peoples in Cameroon]. In P. Bigombé Logo (Ed.), *Le retournement de l'etat forestiere. L'endroit et l'envers des processus de Gestion Forestière au Cameroun* (pp. 243-271). Yaoundé, Cameroon : Presses de L'UCAC.

Brossius, J.P., and D. Russell. 2003. Conservation from Above: An Anthropological Perspective on Transboundary Protected Areas and Ecoregional Planning. Journal of Sustainable Forestry. 17:39-65.

Brown, D. 1999. "Principles and Practice of Forest Co-management: Evidence from west-central Africa, Draft Report. Washington, DC: CARPE.

Brown, D. and K. Schreckenberg. 2001. Community Forestry Facing up to the challenge in Cameroon. Network Paper 25a. Rural Development Forestry Network. ODI. London.

CARPE. 2000. Results and Lessons Learned from the First Phase, 1996-2000.

Cunningham, M., A.B. Cunningham and U. Schippmann. 1997. Trade in *Prunus africana* and the implementation of CITES. Bundesamt für Naturschutz, Bonn, Germany.

Diaw, M.C. and J.C.S. Njomkap. 1998. *La terre et le droit : Une anthropologie institutionelle de la tenure coutumière, de la jurisprudence et du droit forestier chez les peuples Bantou et Pygmée du Cameroun Méridional Forestier* [The land and the law : An institutional anthropology of customary tenure, *juris prudence* and « forestry tenure » among Bantu and the Pygmies of the forested southern Cameroon] Unpublished consultancy report.

Egbe, S. 1997. "Legal Constraints to Community-Based Forest Management in Cameroon". Paprer Presented at the Workshop on "Community-based Forest Management", Nkongsamba, Cameroon.

Ekoko, F. 1998. *Environmental Adjustment I Cameroon: Challenges and Opportunities for policy reform in the forestry sector*, Washington, DC:WRI

Etoungou, P. 2003. Decentralization viewed from the inside: The implementation of community forest in east Cameroon. Working Paper Series. Washington. DC:WRI

Falconer, J. 1990. The major significance of minor forest products: The local uses and value of forest in the West African humid forest zone. Community Forestry Note 6. FAO, Rome.

Gunderson, L.H. 1999. Resilience, flexibility and adaptive management: antidotes for spurious certitude? Conservation Ecology 3 (1): 7

Hackel, J.D. 1999. Community conservation and the future of Africa's wildlife. Conservation biology 13:726-734.

Leakey, R.R.B. and A.C. Newton. 1994. Tropical trees: Potentials for domestication and the rebuilding of forest resources. Proceeding of ITE (Institute of Terrestrial Ecology) Symposium no 29 and ECTF (Edinburgh Centre for Tropical Forest) symposium no 1. Heriot-Watt University, Edingburgh.

Leakey, R.R.B. 1999. Potential for novel food products from agroforestry trees. A review. Food chemistry, 66, 1-14.

Leakey, R.R.B. and Z. Tchoundjeu. 2001. Diversification of tree crops: Domestication of companion crops for poverty reduction and environmental services. Experimental Agriculture, 37(3):279-296.

LBZG. 2002. Sustainable Yield and Monitoring System. Inventory of the CODEVIR Community Forest, East Province, Cameroon. Final Report. Limbe Botanic and Zoologic Gardens.

Mbile P., A. Degrande and D. Okon. 2003. Integrating Participatory Resource Mapping and Geographic Information Systems in Forest Conservation and Natural Resources Management in Cameroon: *A Methodological Guide*. EJISDC. 14, 2, 1-11.

Mpeck M.L. 2006. Population structure and natural regeneration of MOABI in a Community Forest in the periphery of the DJA Faunal Reserve in Eastern Cameroon: In, Peter Mbile, Ndzomo Abanda, Ann Degrande, Marie-Laure Mpeck, Zac Tchoundjeu, Catherine Ngo-Momha, Patrice Pa'ah Andre. "HOME-GROWN PLUS": Local knowledge, Livelihoods, Policies and Science. Proceedings of the Regional Workshop on Aroforestry in the DJA Landscape, Lomie 21 – 22 June 2006.

Ndoye, O., A.J. Eyebe and M. Ruiz Perez. 1998. NTFP markets and potential forest resource degradation in Central Africa. The role of research for a balance between welfare improvement and forest conservation. In: proceeding of the conference on non-wood forest products for Central Africa. Edited by T. Sunderland and L. Clarck. Limbe Botanic Garden, Cameroon.

Okafor, J.C.1991. Amélioration des essences forestières donnant des produits comestibles. Unasylva, 42(165), 1-10.

Oyono, P.R. 2003. "Institutional Paralysis, Representation and Decentralized Forest Management in Cameroon: Elements of Natural Resources Sociology for Social Theory and Public Policy". Working paper No 15, Washington, DC: WRI.

Oyono, P.R. 2004a. *Institutional deficit, representation and decentralized forest management in Cameroon. Elements of natural resource sociology for social theory and public policy* (working paper No 15). Washington, DC: world Resources Institute.

Oyono, P.R. 2004b. One step forward, two steps back? Paradoxes of natural resource management decentralization in Cameroon. Journal of Modern African Studies, 42(1), 91-111.

Oyono, P.R. 2005. From diversity to exclusion for minorities in Cameroon. In C. Colfer (Ed.), The equitable forest (pp.113-130). Washington, DC: Resources for the Future.

Oyono, P.R., C. Kouna and W.Mala, 2003. "Benefits of Forests in Cameroon: Global Structure, Issues Involving Access and Decision-making Hiccoughs", Forest Policy and Economics 7 (2005) 357-368

Paludosi, S., T. Hodgkin, J.T. Williams and N. Haq.1999 Conserving and increasing the use of Neglected and Under-utilised crop species. Article on line at http://www.ipgri.cgiar.org/nus/docs/sat21.doc [accessed November 2002]

Peters, C.M., J.M. Balick, F. Kahn and A.B. Anderson. 1989. Oligarchic forests of economic plants in Amazonia: Utilisation and conservation of an important tropical resource. Conservation Biology, 3, 341-349.

Plenderleith, K. and N. Brown, 2004, Moabi (Bailonella toxisperma) In: Laurie E Clarke and Tery CH Sunderland (eds). The Key Non-Timber Forest Products of Central Africa: State of the Knowledge. SD Publications. Technical Paper No. 122 USAID

Sanchez P. and Leakey, R.R.B. 1997. Land use transformation in Africa. Three determinants for balancing food security with natural resource utilization. European Journal of Agronomy, 7,15-23.

Schroth, G., G. Fonseca, C.A. Harvey, C. Gascon, H. Asconcelos and A.M. Izac (Eds) 2004. Agroforestry and biodiversity conservation in tropical landscapes. Island Press, Washington.

Sunderland, T.C.H., and P. Tchouto. 1999. A participatory survey and inventory of Timber and Non-timber Forest Products of the Mokoko River Forest Reserve, SW Province, Cameroon. Unpubl. Report for USAID/CARPE

Sunderland T.C.H, S. Besong and J.S.O. Ayeni. 2003. Distribution, utilisation and sustainability of non-timber forest products from Takamanda forest reserve, Cameroon. In: Takamanda: The Biodiversity of an African Rainforest (eds) Comiskey J.A.,Sunderland T.C.H and J.L. Sunderland-Groves.

Tabuna H.. 1999. Le marché des produits forestiers non-ligneux de l'Afrique centrale en France et en Belgique, papier occasionnel CIFOR, No 19, 31p.

Walker D.H., P.J. Thorne, F.L. Sinclair, B. Thapa , C.D. Wood and D.B. Subba. 1999. A systems approach to comparing indigenous and scientific knowledge: consistence and discriminatory power of indigenous and laboratory assessment of the nutritive value of tree fodder. Agricultural systems 62: 87-103.

Wild, R.G. and J. Mutebi.1996. Conservation through community use of plant resources: Establishing collaborative management at Bwindi impenetrable and Mgahinga Gorilla National Parks, Uganda. Working Paper, People and Plants 5:47 Paris: UNESCO.

Wong, J. 2000. Developing needs-based inventory methods for non-timber forest products. application and development of current research to identify practical solutions for developing countries. 4-5 May, FAO, ROME. 2000. (acessible at http://www.fao.org/DOCREP/004/Y1457E/Y1457e06.html)

[i] Law N° 94/01 of 20 January 1994 and texts of application N° 95 / 531 / PM of 23 August 1995

[ii] The National Forestry Action Plan of the Republic of Cameroon of November 1995, being Texts of Application of the Forestry and Wildlife laws of January 1994

POTENTIAL OF *DALBERGIA LATIFOLIA, EUCALYPTUS GLOBULUS* AND *TECTONA GRANDIS* LEAVES FOR DYEING OF COTTON

SUJATA SAXENA[1], P.V. VARDARAJAN[2] AND A. J. SHAIKH[3]

Abstract — Dyeing potential of the leaves of *Dalbergia latifolia*, *Eucalyptus globulus* and *Tectona grandis* collected from the forests of Western Ghats, in India for cotton fabrics was investigated. Collected leaves were dried and powdered. Dye extraction and dyeing conditions were optimised and dyed samples were evaluated for fastness to washing and light. *Dalbergia latifolia* leaves produced dark blonde, golden blonde and camel colors on cotton. Dark blonde and camel colors had moderate fastness properties and golden blonde had good lightfastness but poor washing fastness. Bamboo color with good fastness properties was obtained with *Eucalyptus* leaves. *Tectona* yielded a greyish ruby color with moderate fastness to light and very good fastness to washing.

INTRODUCTION

Forests are the source of many important products like wood, medicines etc. Many dyes for coloring textiles were also being obtained from forest vegetation in earlier days. India in its glorious past was well known for its textiles and Indian craftsmen had perfected the art of producing fast and beautiful colors on textiles using plant materials (Srivastava 1989). But synthetic dyes appeared on the scene in 1856 and these gradually replaced the natural dyes world over and in India as well on account of their easy availability in a wide array of colors, simple application procedure and superior fastness properties (Grierson and others 1985, Saxena and others 1997). Environmental considerations have once again revived interest in natural dyes as these are renewable and biodegradable. Moreover a niche market is growing world over for fabrics dyed with these dyes.

Natural dyes are especially suited for cottage industry and can be easily used by rural weavers and artisans producing traditional fabrics like ikat, bandhani, kalamkari etc. It will help in increasing their revenue and also preserve the environment. Since the traditional knowledge of extraction and application of natural dyes is now almost lost in the absence of proper documentation (Srivastava 1989), it becomes necessary to reinvent these using modern scientific inputs. There is a need to explore the vast plant resources for obtaining natural dyes with good fastness characteristics. Tree leaves can be a sustainable source as their judicious harvesting will not harm the tree. In the present study, potential of the leaves of *Dalbergia latifolia*, *Eucalyptus globulus* and *Tectona grandis* commonly growing trees in the forests of Western Ghats in India for dyeing of cotton has been investigated.

Dalbergia latifolia (Indian rosewood) is one of the finest woods for furniture and cabinet works. The leaves are used as fodder (Shastri 1952) but no use as dye has been mentioned in the

[1] Senior Scientist, Central Institute for Research on Cotton Technology, (ICAR)
[2] Principal Scientist, Central Institute for Research on Cotton Technology (ICAR)
[3] Principal Scientist, Central Institute for Research on Cotton Technology (ICAR), Adenwala Road, Matunga, Mumbai, 400 019, India

literature. *Eucalyptus globulus* (Eucalyptus) was introduced into India as fuel tree. Essential oil is distilled from its leaves (Shastri 1952) but no reports on its use as dye source are available. *Tectona grandis* (Teak) is well known for its timber. Leaves are reported to contain 6% tannins along with yellow or red dye which was used to dye silk yellow, olive and related shades. Olive brown and medium grey shades could be obtained on cotton with mordants (Chadha 1976). All three species are widely grown in plantations as their wood is of commercial importance. It is a common practice to prune the tree branches to improve wood quality thus leaves are easily available as by product from pruning and also from wood harvesting.

MATERIALS AND METHODS

Cotton Fabric

Scoured and peroxide bleached ready to dye 100 percent cotton long cloth from a local textile mill was used for this study.

Dye Material

Shade dried and powdered leaves of Indian rosewood, Eucalyptus and Teak were supplied by the Blatter Herbarium, St. Xavier's College, Mumbai. These were collected from the forests of Western Ghats in India.

Mordanting

Before dyeing, ready to dye cotton fabric was mordanted with tannic acid followed by basic alum (potash alum made alkaline with sodium hydroxide), rinsed well with water and air dried. All chemicals used were of reagent grade.

Dye Extraction

Leaf powders (60 percent on weight of fabric,) after soaking overnight in water (material to liquor ratio 1:50) were used as such and also after boiling for 15 and 30 min. cooling and making up the volume. Extraction with dilute sodium carbonate solution was also tried for Indian rosewood and Eucalyptus. Like aqueous extracts these were also used without any boiling and after boiling for 15 and 30 min.

Dyeing Trials

In preliminary dyeing trials, each of the dye extract obtained above (subjected to varied degree of pre-boiling) was used for dyeing 1 g pre-mordanted cotton fabric samples at three different dyeing temperatures viz., 27°C, 60°C and 100°C. Dyeing was carried out in glass conical flasks kept in a shaker water bath. Pre-mordanted cotton samples were introduced into the dye extract (material to liquor ratio 1:30) at room temperature (27°C) and the temperature if necessary was slowly raised to the required value. Dyeing was carried out for one hour at the end of which the dyed samples were removed, washed well with water and air dried in shade. These were assessed visually and the dye extraction and dyeing conditions giving good color as seen visually were selected.

A larger fabric (6g) was then dyed in stainless steel beakers in the launderometer using the selected procedure. Dyed samples were soaped with non ionic detergent Auxipon NP Solution (2g/L) at 60°C for 15 min, rinsed with water and air dried.

Evaluation of Dyed Samples

Color coordinates (CIELAB 1976) of samples dyed under selected conditions were determined on Jaypak computerized color matching system with D65 illuminant and 10 degree observer. Colour names were assigned by comparing the dyed fabric in tropical daylight with plates in Kornerup and Wanscher(1978). Dyed samples were evaluated for colorfastness to light on a Xenotester using AATCC Test Method 16E-1993and their colorfastness to washing was tested by IS Test Method 3361-1979 (ISO 2).

RESULTS AND DISCUSSION

Visual assessment of dyed samples in the preliminary dyeing trials revealed that three different shades could be obtained with *Dalbergia* leaves by varying the dye extraction and dyeing conditions. It was observed that the color obtained was darker at boil and brighter at lower temperature (27°C).On the other hand, very light color was obtained at boil with Eucalyptus leaves irrespective of the aqueous or alkaline extraction. Samples dyed at 27°C were visually found to have better color and pre-boiling the dye extract for 15 min further improved the color for both aqueous and alkaline extracts. Perhaps during dyeing at boil the coloring matter was getting degraded due to prolonged exposure to boiling temperature. Aqueous extraction was selected for being simpler. It was observed that good color on cotton could be obtained with *Tectona* leaves only upon dyeing at boil, lower temperatures were not satisfactory. Interestingly, pre-boiling of dye extract reduced the color yield. Dye extraction and dyeing conditions selected for each leaf powder along with the colors obtained on cotton under these conditions have been listed in Table 1.

Table 1. Selected dye extraction and dyeing conditions for leaf powders and the color produced on mordanted cotton

Plant	Extraction type	Pre-boiling time	Dyeing temp	Color produced
Dalbergia latifolia	a) aqueous	-	100°C	Dark blonde
	b) alkaline	30 min	27°C	Golden blonde
	c) alkaline	15 min	100°C	Camel
Eucalyptus globulus	aqueous	15 min	27°C	Bamboo
Tectona grandis	aqueous	-	100°C	Greyish ruby

Table 2 contains the color parameters and colorfastness properties of cotton samples dyed under selected conditions. It was observed visually that samples dyed with *Dalbergia* leaves at boil were darker and the same can be inferred from the color coordinates as their L* values (Spatial coordinate on the lightness axis) are lower in comparison to the sample dyed at 27°C. However the samples dyed at 27°C was more yellow as b* value (Spatial coordinate on the yellow-blue axis) was positive and higher. It was redder also as seen from the positive and greater a* value

(Spatial coordinate on red-green axis) and possessed stronger color which was reflected by higher C* (Chroma) value. Sample dyed at boil with alkaline extract was redder in comparison to the sample dyed with aqueous extract. All three dyed samples were predominantly of yellow color as their wavelength of maximum absorption was 400nm and their H* (Hue) values did not differ much. Lightfastness of cotton dyed with alkaline extract at 27°C was good but its washfastness was poor though there was no staining on the adjacent cotton and woolen fabric. Dyeing at boil reduced the lightfastness but improved the washfastness which made both the values satisfactory. Sample dyed at boil with aqueous extract showed slightly lower washfastness.

Table 2. Color parameters and colorfastness properties of cotton samples dyed with leaf powders

Plant		Color coordinates (CIELAB 1976)					Wave length of max. absorption	Fastness to light[a]	Fastness to washing	
		L*	a*	b*	C*	H*			Color change[a]	Staining[b] cotton/wool
Dalbergia latifolia	a)	55.62	7.68	17.97	19.55	66.87	400 nm	3	2-3	4-5/5
	b)	61.52	10.81	24.87	27.11	66.51	400 nm	4	1-2	4-5/5
	c)	53.18	9.19	17.95	20.16	62.89	400 nm	3	3	4-5/5
Eucalyptus globulus		76.30	1.35	27.0	27.03	87.14	400 nm	4	4	4-5/4-5
Tectona grandis		41.91	17.29	2.24	17.44	7.37	530 nm	2-3	4	4-5/4

a- ratings on grey scales for evaluating change in colour ranging from 1 (very poor)- 5 (very good), rating of 3 and above satisfactory

b- ratings based on grey scales for assessing staining ranging from 1 (heavy staining) – 5 (no staining)

Eucalyptus dyed cotton was brighter and almost pure yellow due to high L* value, positive and high b*value and very low a* value. Its wavelength of maximum absorption as expected was in the region for yellow i.e. 400 nm. It had good light and washing fastness without any staining on the adjacent fabrics.

Tectona dyed sample was the darkest as its L* value was the lowest. It had a positive a* value and very small b* value so it was a shade of red. Its wavelength of maximum absorption was 530 nm which falls in the region for red color. Its H* value was also very different from other dyed samples. It had fair lightfastness and good washing fastness with only slight staining on adjacent woolen fabric and almost no staining on cotton fabric. Mahale and others (2001) attempted dyeing of silk with *Tectona* leaves and found good fastness to washing and light. Perhaps the different nature of bond between the dye and silk which is a protein fibre and differences in the photofading mechanisms on two substrates may be responsible for the better lightfastness observed in their experiment.

CONCLUSION

Leaves of all the three trees can be a potential source of dye for cotton materials. As these are available as by product from wood plantations these can be used to meet the demand of natural dyes from rural weavers and artisans. *Dalbergia* and *Eucalyptus* leaves can be used to obtain different shades of yellow and *Tectona* leaves can produce greyish ruby color. Except for the golden blonde shade from *Dalbergia*, which is suitable only for infrequently washed items due to poor colour fastness, these shades can be put to various end uses like apparel, furnishings, bedsheets, wall hangings and other decorative cottage industry items.

ACKNOWLEDGMENTS

This work was a part of the project funded by United Nations Development Programme (UNDP), implemented by Punjab Durrie Weavers, Chandigarh, India. Authors acknowledge the financial assistance. Authors thank Blatter Herbarium, St. Xaviers College, Mumbai for supply of plant material and Mr. Sanjay Joshi, Mrs. Pallavi Joshi, Project Assistants and Mr. R.R. Chhagani, Technical Officer, CIRCOT for Technical Assistance.

LITERATURE CITED

Chadha, Y.R. ed. 1976. The wealth of India (A dictionary of Indian raw materials and industrial products), raw materials. Vol. 10. New Delhi: Council of Scientific and Industrial Research. 591 p.

CIELAB 1976. In: CIE Recommendations on Uniform Color Spaces, Color Difference Equations and Metric Color Terms. Supplement No.2 to CIE Publication No.15.

Grierson, S., Duff, D.G. and Sinclair, R. S. 1985. The color and fastness of natural dyes of the Scottish Highlands. Journal of the Society of Dyers and Colorists. 101:220-227.

Kornerup, A. and Wanscher, J.H. 1978 3rd ed. Reprint 1983. Methuen Handbook of Color. London:Methuen.

Mahale, G., Sunanda, R.K. and Sakshi. 2001. Natural dyeing of silk with teak leaves and its fastness. In: Proceedings natural dyes convention. Delhi: Indian Institute of Technology, Department of Textile Technology. 203p.

Saxena, S., Iyer, V., Shaikh, A.J. and Shenai, V. A. 1997. Dyeing of Cotton with Lac dye. Colourage.44: 23-28.

Shastri, B.N. ed. 1952. The wealth of India (A dictionary of Indian raw materials and industrial products), raw materials, Vol.3. New Delhi: Council of Scientific and Industrial Research. 236p.

Srivastava, M.G. 1989. Natural dyes-an overview. In: Compendium of the first national seminar on natural dyes, Jaipur. Lucknow: National Handloom Development Corporation. 124p.

MEDICINAL PLANTS AS A VIABLE MEANS OF HEALTH AND LIVELIHOOD IN THE INDIAN CONTEXT

RAGHUBIR SINGH RAWAT[1] AND RAMESH CHANDRA UNIYAL[2]

Abstract -- Forest resources including medicinal plants have always remained the principal means of health and livelihood support systems to the majority of the rural Indian population. Indian flora includes about 17000 species of higher plants, more than 50% of which are used in one or the other systems of traditional medicine in the country, benefiting about 80% of the rural population.

Medicinal plant-based industries are flourishing well in the country and the products gaining considerable popularity in the developed countries as well. Recently, the renewed interest in plant-based traditional medicine has evolved the world over, especially in the developed countries providing enhanced opportunities for the trade and industrial developments.

About 90% of the commercial and industrial raw materials are currently harvested from the wild. Their collection, transportation and sale have been generating steady off-farm employment opportunities and supporting a significant proportion of the livelihoods in remote areas where majority of the people is poor. In addition, the medicinal plant-based industries have been providing considerable employments, directly or indirectly, to a big sector of the country's population. Despite these, the expansion of the sector has exerted visible threats to the resource base at many places.

The initiatives taken by the National Medicinal Plants Board (NMPB), India have facilitated coordination among various stakeholders, formulation of policies and strategies for conservation, cultivation, research and development, value addition and marketing. Despite many constraints, the future of medicinal plants sector in India is promising which, along with industrial development in the country, is likely to serve the purpose of fulfilling a major part of the Millennium Development Goals (MDGs) in India.

INTRODUCTION

Plants have always been the principal means of therapy since prehistoric times. More than two billion people on earth depend on herbal medicines that have been significantly contributing to their primary health care needs. The various other uses of plants are in the form of food, fatty oil, essential oil, spices, condiment, fibre, dye, tan, gum, resin, etc. As majority of these plants and their products are also used for medicinal purposes, recently some scholars have considered all economically useful plants under one umbrella, the medicinal plants. However, the empiric and traditional knowledge-based uses of plants in medicine has a very long history, developed as the result of many trial and errors through generations (Anonymous 2000). The WHO has listed

[1] Chief Executive Officer, National Medicinal Plants Board (NMPB), Department of AYUSH, Ministry of Health and Family Welfare, Chandralok Building, 36 Janpath, New Delhi–110001, India
[2] Consultant, National Medicinal Plants Board, New Delhi, India

20,000 species of medicinal plants used in different parts of the globe. Various other estimates indicate the number to range between 35,000-70,000 worldwide (Bhattarai and Karki 2004).

Medicinal Plants in the Modern Societies

A large number of drugs of the modern system or allopathy were discovered from plants based on their ethno botanical uses. Further, many other pure constituents obtained from plant sources are used as drugs in modern medicine. Today, there are 120 pure chemical substances extracted from 90 species of higher plants are available as prescription drugs used in modern medicine throughout the world (Choudhary and Rahman 2002). Indian flora is represented by many of these plant species, viz. *Rauvolfia canescens, R. serpentina, Colchicum autumnale, Hyoscymus niger, Podophullum hexandrum, Cassia angustifolia, Datura stramonium, Mucuna pruriens, Taxus wallichiana,* etc., to mention a few. In addition, herbal medicine is becoming even more popular in richer countries, where the demand is being fueled by an outburst of consumer interest in natural products.

Medicinal Plants in International Trade

During the last two decades, a renewed interest in traditional medicine is seen and there has been an increasing demand, especially from developed countries, for drugs of plant origin. This revival of interest in plant-derived drugs is mainly due to the current widespread belief that 'green medicine' is safe and more dependable than the synthetic drugs, many of which have adverse side effects as well.

It is difficult to assess with accuracy, the volume or value of trade in medicinal plants. However, Intercontinental Marketing Services (IMS) data show that the audited global pharmaceutical sales reached USD 364.2 billion in 2001 (Nagpal and Karki 2004). Retail sales of personal care products in the EU stood at USD 56 billion (CBI 2001). The US market for personal care and cosmetic products touched USD 52.7 billion in retail sales. The US and EU markets alone represent a USD 108 billion market for personal care and cosmetics products – quite naturally, the global market would be substantially higher. Worldwide demand for flavors and fragrances, including blends, aroma, chemicals and essential oils, was estimated to exceed USD 18 billion by 2004. The total world market for dyes was valued at USD 4.2 billion in 1997, and various studies projected the demand to grow to USD 7 billion by 2003, with the US alone accounting for USD 3 billion. The world market for pharmaceuticals, personal care products, flavors and fragrances, and dyes is thus in excess of USD 600 billion, and it is still growing (Nagpal and Karki 2004).

The WHO has estimated the global market for herbal products at over $60 b and growing at rate of 7% per annum (Anonymous 2000). The market for herbal remedies stood at USD16.7 billion in 1997 (EXIM Bank 2003). The herbal market has been estimated at USD 17 billion for the European region (CS, 2001). Another study (Laird and Pierce 2002) places the world market for herbal remedies at USD 19.4 billion, while the Task Force for Conservation and Sustainable Use of Medicinal Plants set up in 2000 by the Planning Commission, Government of India assessed this figure at USD 38 billion in 2002 (Anonymous 2000).

It is, thus, evident that widely varying figures are quoted for the world market for medicinal plants and plant based material/products, making it difficult to analyze data relating to the

international market for medicinal plants. The industry is complex and generally hesitant to share data. Cross trading between companies is common practice and, in most cases, manufacturers do not even know the original sources of their raw materials, adding difficulties to understand the trade. Moreover, medicinal plants find applications across a range of industries, and trade statistics, where available, do not identify the plants individually and/or by application.

Based on the above, while it may be difficult to accurately estimate the market size per se, it is reasonably to assumed that the market for medicinal plants and related products is between USD 40 to 60 billion, growing at the rate of 7-10% per annum. This includes the market for end products including health supplements, cosmeceuticals, botanicals, etc., derived from medicinal plants, while the reported average annual global import of medicinal plant raw material itself stood at an average of USD 1.2 billion during the 1990s. Quite evidently, value addition to the medicinal plants is very significant as it moves up the value chain while being processed from raw material to consumer product. The value addition aspect will have significant implications for any initiative aimed at generating sustainable livelihood and marketing opportunities for medicinal plants (Karki and Nagpal 2004).

Medicinal Plants in the Indian Systems of Treatment

The Indian flora includes about 17,000 species of higher plants but the intraspecific variability makes it one of the highest in the world (Rawat and Uniyal 2004). Out of the 17,000 species, about 2000 species are used in various codified systems of traditional medicine (Pushpangadan 1995; Anonymous 2000). In India, these organized or codified traditional medicinal systems employ relatively few species, viz. 1500 in Ayurvedic system, 1100 in Sowa-ripe or the Tibetan system, 500-600 in traditional Chinese medicine, 450 in Homoeopathy, 342 in the Unani system and 328 in the Siddha system. The traditional village-based physicians and herbal healers of India are using about 4500-5000 species of plants for medicinal purposes (Anonymous 2000). In addition, various tribes and ethnic groups throughout the country are using some 4000 additional species in ethnomedicine or home remedies. All of these systems collectively constitute the Indian Systems of Medicine (ISM) that is currently providing primary health care facilities to more than 80% of the rural population of the country.

In India, like in many other developing countries, locally available medicinal plants form the primary source of medicines for traditional system of health at the community level, and the use of wild plants in medicine and for many other purposes is not merely an economic system but is, in fact, a part of the culture. These remedies are easily available in the vicinity, less expensive and, mostly, the only available sources.

Medicinal Plants Sector in Rural Livelihood

The medicinal plant sector in India is very vast and expanding. The country is a leading supplier of raw herbs to the international markets that constitute a significant proportion of the country's export trade. In India, cultivation practice of medicinal plants for industrial and commercial uses is still not well developed. The supply base of 90% of the raw materials used in trade and industries is from the wild sources, ranging from easily accessible forests to difficult mountainous regions. Their collection, transportation and sale have been generating steady sources off-farm employment opportunities and significant proportion of the livelihoods in

remote areas where majority of the people are poor. The trade in medicinal plants is an important source of revenue to the government and a major source of cash income to rural people.

In addition, many industries are involved in the manufacture of *Ayurvedic, Siddha, Unani,* and Homoeopathic drugs and preparations while, at the same time, a large number of medicinal plants are also used in various industries to produce cosmetics, health foods, etc. These industries have been providing accountable employment opportunities, both directly as well as indirectly, to a very big sector of the country's population.

Trade Structure and Practices in India

The main players in the MADP supply chain include collectors/ cultivators, local (petty) traders or agents at the village level, commission agents, wholesale merchants and retailers in the major markets, and exporters and industrial consumers. On an average, the share of the collectors in the final price paid by the consumer ranges between 10% and 58%, in most cases being lower than 33%. There is generally no contact between the collectors/growers and the end user; the primary collectors or farmers are usually unaware of the final prices, the end destination of the material, or the final form of their output (Karki and others 2003).

In Europe and some other developed countries as well, a number of partnerships have been created based on the sourcing of raw materials, often with the express purpose of contributing to environmental and social objectives, and sharing commercial benefits. The Body Shop, for example, has a Community Trade Program in order to achieve long-term sustainable relationships. In 2000/2001, over USD 0.33 million worth of natural ingredients and accessory items were procured through this program in India, including nearly 400000kgs of natural ingredients (Karki and others 2004). The Program today covers over 42 Community Trade Suppliers in more than 26 countries – many of them in Asia. Throughout the world, there are similar examples of direct sourcing relationships and partnerships for specific products. Thus, while traders and brokers perform important functions in the supply chain including purchases throughout the world or from specific areas, consolidation, analysis and quality control, rectification of sourced material to bring it up to specified norms, blending/value addition, etc., direct relationships and strategic sourcing relationships are also on the rise.

A distinctive feature of MADP trade is its highly secretive nature. Traders are well aware of the price and trends in the markets and have very strong, though informal business networks. No formal documentation is attempted, and no reliable information on prices, commissions and marketing costs are available in a regular or organized manner. A welcome trend in the recent past is towards contract farming, where identified species are cultivated as per specifications of the end user/customer, and where a direct, one-to-one relationship exists between the supplier and the customer. This is increasingly seen in the case of reputed manufacturers of Ayurvedic and herbal products in India, for instance (Nagpal and Karki 2004).

The Current Scenario

The export of herbs and herbal medicines from India is estimated at USD 272 million. India exports plant derived crude drugs mainly to developed countries, viz. USA, Germany, France, Switzerland, UK and Japan, who share between 75 to 80 percent of the total export. The principal herbal drugs having good market in foreign countries are *Aconitum spp.*, *Aloe vera*,

Atropa belladonna, *Acorus calamus*, *Cinchona calisaya*, *Cassia occidentalis, C. tora*, *Dioscorea deltoidea*, *Digitalis lanata, D. purpurea*, *Ephedra gerardiana*, *Plantago ovata*, etc. (Anonymous 2000; Karki and others 2004).

Many studies have highlighted depletion of many valuable species due to unsustainable harvesting practices while others have blamed the pharmaceutical companies being responsible for inefficient, imperfect, informal and opportunistic marketing of medicinal plants. The main characteristics of trade emanating from India as well as other South Asian countries can be summarized as follows:

- Medicinal plants are mostly traded in raw forms, with little or no value addition and thus low prices and, regrettably, the sector has an insignificant presence in the finished products market.

- Collectors and farmers are unorganized and largely unaware of the inherent value of their produce. This has led to inequitable trade practices with middlemen cornering profits disproportionate to their inputs while only a small fraction of the final price finds its way to the base of the chain.

- Due to lack of basic education and awareness, there is a tendency towards over harvesting of the most valuable or most popular plant species exerting threats to biodiversity in general and the resource base in particular. The growing practice of supplying spurious and/or adulterated raw material in the market is yet another consequence of unfair and unregulated trade practices.

Major constraints in systematic exploitation of the vast potential available include:

- Lack of official data regarding organic production/consumption/trade/prices. There is no adequate transparency in market operations making scientific assessment and an integrated strategy difficult to conceptualize and implement;

- Lack of resources among collectors/cultivators – funding, transportation, storage facilities and market information, to name a few. To that extent, middlemen do perform a necessary role, through at a disproportionately higher cost;

- Lack of coordination between different elements of the supply chain from the supplier to the consumer – includes various intermediaries such as logistics, service providers, and facilitators like trade agencies and the Government;

- Lack of understanding about, and the ability to operate within, a complex marketing chain/channel encompassing national and international boundaries and cutting across socio-economics and political landscapes;

- Mindset issues on quality, logistics, availability, certification, etc., in connection with material emanating from the region. International customers remain skeptical about the credibility of commitments made (Anonymous 2000; Karki and others 2004).

Initiatives of the National Medicinal Plants Board

The National Medicinal Plants Board (NMPB), India set up by the government to act as an agency responsible for coordination of all matters related to medicinal plants, including drawing up policies and strategies for conservation, cultivation, research and development, value addition and marketing in order to manage and sustainably develop the sector.

With a view to give impetus to the on-going activities and overall development of the medicinal plants sector in India, the NMPB has formulated and implemented promotional and commercial schemes for providing financial assistance to a range of stakeholders including growers, traders and manufacturers. The promotional schemes are mainly aimed at bringing awareness about the overall importance of the medicinal plants sector besides covering basic studies in areas like survey, inventory, applied research and development, *in situ* and *ex situ* conservation and management, production of quality planting materials, value addition, assessments of resource base, demand and supply, developing database on marketing information system, extension activities, etc. The commercial schemes are aimed at the creation of innovative market value addition in the techniques of production, harvesting, processing, storage, packaging and contractual farming (cultivation) of medicinal plants. Contractual farming is mainly meant for farmers cultivating medicinal plants on a large scale.

Thirty-two State Medicinal Plant Boards (SMPBs) have been established for smooth functioning of the medicinal plants sector in the States. Over the last three years, more than 2200 projects have been sanctioned to various government and non-government agencies and these are being implemented in different parts of the country. More than 62,000 acres have been brought under cultivation of species with high value and demand; and 35,000 acres have been preserved to ensure conservation of rare, endangered and threatened species. In this process the Board has generated five million man-days of employment. The prioritized medicinal plant species considered by the projects are –

Serial No.	Common Name	Botanical name
1	Atees	*Aconitum heterophyllum Wall. Ex Royle*
2	Kutki	*Picrorhiza kurrooa Benth. Ex Royle*
3	Kuth	*Saussurea cstus C.B. Clarke*
4	Chirayita	*Swertia chirayita Buch-Ham*
5	Kesar	*Crocus sativus Linn*.
6	Amla	*Phyllanthus emblica L.*
7	Ashwagandha	*Withania somnifera (Linn.) Dunal*
8	Senna	*Cassia angustifolia Vahl*.
9	Isabgol	*Plantago ovata Forsk*
10	Guggal	*Commiphora wightii (Arn.) Bhandari*
11	Mulethi	*Glycyrrhiza glabra Linn.*
12	Aloe	*Aloe vera Tourn. ex Linn*.
13	Safed musli	*Chlorophytum borivillianum Sant.*
14	Kalmegh	*Andrographis paniculata Wall. Ex Nees*
15	Stevia	*Stevia rebaudiana Bert*.
16	Coleus	*Coleus barbatus Benth*

17	Kokum	*Garcinia indica Chois*.
18	Bach	*Acorus calamus Linn*.
19	Brahmi	*Bacopa monnieri (L.) Pennell*
20	Pippali	*Piper longum Linn*.
21	Chandan	*Santalum album Linn*.

CONCLUSIONS

By ensuring conservation, sustainable management and cultivation of commercially viable medicinal plant species, the local communities in India stand to benefit immensely. Such initiatives would generate local employment, enhance the standard of living and subsequently play an important role in the economic development of the region. There is also a need to create opportunities for increasing the flow of economic benefits derived from the collection and sale of medicinal plants, to the local communities through launching other programs such as agricultural development, rural development watershed management and agro-based export promotion. Local economic and social development initiatives aimed at value-addition and processing on medicinal plants are the inevitable needs for the long-term development of the medicinal plants sector in India including production of quality assured products meeting international phyto-sanitary standards.

Finally, in the Indian context, despite enormous constraints, medicinal plants have been contributing significantly towards health care facilities to the majority of its population while providing considerable employment opportunities to a big sector of the population. The major problems, constraints and shortcomings associated with the sector have already been identified and measures to address them have already been initiated at different levels. Therefore, it is likely that in near future, the medicinal plant sector in India is likely to provide increased health care facilities and livelihood opportunities and, on the whole, contribute to the realization of the Millennium Development Goal (MDG).

LITERATURE CITED

Anonymous. 2000. *Report of the task force on conservation and sustainable use of medicinal plants of India*. Planning Commission, Government of India.

Anonymous. 2004. *Cultivation of selected medicinal plants, National Medicinal Plants Board, India.*

Bhattarai, N. and Karki, M. 2004. Medicinal and Aromatic plants: Ethno botany and Conservation Status. In: J. Burley, J. Evans and J. Youngquist (Eds.). *Encyclopedia of Forest Sciences*. Academic Press, London, UK. Pp.523-532.

CBI. 2001. *EU Market Survey - 2001: Natural Ingredients for Pharmaceuticals*. CBI, the Netherlands.

Choudhary, M. I. and Rahman, Atta-ur. 2002. Recent Trends in Medicinal Plants Research. In: N. Bhattarai and M. Karki (eds.), *Sharing Local and National Experience in Conservation of*

Medicinal and Aromatic Plants in South Asia. Ministry of Forests and Soil Conservation, HMG/Nepal and Medicinal and Aromatic Plants Programme in Asia (MAPPA), International Development Research Centre (IDRC), SARO, New Delhi, India. pp. 62-66.

CS. 2001. *Commonwealth Secretariats Guide -2001: A guide to the European market for medicinal plants and extracts*. Commonwealth Secretariats, London, UK.

EXIM Bank. 2003. *Exporting Indian Healthcare. Road beyond boundaries (the case of select Indian Healthcare System).*

Karki, M., Tiwari, B.K., Badoni, A.K. and Bhattarai, N. 2003. *Creating livelihoods enhancing medicinal and aromatic plants based biodiversity rich production systems: Preliminary lessons from South Asia.* Paper presented at the 3rd World Congress on Medicinal and Aromatic Plants for Human Welfare (WOCMAP III); Feb. 3-7, 2003, Chiang Mai, Thailand.

Karki, M. and Nagpal, A.. 2004. *Marketing Opportunities and Challenges for Medicinal, Aromatic and Dye Plants*. Paper presented at the International Conference on Medicinal Herbs and Herbal Products: Livelihood and Trade Options. 26-27 March, New Delhi, India.

Karki, M. Rawat, R.B.S. and Uniyal, R.C.. 2004. *Revitalizing South Asian Heritage of Traditional Medicine and Medicinal Plants*. IDRC, New Delhi, India.

Laird, S.A. and Pierce, A.R.. 2002. *Promoting Sustainable and Ethical Botanicals. Strategies to Improve Commercial Raw Material Sourcing.* Results from the Sustainable Botanicals Pilot Project: Industry Surveys, Case Studies and Standards Collection. Rainforest Alliance, New York, USA. (www.rainforest-alliance.org/news)

Nagpal, A. and Karki, M.. 2004. *A Study on Marketing Opportunities for Medicinal, Aromatic and Dye Plants in South Asia.* Medicinal and Aromatic Plants Programme in Asia (MAPPA), International Development Research Centre (IDRC), South Asia Regional Office (SARO), New Delhi, India.

Pushpangadan, P.. 1995. *Ethno biology in India: A Status Report.* Ministry of Environment and Forest, Government of India, New Delhi, India.

Rawat, R.B.S. and Uniyal, R.C.. 2004. Status of the medicinal and aromatic plants sector in Uttaranchal: Initiative taken by the Government of India. *Financing Agriculture* 36: 7-13

TPCG and Kalpavriksh. 2005. *Securing India's Future: Final technical report of the National Biodiversity Strategy and Action Plan.* National Biodiversity Strategy and Action Plan, Technical and Policy Core Group, Kalpavriksh, Dehli/Pune, India

APPLICATION OF PRODUCTION AND UTILIZATION TECHNOLOGIES FOR RATTAN SUSTAINABLE DEVELOPMENT OF ASEAN MEMBER COUNTRIES: A SYNTHESIS OF PRE-PROJECT

AIDA B. LAPIS[1]

Abstract -- The global threat on ecosystems and environment brought about by forest destruction and deforestation particularly in tropical Southeast Asia has a strong influence in the major shift from timber-oriented program to non-wood forest products or NWFPs such as rattan ones, among others. The principal aim of the project is to assess the status of rattan resources in the ASEAN member countries including the aspects on socio-economics. The situational analysis of rattan commodity includes analyses of production, harvesting, processing, utilization, and markets and socio-economic dimensions of rattan using benefit-cost, market trends and SWOT (strength and weaknesses, opportunities and threats) analyses. The paper presents the regional collaboration strategies in the conduct of the pre-project. It contains the prioritized researchable areas each country would be involved in bringing rattan commodity as the vehicle for community development, poverty alleviation, enhancement of raw cane materials supply to sustain local and export markets in the region.

INTRODUCTION

A common natural resource that is shared by the ASEAN member countries is the widely distributed rattans in the tropical forest. Rattans are economic species because of its remarkable value as raw material for the furniture and handicraft industries. Asian countries are known for in the global market.

It is either a commodity that the life of many most local people in the forest zones revolved around as players in the chain of activities that commenced from gathering of canes to marketing of the finished products.

The once flourishing and lucrative business of rattan furniture making now faces the acute problem of dwindling source from the natural stands. The threat on rattans was brought by unabated forest destruction, loss of habitat due to conversion of forested areas to other uses and unregulated harvesting, among others. These were recognized in the region and became the focus of the discussion meeting in 2000 when an Experts consultation on rattan development was held in Rome. In the said meeting it was emphasized that rattan is economically, socio-culturally and ecologically important to a large number of stakeholders.

In response to the significant concern of experts' consultation on the sustainability of rattan resources to meet the demand of the commodity, the Ecosystems Research and Development

[1] Chief, Land Rehabilitation Section and Project Leader, ITTO-Philippines-ASEAN Rattan Project, Ecosystems Research and Development Bureau (ERDB), Department of Environment and Natural Resources (DENR), College, Laguna, e-mail: a.lapis@aseanrattan.org, acbl2002@yahoo.com, Tel.No.: (6349) 536-2229, 536-2269, Fax: (6349) 536-4051.

Bureau (ERDB) in collaboration with the Forest Products Research and Development Institute (FPRDI) conducted a one year pre project, with financial support from the International Tropical Timber Organization (ITTO). The project is a survey on the status of the rattan production and industry in the 9 ASEAN member countries, namely, Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Thailand and Vietnam. The nine ASEAN Contact Persons (CPs) gathered the data through surveys, personal interviews, group discussions and key informant interviews. Annex A shows the list of ASEAN CPs. Other data were collected through surfing different websites and review of literatures. The Focal Persons from the Philippines validated the data gathered and assisted the CPs in revising the country report. The data and information gathered were subjected to sustainability and SWOT analyses. A regional conference on rattan was held in Manila in 2004 as a culminating activity of the project wherein representatives from the 9 ASEAN member countries presented their papers on sustainable development of rattan resources.

Based on the country reports, rattan is a very important source of livelihood for rural people but despite their importance in the socio-economic and cultural contribution, little effort has been given to manage these resources on a sustainable basis which resulted to the decline in the raw material supply (Proceedings of the Regional Conference of Rattan in Asia 2004). Inadequate knowledge on advanced production and utilization technologies has resulted in the desultory development of the rattan industry because transfer of technologies to the direct beneficiaries has not been conducted.

OBJECTIVES

This paper aims to present the output of the ITTO funded project PPD 51/02 Rev. 1 (I) entitled "Application of Production and Utilization Technologies for Sustainable Development of Rattan in the ASEAN Member Countries". The output shows assessment of the status of rattan resources in the ASEAN member countries including the aspect of socio- economics.

METHODOLOGY

The over all coordination of the project was led by the Ecosystems Research and Development Bureau (ERDB) in collaboration with the Forest Products Research and Development Institute (FPRDI). An inception meeting was held and convened the assigned focal persons. During this meeting, the strategies to meet the objectives of the pre project were decided upon such as the formulation of the questionnaire to be used in data gathering and the format in writing the country report.

Being an ASEAN wide pre-project, contact persons representing member countries were designated as per nomination of the head of research agencies working on rattans. As counterparts, the Philippines assigned technical personnel as focal persons that worked hand in hand with the contact persons of the ASEAN Member Countries (AMCs).

Using the formulated questionnaire, the contact persons collected the data in their respective countries. The contact persons were requested to draft the country report. Draft reports were sent to ERDB. The Philippine focal persons were dispatched to each AMCs to support the contact

persons in collation of data gathered and ensure that the relevant information for the study were included. The focal persons helped in the final write up of the country reports.

The country status reports were presented during the International Conference on Rattans held in Manila. The issues, problems and gaps confronting the rattan commodity in the region were identified and discussed. The priority areas for the sustainable development of rattans were set to be the subject of the future project.

The integration and synthesis of an ASEAN rattan situation was done at ERDB.

RESULTS

Production

There are about 650 rattan species in 13 Genera in the world and they are confined to the tropics. Only less than 10% of these are being used commercially. The ASEAN member countries are endowed of these highly valuable non-wood forest products that are considered next to timber in monetary value.

Natural Stands – The rich species diversity of rattans has been known as the study of their taxonomy progressed in the last two decade. Table 1 presents that Indonesia (312) ranks first in the number of taxa recognized. Malaysia ranks second with 311 species and the Philippines (96 species) ranks third. Each country reported the top 5 commercial species as reflected in Table 1.

Commercial Plantation – The countries that reported on plantation establishment are Brunei (900 ha), Indonesia (118,802 ha), Malaysia (23,157 ha), Philippines (17,395 ha), Thailand (35,292 ha) and Vietnam (25,000 ha), for cane production however, Lao PDR established plantation for edible shoot production of about 150 ha.

Conservation Plots -- Conservation plots as genebanks and germplasm collection were initiated in the Philippines (45 taxa in Laguna, Luzon and 25 taxa in Bukidnon Mindanao), Indonesia (20 species in Bogor Botanical Garden and Malaysia 33 genetic materials of 478 origins of 4 major commercial species) and Lao PDR (8 species).

Propagation – In all countries, propagation material used are seeds sourced from the wild thru the natives and aborigines except for Brunei where they source seed by importing. Generally, the seeds are extracted by maceration. Scarification and slicing the embryo cover or soaking in water overnight (Malaysia) to 10 days (Lao PDR). The germination of seeds on seedbeds is done with garden soil and humus after dressing with fungicide. Other methods of propagation are suckers and wildlings, tissue culture (Malaysia and Philippines) for selected commercial species. Potting, transplanting and care of seedling follow the usual nursery technique. Hardening of seedlings before out planting improves survival in the field.

Plantation establishment – Sites for plantation are logged over areas Philippines), tree plantation areas, mature rubber plantation (Malaysia), communal tree plantations, oil palm plantations, reforestation areas and slash and burn areas with fruit trees. Preferred sites are secondary forest with low to non-commercial significance.

Table 1. Taxonomically recognized and commercial rattan species.

Country	Taxonomically recognized species		Top 5 COMMERCIAL SPECIES
	Total	Commercial	
Brunei Darussalam	80	5	*Calamus optimus, C. ornatus var. ornatus, C. scipionum. Text says 5 but only three in the actual list, and no common names*
Cambodia	11	5	*Calamus rudentum, C. poilanei, C. tetradactylus, C. tenuis, C. viminalis (piidau). From the list of Tom Evans et al, no common names either.*
Indonesia	312	28	*Calamus caesius (sega), C. trachycoleus (irit),C. manna (manau), Calamus spp. (pulut), and Calamus ornatus (sega badak)*
Lao PDR	44	11	*4 main species: Large-diameter Calamus poilan medium-diameter C. nambariensis, and small-diameter canes C. gracilis, and C. solitarius*
Malaysia	311	30	*Calamus manna (rotan manau), C. tumidus (rotan manau tikus), C. scipionum (rotan semambu), C. caesius (rotan sega), and C. trachycoleus (rotan irit)*
Myanmar	38	5	*Calamus latifolius (yamata kyein), C. tumidus (kabaung kyein), C. platyspathus (kuet-u kyein), C. floribundus (ye kyein), C. guruba (kyein ni)*
Philippines	96	12	*Calamus merrillii (palasan), C. ornatus var. philippinensis (limuran), C. mindorensis (tumalim), C. ramulosus (panlis), C. scipionum (Malacca cane)*
Thailand	62	9	*Calamus longisetus, C. wailing, C. erectus, C. manan (wai kor dum), C. peregrinus*
Vietnam	30	5	*Calamus tetradactylus (maay neeps), C. tongkinensis (maay ddawngs), C. platyacanthus (song maatj), C. rudentum (song ddas), C. poilanei (song bootj)*

Site Preparation -- Site preparation for logged over areas is by clearing the area of trees, brushes and climbers except the timber of large pole in a strip line system. The approximate density of planting is 400 (Philippines) or 495 seedlings per hectare. Soil analysis is required to determine the sites soil amendments need. Spacing between seedlings is 2 x 2 m for solitary type and 5 x5 for clustering type. For edible shoot plantation, Lao PDR using *Calamus tenuis*, the area is cleared and plowed a week before planting. The area should be close to water source

since *C. tenuis* prefers moist places to grow. In Thailand, *C. siamensis* is grown in plantation for edible shoot.

Outplanting – The steps of rattan field planting are similar to the method of seedling planting for any forest trees species in establishing tree plantations. Rattan seedlings of 30 cm height or about 9 to 11 months old with 4 to 5 leaves and hardened for a month or two are ready for outplanting. Planting holes are dug 4 cm to 5 cm deeper than height and 4 cm wider than the diameter of earth balled root system.

Care and Maintenance – Application of fertilizer is done in almost all countries engaged in plantation establishment. For example, complete fertilizer (NPK) comes in different dosages: to wit Brunei (12-12-17 and 2 mg TE), Lao PDR (15-15-15), Malaysia (16-8-9+3Mg, Agroblen, 11-8-8+TE), and Philippines (14-14-14). Thailand applies rock phosphate. Weeding of competing vegetation with seedlings is done. Canopy opening/thinning after 9 months from outplanting increases sunlight up to 60 to 70 percent. Monitoring of incidence of pest and diseases is done to prevent attack of insects.

Harvesting from the natural stands

For edible shoot – Local people gathers young shoots from the forest as a source of income and subsistence. Indonesia, Thailand and Lao PDR harvest the shoots for food. Indonesia harvests the young cabbage of *Daemonorops* species. Lao PDR harvests the young shoots of *C. poilanei, C. platyacanthus* and *C. solitarius*, although these species produces valuable cane for furniture. In Thailand, as of 2003, the total area of plantation for shoot production is 6,216 ha that was initiated by the Royalty of Thailand in 1997 as a program of producing food from rattan and turning rattan in the food bank.

For cane – Gathering of canes is done all year round in Thailand, Myanmar and in the Philippines. Rattan permits practice rotation cutting (Diaz and Ramos 2004). Seasonal gathering by local people depends on agricultural activities. In areas where rattan industry is booming, cane harvesting in continuous. According to Bich and Lapis (2004) in Vietnam, harvesting is during the months of June to October. Tools used for harvesting are still crude, bolo, machete or axe. No mechanized cutter is used except when the Forest Research Institute, Malaysia, fabricated a cutter. Cut and pull method is applied in gathering canes. For large diameter canes, stem is cut and left for few days for the leaves and whip to dry, then it is pull down the stem and easier to clean off the stem of its leaf sheaths. Harvesting rattans is done either by groups or by families, mostly belonging to the indigenous people. Maturity of canes is observed for small diameter and large diameter at 6 yr. to 10 yr. and 10yr. to 15 yr., respectively.

Identified priority research and development projects

During the International Conference held in Manila, the countries deliberated on the research and development needs. Below are the identified and prioritized research and development projects for the production aspects:

Research

- The use of chemical induction to break the grass stage and hasten growth
- Isozyme and DNA analysis

- Regeneration system
- Proven germination techniques for lesser known species
- Potential lesser used species
- Ecophysiological site characterization
- Comparative analysis of intercropping with tree species
- Silvicultural requirements of commercially potential species
- Ex-situ conservation
- Harvesting cycle/economic rotation
- Analysis of demand vs. annual allowable cut for sustainable levels of supply and demand
- Planting technology for edible shoot production
- Technology to reduce waste in harvesting
- Appropriate harvesting tool
- Establish rattan section on national herbarium

Training needs

- Seed and seedling production and plantation development at the village level
- Taxonomy
- Harvesting methods
- Inventory techniques

Utilization aspects

Primary and pre-treatment processing- In all countries, the length fresh stems/canes are cut into 5-6 pieces and sorted according to species, size, straightness or smoothness (Ahmad and others 2004; Win Myint 2004; Diaz and Ramos 2004; Sutthisrisilapa and Puriyakorn 2004). Canes are sorted into large, medium and small diameter or may be classified as good and heavily defective (Ketphanh and others 2004; Samphan and others 2004 and Raja 2004). Initial processing includes trimming, scraping, treating, drying, straightening, grading and sorting at the village level. Splitting is also done at this stage (Tesoro 2004).

In Indonesia, canes may undergo pre-treatment of grading, washing, drying, whitening, fumigation, scraping, sorting into large and small diameter canes (Wiyono and Santos 2004). In Myanmar, Win Myint (2004) reported that pre-treatment methods include draining off of water, skin off and sun drying, smoking and diesel-cooking.

In all countries, canes are generally subjected to sanding and scraping. Further processing is done such as bending by torching, painting and finishing (Brunei Darussalam), sulfur fumigation, moulding, drilling and grooving and weaving (Cambodia), bleaching with potassium hypochlorite and water (Indonesia), straightening and bending (Lao PDR), end capping, drilling and grooving (Malaysia), bleaching using peroxide and hypochlorite (Philippines), sulfur application, bleaching with chlorine and sodium hypochlorite (Thailand) and painting, smoking and varnish and lacquer application (Vietnam).

Non-chemical method of treatments to prevent fungal stains is air drying, smoking, kiln drying and boiling in oil. Chemically, using preservatives, cane quality is improved. Water-borne preservatives like 2-thiocyanomethylthiobenzothiozole and deltamethrin are used to control

staining fungi and insect attack in the Philippines. Chemicals for bleaching are potassium hypochlorite and hydrogen peroxide (Indonesia and Philippines), and sodium hypochlorite and chlorine (Thailand).

The general processing steps for big diameter cane for furniture making is shown in Figure 1.

Products are wrapped with plastic sheets and boxed when exported while locally sold items are displayed and sent to shops without special packaging.

Primary products are the whole and split canes. The secondary products include the semi finished products like fine polished rattan, skin, separate furniture components and core. Other useful products are edible fruits, young shoots as vegetable and roots as traditional medicine. In Malaysia and Indonesia, fruit scales are extracted of coloring or dyes for ceramic coloring and pharmaceutical industry. Skin scrapings are used as filler of chair. Rattans are used for cordage, thatching, tying materials for light construction, broom handles, walking sticks and ornaments (Philippines).

In Indonesia rattan mat or "lampit" is famous export. The rattan rich countries (Indonesia, Lao PDR, Vietnam and Myanmar) produce finished products that 99% made of rattan. However, in other countries like the Philippines, rattan crafts incorporate stone, steel and other indigenous materials which can be gleaned as resulting from difficulty in sourcing canes felt by many manufacturers.

Identified priority of Science & Technology projects

Research

- Development and adoption of ASEAN grading standard
- Determination of right harvesting season to reduce susceptibility to insect destruction and staining
- Comparative study on preservation practices
- Application of existing technology on kiln drying
- Improvement of product design based on market demands
- Technology on mechanized weaving
- Development of bleaching technologies
- Preservation technologies at depot

Training needs

- Application of post harvest technologies
- Processing techniques

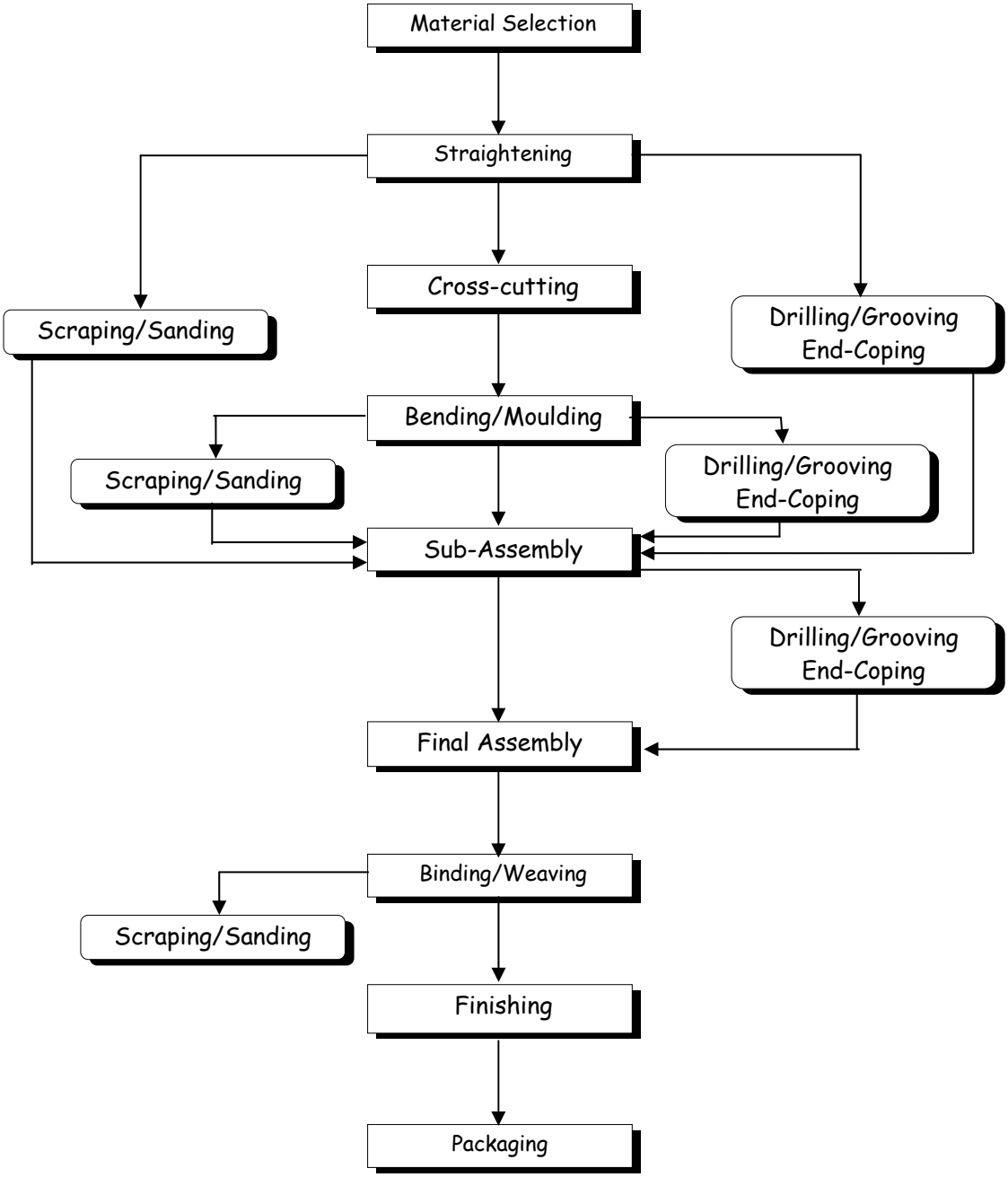

Figure 1. Rattan Manufacturing Processes

SOCIO ECONOMICS, MARKETING, POLICIES AND LINKAGES

Village level – Throughout the ASEAN region it is the village communities that depend and benefit most from rattans. Commencing from rattan gathering to weaving rattans provide livelihood to the indigenous and forest periphery dwellers. In Myanmar, about 2700 household

have evolved into a major center for rattan production (Win Myint 2004). About 4,200 households in Kalimantan, Cirebon and Central Sulawesi of Indonesia produce rattan handicrafts and traditional "lampit" or rattan mats. In Vietnam, an estimated 5000 villagers supply rattan and bamboo handicrafts to exporters. Bich and Lapis (2004) reported that the income generated for weaving rattan is 75% higher that the income from farming.

Exports – The contribution of rattan to the national economies of ASEAN countries can be gauged from the value of their rattan exports. Table 2 shows the significant export earnings of Indonesia, Myanmar, Thailand, Lao PDR, Malaysia and the Philippines. Indonesia and the Philippines rank first and second in exports.

Table 2. Export values of rattan raw material and finished products of five ASEAN Member Countries.

Country	Exports (million USD)	%
Indonesia	291.04	68.82
Philippines	96.94	22.92
Malaysia	24.00	5.67
Myanmar	10.00	2.36
Thailand	0.89	0.02
Total	422.087	100.00

/as reported in the country report-papers; figures are for 2002, except for Malaysia which is an estimated annual figure.

Prices – Prices of rattan, whether as raw material or finished product reflect the costs associated with harvesting, transporting and processing plus profit of margin. In Indonesia, profits are greatest for traders of W&S rattan who net around USD 28 per ton to USD 33 per ton of raw cane rattan, while profits are least for weavers of rattan carpets where net gain is only USD 0.70 per carpet (Wiyono and Santos 2004).

Policies – Most ASEAN countries have policies pertaining to regulation of resources and trade of rattan. They differ in scope or degree of rigidity. Malaysia and the Philippines have extensive policies regulating the harvesting and trade and promoting the establishment of rattan plantations. Permitting systems are in placed in harvesting in accordance to allowable cut. On marketing, of products, Indonesia banned the export of raw rattan in 1979 and total export ban of half finished products in 1988. However, the policy on export of product was softened in 1992 by imposing export taxes and in 1998 tax incentives were provided for the industry. In the Philippines, the industry is encouraged by providing the exemption from advanced payments of duties and taxes, some percent duty on equipment importation. Except for the Philippines where conservation measures for rattans are built in NIPAS Law, EIS System and Wildlife Act. Most countries have no known policies on biological protection and genetic conservation.

Institutional capabilities – The ASEAN countries' capabilities for research and development are provided by various academic institutions and forestry agencies. The government ministries, research institutes, and institutions take a major role in rattan development for policy formulation and implementation of regulations. Non-governmental organizations and private sectors provide the support to industry, marketing, banking needs, among others.

International Linkages – The interest on rattan as an international commodity gained the support of external organizations and funding/donor agencies. Foremost of all, FAO, ITTO, INBAR, UNDP, IDRC of CIDA,IUCN, DANIDA, IPGRI and etc.

Identified priority areas of concerns on socioeconomics, marketing and linkages

- Study on socioeconomic aspects of rattan (financial analysis, indigenous knowledge system and gender roles).
- Study on consumption patterns and market preferences.
- Review market chain to determine what is economically viable to the farmers.
- Establish a database, i.e. statistical and taxonomic data.
- Establish an ASEAN certification and fair trade practices.
- Establish an ASEAN network that would discuss and share policies to complement or support implementation of rattan projects (Rattan project website, transboundary issues).
- Coordinate, compile documents and strengthen the sharing, e.g. dissemination of information through RIC electronic bulletin established at FRIM.

CONCLUSIONS

The pre-project concluded that rattan is a very important source of livelihood for the rural and local peoples in all ASEAN countries.

A significant number of indigenous and local people are dependent on rattan for their subsistence and income especially during off farm season. It was recognized that the supply of canes are diminishing from the wild stands and the raw materials are of low quality.

This is aggravated by the high wastage in harvesting and the crude methods inflicting defects to the products. The inadequacy of knowledge on advanced production and utilization is desired. Much attention is needed for improvement and proper dissemination of technologies. Also the limited information on rattan marketing practices; product promotion and pricing have placed the industry to a disadvantage situation.

RECOMMENDATIONS

For the sustainable development of the rattan industry in the region, the following recommendations are put forward:

- Strengthening the program on seed production, nursery and plantation development to address the problem of raw material supply and ease up pressure on the natural sources.
- Intensify training and demonstration on the application of production and utilization technologies.
- Development of harvesting technologies to minimize wastage and the utilization of industrial waste for other useful products.
- Research and development to generate new and improved technologies.
- Improvement of access to marketing practices, product promotion and pricing.

- Sustained information dissemination and database.
- Provision of government support in terms of incentives, financial and technical resources for the sustainable development.
- Development of rattan network for the exchange and sharing of information and ideas.

ACKNOWLEDGMENTS

The Ecosystems Research and Development Bureau (ERDB) of the Department of Environment and Natural Resources (DENR) Republic of the Philippines wishes to thank the International Tropical Timber Organization (ITTO) for its funding support to this pre-project; and the Forest Products Research and Development Institute (FPRDI) of the Department of Science and Technology (DOST) as the principal collaborator during the project implementation. Special thanks also to Dr. Florentino O. Tesoro, Undersecretary for Regional Operations-DOST and Dr. Renuka, Kerala Forest Research Institute-India who served as resource persons in the conference. Also thanks to Secretary Elisea G. Gozun, Dir. Romeo Acosta, Dir. Florence Soriano, Dir. Edilberto C. Argete, Assistant Dir. Neria Andin, Dr. Armando Palijon, and Dr. Mercedes Garcia for their support to the pre-project.

To all contact persons namely: Mr. Joffre Bin Ali Ahmad of Ministry of Industry and Primary Resources-Brunei Darussalam, Mr. Pen Samphan of Department of Forestry and Wildlife-Cambodia, Mr. Bambang Wiyono of Non-Wood Forest Product Division-Forestry Research and Development Agency-Indonesia, Mr. Sounthone Kepthanh of the National Agriculture and Forestry Research Institute-Lao PDR, Dr. Raja Barizan Raja Sulaiman of Forest Research Institute-Malaysia, Mr. U Win Myint of Ministry of Forestry-Myanmar, Mr. Chudchawan Sutthisrisilapa of the National Park, Wildlife and Plant Conservation Department-Thailand and Ms. Do Thi Ngoc Bich of Vietnam Forestry University for their invaluable support in the implementation of the project and their participation in rattan conference.

Likewise, to the Philippines' focal persons who assisted the member country contact persons, namely: Dr. Merlyn Carmelita N. Rivera for Brunei Darussalam and Malaysia; For. Maura D. Dimayuga for Cambodia; For. Gregorio E. Santos, Jr. for Indonesia; Dr. Feurdeliz L. Dalmacio and For. Moreno L. Santander for Lao PDR; Ms. Carolyn Marie C. Garcia for Myanmar; Dir. Celso P. Diaz and For. Mario DR. Ramos for the Philippines; Dr. Magdalena Y. Giron for Thailand; and Dr. Aida B. Lapis for Vietnam, a grateful appreciation is extended to them for their collective and individual support on the successful implementation of the project.

Special thanks and appreciation go to the hard-working Project Personnel and Support Staff namely: Ms. Norma R. Pablo-Head Support Staff, For. Kharina G. Bueser, For. Alvin A. Faraon, and Ms. Vivian dP. Abarro.

LITERATURE CITED

Ahmad, J., Hj, A., Mabong, D.H. and Arroyo, C.A.. 2004. Country Status Report on rattan industry of Brunei Darussalam. Paper presented in the Regional conference on Sustainable Development of Rattan in Asia, 21-23 January 2004, Manila Philippines.

Bich, D.T.N. and Lapis, A.B.. 2004. Country report of rattan in Vietnam. Paper presented in the Regional Conference on Sustainable Development of Rattan in Asia, 21-23 January 2004, Manila, Philippines.

Diaz C. P. and Ramos, M. dR. 2004. Country report of production and utilization of rattan in the Philippines. Paper presented in the Regional Conference on Sustainable Development of rattan in Asia, 21-23 January 2004, Manila, Philippines.

Ketphanh, S., Dalmacio, F.L and Santander Jr., M.L.. 2004. Country report on status of rattan production and utilization in Lao PDR. Paper presented in the Regional Conference on Sustainable Development of Rattan in Asia, 21 –23 January 2004.

Proceedings of the Reginal Conference for Sustainable Development of Rattan in Asia. 2004. ITTO – ERDB, Manila, Philippines.

Raja, B.R.S. 2004. Country report of rattan in Malaysia. Paper presented in the regional Conference on sustainable Development of Rattan in Asia, 21-23 January 2004, manila, Philippines.

Samphan, P., Lic, V.S., Chuk, A. and Vannara, N.. 2004. Status of rattan resources and mills in Cambodia. Paper presented in the regional conference on sustainable Development of Rattan in Asia, 21-23 January 2004, Manila. Philippines.

Sutthisrisilapa, C. and Puriyakorn 2004. Country report of rattan in Thailand. Paper presented in the Regional Conference on sustainable Development of Rattan in Asia, 21-23 January 2004, Manila, Philippines.

Tesoro, F. 2004. Sustainable Rattan Management and Utilization in Southeast Asia. In Proceedings of the Regional Conference for Sustainable Development of Rattan in Asia. ITTO-ERDB, Manila, Philippines.

Win Myint, U. 2004. Country report on rattan in Myanmar. Paper presented in the Regional Conference on Sustainable Development of Rattan in Asia, 21-23 January 2004, Manila, Philippines.

Wiyono, B. and Santos Jr., G. E.. 2004. Country report on rattan in Indonesia. Paper presented in the regional Conference on Sustainable Development of rattan in Asia, 21-23 January 2004, Manila, Philippines.

THE STATE OF GLOBAL RESEARCH CONCERNING EDIBLE FOREST PRODUCTS

SU-SEE LEE[1], KAUKO SALO[2] & SUSAN ALEXANDER[3]

Abstract – Once found primarily in specialty shops, non-wood forest products (NWFP) such as medicinal herbs and edible wild fungi are now more commonly found on the shelves of mainstream drug and grocery shelves. Although many countries emphasize the use and harvest of NWFP, Asia is the world's largest producer and consumer of NWFP of which edible forest products make up a significant proportion. There are a wide variety of edible forest products ranging from fruits, berries, nuts, mushrooms, spices and herbs, 'forest drinks', wild vegetables, to oil, wild honey and bushmeat, including insects. In many countries, local forest communities collect/harvest edible forest products on a subsistence level but some countries like China and India, harvest and export large quantities of edible forest products, such as nuts and mushrooms. Depleting forest resources and increased awareness of the importance of edible forest products to local and rural communities has spurred recent interest in edible forest products research, particularly in Asia. Generally, information on the exploitation, management, consumption and trade of edible forest products is difficult to obtain for many countries, perhaps a reflection of the limited research that has been carried out.

INTRODUCTION

According to FAO's working definition, "Non-Wood Forest Products (NWFP) consist of goods of biological origin other than wood, derived from forests, other wooded land and trees outside forests" (Non-Wood News 2005). Edible forest products make up one of the main categories of NWFP and range from fruits, berries, nuts, mushrooms, wild vegetables, 'forest drinks', spices and herbs, to edible oils, wild honey and bushmeat, including insects; and their importance and usage varies considerably from one part of the world to another. For example, wild berries and mushrooms are very important in the northern hemisphere, particularly in the Nordic countries and former territories of the USSR. In tropical Asia, fruits are the most important edible forest product, followed by nuts, mushrooms and wild vegetables. Asia is the world's largest producer and consumer of NWFP because of its population size and the traditional use of a vast variety of products for food, shelter and cultural needs. The importance of NWFP in Asia and the Baltic countries is highlighted by the fact that most countries in these regions have included data on production and trade of major NWFP, including some edible forest products such as pine nuts, mushrooms, spices and herbs, honey, and sometimes bushmeat, in their national statistics for many decades. Some of the data may, however, be incomplete, unavailable or only based on case studies (Walter 2001). The bulk of NWFP consumption in Asia as elsewhere in the world, especially for edible forest products such as fruits and wild vegetables, is for subsistence needs or for local barter and these data are not reported in national statistics. There has been increasing attention on the biology and policies of NWFP harvesting in

[1] Senior Research Officer, Forest Research Institute Malaysia, Kepong, 52109 Selangor, Malaysia
[2] Senior Researcher, Finnish Forest Research Institute, Joensuu Research Unit, P.O.Box 68, FIN-80101 Joensuu, Finland
[3] Regional Economist, Alaska Region, USDA Forest Service, PO Box 21628, Juneau AK 99802, Alaska, United States of America

North America in the past decade. Alexander and others (2001) describe socio-economic research taking place in the Pacific Northwest of the US while knowledge of NWFP in the US is summarized in Jones and others (2002).Generally, however, very limited statistical data is currently available on the exploitation, management, consumption and trade of NWFP.

The study of edible forest products is multidisciplinary, involving the disciplines of ethnobotany, biology, forestry, socio-economics, environmental and legal issues, agronomy, etc. Edible forest products are one of the many components of NWFP and there are numerous publications concerning NWFP but few dedicated solely to edible forest products (see the FAO website at www.fao.org/forestry/site/6366/en). Therefore, it is a huge task sifting through the literature to review the research that has been conducted on edible forest products worldwide. However, in view of the current interest in NWFP and multiple-use forestry, it is timely that such a review be conducted to take stock of the state of global research concerning edible forest products as well as to highlight some of the needs and opportunities for further research. We have tried to cover the topic comprehensively but many gaps exist, because we did not come across the literature or because there was a lack of research. In this paper we focus on forest products used for food, namely, edible plants and plant parts, not including spices and herbs or plants used for medicinal purposes; mushrooms; honey; and some edible animal products.

EDIBLE PLANTS, FRUITS AND NUTS

Extensive records exist of the multiple uses of plants from around the world. As a researcher in Sarawak, Malaysia, observed, it is a never-ending task to record all known uses of plants within an indigenous community (Christensen 2002). Plants used for food are often not separable from those used for their medicinal action, for example, the “food as medicine” concept in Chinese medical theories, but in this paper we have tried as far as possible to restrict the discussion on edible plants to those that are consumed as food since medicinal plants, and herbs and spices, are being discussed elsewhere in these proceedings. Wild edible plants have been used as food since ancient times and are traditionally an important resource for the subsistence of many ethnic groups throughout Asia, Africa, South and Central America, the Near East, and among varied populations of North America. For example, wild edible plants play a major role in meeting the nutritional requirement of the tribal population in remote areas of the Himalayas where 190 wild edible plant species are consumed by the natives (Sundriyal and Sundriyal 2004a). In the United States, subsistence use of plants and animals for food, trade, and barter is protected by state law in Alaska for all rural Alaska residents, and state laws also protect subsistence use in Hawaii for Native Hawaiians.

Trees become more important as sources of food as one moves from high latitudes towards the equator. While annual staple foods dominate in areas with cold winters, in the tropics and particularly in the humid tropics, many people rely largely on trees for their food. Thus it is not surprising that fruit trees figure prominently in the cultural traditions of South-East Asia. Malaysia has a rich diversity of fruit trees, many of which are indigenous and endemic to the country. Of the estimated 500 species of fruit trees found in the forests of the peninsula, about 100 produce fruit considered edible (Rukayah 1998). The publication, Plant Resources of South-East Asia No. 2 (Verheij and Coronel 1991) provides detailed information ranging from vernacular names and uses to the cultivation and harvesting for 120 species of edible fruits and

nuts with less detailed information for another 275 minor species. Of these 395 species, more than half are not cultivated and are collected from the wild. The authors note that edible fruits and nuts are an ill understood commodity group which has so far benefited little from the contributions of crop science and that information on factors determining tree productivity are generally fragmentary. Because most of the fruits come from trees scattered in forests, home gardens and field or forest borders, it is next to impossible to compile reliable statistical data therefore making it difficult to quantify production and consumption.

For many countries in Asia, forests play an important role in assuring food security. Edible fruits, fern shoots, bamboo and cane shoots, flowers, seeds including oil producing seeds, roots, tubers, the pith of certain plants like the sago palm, and wild vegetables are collected for food by local people. In the intermediate and dry forest zones of Sri Lanka, 65-70 percent of households collect food from the forests (Bandaratillake 1995 in Vantomme and others 2002). In remote areas of the Himalayas, wild edible plants are much in demand and most consumed during the dry season when other traditional vegetable crops are least available (Sundriyal and Sundriyal 2004b). Some 251 species of food plants are recorded for Papua New Guinea of which about 62% are collected from savannahs, forests and grasslands; 20% are harvested from the wild and cultivated, and only 17% cultivated (Powel 1976 in Saulei and Aruga 1994). In a study of two indigenous communities in Sarawak, Malaysia, Christensen (2002) recorded the use of 263 fruit species with edible fresh flesh of which 196 species were collected solely from wild populations. It was heartening to note that over 87 percent of the prized fruits were already under some kind of cultivation and or management by the rural communities.

Over 500 species of edible forest plants are sold in Thai markets while over 100 species of edible ferns are found in the forests of Heilongjiang Province, China (Vantomme and others 2002). In Xishuangbanna, Southwest China, 284 species of wild plants used as vegetables have been identified and studied (Xu and others 2004). There wild vegetables make up about 20 percent of all vegetables sold in local markets, and are priced 72 percent higher than cultivated vegetables. Moreover, 36.2 percent of vendors of whom 95.7 percent are women, sell only wild vegetables. Wild edible plants are also very important to the people of Turkey where 121 edible species and methods of preparation for consumption have been identified in Western and Central Anatolia (Dogan and others 2004). In some countries, wild tubers e.g. *Dioscorea* are important substitutes for grains, as in Papua New Guinea, and particularly in times of drought or when food problems occur as in Bhutan.

In the Near East, including Afghanistan, Cyprus, Iran, Jordon, and other countries in the region, edible NWFP support small-scale, household-based enterprises, providing employment and income for rural people, especially women. Non-wood forest product gathering varies greatly in local availability and preferences in the Near East, and range from products used for local consumption to major commodities traded in international markets. Tree nuts and seeds, including pistachios and pine nuts, are gathered in Afghanistan, Iran, Jordan, Lebanon, and Syria. Carob, date palm, and fruits are harvested throughout the region. In the Near East, goods and services provided by forests and trees are more important than timber production (Sabra and Walter 2001).

Edible plants are considered very important to the countries of West Africa, Central Africa, Southern Africa and the East African Islands and of medium importance to the countries of North and East Africa (Walter 2001). There is a multitude of edible wild plant species in Central, West and South Africa and most are utilized at a subsistence level with very few cultivated or exploited on a commercial level. Many fruits and vegetables contribute significantly to the diet of the people, providing essential nutrients and vitamins. However, despite their importance only limited information is available on their socio-economic importance or the ecological impact of their exploitation. According to Walter (2001), due to the scarcity and unreliability of the available NWFP data for Africa, most of the information has to be considered "tentative" and "preliminary". In South Africa research has shown that some knowledge of local plants gained from native foragers one hundred and fifty or more years ago has remained in Afrikaans families, passed down from land-owning parent to child and that native foraging groups now extinct in the vicinity may have been more than 60 percent dependent on plant food resources despite the abundance of game (Youngblood 2004). Several studies have focused on NWFP and markets for products harvested in Cameroon. Safou, or African pear (*Dacryodes edulis*), the fruits and kernels from *Ricinodendron heudelotii*, kola (*Cola acuminata*), and kernels from *Irvington* spp. are the four main NWFPs sold in the humid forest zone of Cameroon. Local, regional, and international demand for these species is driving efforts at domestication and protection of native populations (Awono and others 2002; Mbile and others 2005; Ndoye and others 1998; Ngo Mpeck and others 2003). The shea butter tree (*Vitellaria paradoxa*) is the source of one of Africa's most ancient food oils; use of shea oil was documented 4000 years ago in Egypt. It is a semi-domesticated slow-growing tree indigenous across 16 countries, from Senegal to Ethiopia and Uganda. An international workshop in Senegal in 2002 provided a forum for the exchange of information for this important African NWFP (CFC 2002).

In some Central American countries such as Costa Rica, the importance of edible wild plants is diminishing due to acculturation, leading to loss of traditional botanical knowledge (Garcia-Serrano and others 2004). In Costa Rica 84 plants were recorded as being used for food, of which 49 were domesticated species and 35 were wild or semi-domesticated species, with only 24 being harvested from the primary forest (Garcia-Serrano and others 2004). Many wild species were grown in home gardens and the culture had evolved from one of wild plant harvesting and tropical home gardens to rotating slash-and-burn agriculture. Previous ethnobotanical studies of wild edible plants in Ecuador are limited and it is sometimes difficult to decide whether the plant is wild or cultivated. In a study conducted in southern Ecuador, 354 species of wild plants (representing 6% of all plants in southern Ecuador), their local names and uses were recorded based on field data (Van den Eynden and others 2003). The majority of the plants are eaten raw (86%) and 85 percent have edible fruits or fruit parts but are of relatively minor economic importance. The researchers also discovered three new species in the course of their research.

In the United States and Canada, NWFP are gathered from biomes as disparate as the arctic regions of Alaska and the Northwest Territories, to the temperate rainforests of Alaska and the Pacific Northwest, the deserts of the Southwest, the prairie grasslands, the eastern coasts, and the tropical forests of Hawaii, Puerto Rico, and Florida. Regional NWFP uses are as varied as the biotic differences, as well as multiple cultural traditions and their interactions (Emery 2002). NWFP have been an important factor in the development and maintenance of many past and present plant assemblages. Emery (2002) found it particularly striking that people of diverse

ancestral origins have used NWFP, and these uses have been both culturally distinct and reflective of intercultural exchange.

Palms are a well known NWFP and yield a wide variety of edible products ranging from palm heart/shoot, fruits, juice, sap, sugar, wine, to vinegar and others, and their multiple uses have been well documented, e.g. Johnson (1997). Pollak and others (1995) outline the economic importance of palm heart extraction in the Amazon and concerns about sustainability. Pattanayak and Sills (2001) found that households rely on gathering edible NWFP in the Brazilian Amazon to mitigate agricultural risk.

As the importance and popularity of edible wild plants is recognized, attempts are being made to domesticate and cultivate more and more species. In some places such as China and Japan, wild vegetables are in high demand and becoming a commercial crop because they are free from pesticides, fertilizers and have high nutritious value. Many wild edible species are now cultivated or grown on farms and plantations, away from the forest sometimes making it difficult to delineate what is produced directly from the forest and what comes from cultivation. For example, China has the largest area of bamboo forests in the world (an estimated area of 7 to 17 million ha), and is the major world producer and exporter of bamboo shoots, but bamboo shoots are produced on farms (Vantomme and others 2002). In 2002 China earned about USD 99 million from the export of fresh, water, dried and canned bamboo shoots (INBAR 2002). In China forest plantations for economic purposes, locally called "economic forests" are a very important feature of the forest resources of the country. Such forests have been established for the production of woody plants for food, fruits, nuts, tea, silk and medicines (Vantomme and others 2002). In 1997 China's forestry sector produced 23.5 million tones of fruits (mainly apples, pears and oranges from economic forest plantations and 0.5 million tones of nuts (Forestry Yearbook of China 1995-1997).

Foods from native North American plant species constitute a small proportion of the food species consumed by Americans and Canadians. An important source of information on the status of advances in agriculture and commercialization of native plant species is the New Crops Center at Purdue University. The California Rare Plants Society also tracks the history of uses and horticultural practices in the production of new or underutilized plant species. The most popular native fruits are species of berry genera also found in Europe, such as *Ribes*, *Rubus*, and *Vaccinium*. Domestic and international markets for wild-harvested berries are significant contributors to some local economies.

In this paper we consider nuts gathered for human consumption and plants grown for their edible seeds but do not include those nuts which are essentially used for oil production such the oil palm (*Elaeis guineensis*) whose oil is used in the manufacture of various edible and industrial products. Many species of nuts are collected from the forest for human consumption but commercially, hazelnuts, walnuts and pine nuts are the most important. Other species are mainly collected for home or local consumption. Nuts are a valuable resource in Russia where *Pinus sibirica*, *P. koraiensis* and *P. pumila* are important pine species for nut production. Nilsson and Shvidenko (1998) reported that there are about 70 million ha of these forests at fruit-bearing age. Other important nut species in Russia are walnut (*Juglands* regia) and chestnut (*Castanea sativa*). China is the world's largest producer and exporter of pine nuts (*P. koraiensis* and *P.*

cembra) and walnuts (Alhojävi 1998) and is also an important exporter of chestnuts (Vantomme and others 2002). In China chestnuts and walnuts are produced from plantations; China has over 300,000 ha and 1 million ha of chestnut and walnut plantations, respectively (Vantomme and others 2002). Information on research concerning nuts is, however, scarce.

Berries

Berries are an important edible NWFP particularly in the boreal zone. Berry picking has a long tradition in the Nordic countries and is also a popular activity in other parts of Europe, the former Baltic countries, Russia, China and North America. In Finland 87 percent of the population pick berries and edible wild mushrooms (Saastamoinen and others 1998), mainly for home consumption. In the Nordic countries of Finland and Sweden rights of public access are recognized whereby citizens have the right of free access to outdoor areas, where they can pick wild berries, mushrooms, wild herbs, wild flowers, fallen dry branches and cones lying on the ground. Income earned from sales of wild berries, herbs and mushrooms is tax free in Finland (Salo 1995). In good crop years, cowberry (*Vaccinium vitis-idaea*) and boletus species (*Boletus pinophilus*, *Suillus variegatus*), may be considered parallel forest products on dryish Scots pine sites in Finland (Salo 1995). On some sites, income from these NWFPs can exceed that from the cut final tree crop. In Finland 16 species of berries are picked for human consumption but cowberry, bilberry (*V. myrtillus*), cloudberry (*Rubus chamaemorus*) and raspberry (*Rubus idaeus*) are the most popular berry species and the most important economically, as in Sweden and Norway (Salo 1995). In a normal crop year, the yield of wild berries (bilberry, cowberry and cloudberry) is 450 million kilos. In recent years, Finns have actually picked 40 to 45 million kilos; i.e. 10 percent of the total amount. The corresponding figure is 7 percent in Sweden (Salo 1995). In Finland the total value of wild berries in 2000 was 90 million USD, mushrooms 27 million USD, natural herbs 7 million USD and harvested reindeer-lichen (*Cladonia alpestris*) 2 million USD (Salo 2002).

Bilberry, cranberry (*V. oxycoccus*) and cowberry are also important berries collected from the forests of Estonia, Lithuania and the Arkhangelsk Region of Russia (Paal and Saastamoinen 1998; Rutkauskas 1998; Lukin and Gushchin 1999). Other important forest berries are rowanberry (*Sorbus aucuparia*), wild raspberries, wild strawberries (*Fragaria vesca*), and bog whortleberries (*V. uliginosum*).

In 2002 the largest amount of harvested berries in Poland consisted of bilberry (35.9 %), dog rose (*Rosa canina*) (32.2 %) and elderberry (*Sambucus nigra*) (26.3 %) with a major proportion being exported to Germany and Austria (Barszcz 2005). In the same year, Germany was also the largest importer of Polish mushrooms. NWFP are picked intensively but mostly not marketed in the Czech Republic (CR). In particular, edible mushrooms, forest berries and medicinal plants have been well known products of Czech forests from time immemorial (Sisak 1998). The main forest berry collected in CR is bilberry; an average of 2.7 kg/household was collected annually between 1994 and 2003. The second most collected is raspberry (*Rubus idaeus*) (1.0 kg/household), followed by blackberry (*Rubus fruticosus*) and elderberry (*Sambucus nigra*)(both 0.6 kg/household), and cowberry (0.2 kg/household)(Sisak 2005).

Most fresh wild blueberry exports in the United States come from northern New England and New York. The major export species is *V. angustifolium*. Exports of fresh wild blueberries have

remained somewhat constant since 1993 at less than 1,000 metric tons, with the largest share going to Canada. The only exception was in 1994, when exports amounted to more than 4,000 metric tons. The shift to exporting frozen products has also extended to wild blueberries. Most frozen blueberries are exported from Portland, Maine, and the total value has been about 8 million USD per year. Dried wild blueberries are a small part of the market, amounting to less than 1 million USD annually. Canned wild blueberry exports rose steadily between 1993 and 1997, with about 4 million USD in sales in 1997. Japan is the largest importer of canned wild blueberries (Alexander and others 2002). Wild berries are an important traditional and subsistence food to Native Americans, First Nations, Native Alaskan, and many non-native peoples throughout North America (Murray and others 2005; Pilz and others 2006).

Berries of several species of *Vaccinium* are important in China for processing into juice, vinegar, wine, sauces and various other products (Jiang and others 1998). Cultivation of some berry species such as cranberry and cowberry is being undertaken in some countries and there is good potential for expansion of this activity to include other berry species as well.

Research on various aspects of berries, ranging from production and yield to economics and cultivation of selected species has been conducted mainly in Europe over a relatively long period of time. Wild berries are generally picked for local consumption and traded locally and increasingly nationally, where there are considerable price differences in the market, such as between the Baltic and Nordic countries (Alhojävi 1998). The international trade of wild berries is growing but globally it is still insignificant.

Forest Drinks

Another category of edible forest product is that of 'forest drinks'. These are natural drinks produced or extracted from tree juice, wild berries, fruit, leaves and flowers of plants, as well as pollen of nectariferous plants (Vantomme and others 2002). In 1997 China produced 74,600 tonnes of forest beverages (Vantomme and others 2002) made from birch, seabuckthorn (*Hippophae rhamnoides*), *Actinidia chinensis*, *Ribes burejense*, raspberry, amur grape (*Vitis amurensis*), wild rose, cowberry, blackcurrant (*Ribes nigrun*), Siberian nitaria (*Nitaria sibirica*) and pine needle powder (Kunshan 1994 in Vantomme and others 2002). Other species from which forest drinks are made include bilberry and cranberry (*Vaccinium oxycoccos*). Gathering tree saps is also popular in Russia, Canada and the United States. Maple sugar and maple syrup (primarily from sugar maple, *Acer saccharum*) are produced in the US; they are consumed domestically and exported. Since 1992, the value of maple product exports has exceeded 3 million USD annually. The USDA Forest Service issues permits for collecting tree sap, primarily sugar maple. Birch (*Betula* spp.) syrup is increasingly being collected and sold in specialty stores and over the internet in Alaska and northern Canada. Syrup from big-leaf maple (*Acer macrophyllum*) is collected in western Canada and sold as syrup and wine products. In the 1980s the average annual commercially harvested volume of tree sap, mainly birch sap, in Russia, was 10,000 to 15,000 tons but this had nearly vanished by the 1990s (Nilsson and Shvidenko 1998) even though there were about 16 million ha of forests suitable for sap tapping.

Mushrooms

Like edible wild plants, edible fungi or mushrooms have been used since ancient times for food and are an important NWFP in many countries of the world. A very comprehensive global

overview of the use and importance of wild edible fungi has recently been published (Boa 2004). This illustrated publication gives strong emphasis on the subsistence uses of wild edible fungi and their importance to rural people in developing countries and also discusses their characteristics, management and commercialization and cultivation potential. Wild edible mushrooms are mainly collected as a subsistence food by people in many countries, and are an important commercial product exported by many countries in Asia, central and Eastern Europe, and North America. Table 1 shows some data in addition to the over 2000 records of edible mushrooms in over 85 countries listed by Boa (2004). The data in Boa (2004) should be examined carefully as some of the mushrooms listed as edible are considered inedible or poisonous in many countries, e.g. several species of the genera *Amanita* and *Boletus*, *Chlorophyllum molybdites*, and *Gyromitra* (*G. esculenta* is very poisonous if eaten fresh but is edible when cooked twice in boiling water: 1 kg fresh mushrooms in 5 litres water).

Edible mushrooms contribute significantly to the diet and nutrition of many poor people, especially in rural and remote areas of many developing countries and studies on the nutritional properties of some mushrooms have been conducted (e.g. Breen 1990; Crisan and Sands 1978). Wild mushrooms are sold in local markets, for example in China, India, Mexico, Nepal, Thailand, Tanzania and Zambia, thereby providing income for many rural people (e.g. Boa 2004; Härkönen 2002; Vantomme and others 2002; Zamora-Martinez and Pascual-Pola 1995). The increased demand in developed countries for gourmet mushrooms such as *Tricholoma matsutake*, chanterelles (*Cantharellus* spp.), morels (*Morchella* spp.) and truffles (*Tuber* spp.), has provided significant opportunities for communities in several developing countries and countries with economies in transition to increase their income. For example, *T. matsutake* is collected in Bhutan, China and notably in the Democratic People's Republic of Korea for export to Japan. In Japan, *T. matsutake* is highly regarded and eating ceremonies are culturally important. Originally collected from Japan's forests, production declined steeply in the 1980s and the search for new sources identified American matsutake (*T. magnivelare*) as an acceptable substitute (Boa 2004). *T. magnivelare* is exported by North American countries and although considered a substitute for *T. matsutake*, is sold at a lower price in Japan. Pakistan, Afghanistan, and India are major exporters of morels (Sabra and Walter 2001). Morels grow naturally in the temperate forests of India, Pakistan, China, Nepal and Bhutan, Europe, Russia and North America. China is a major world producer and exporter of several wild mushroom species such as *Auricularia auricula*, *Tremella fuciformis* and shiitake (*Lentinula edodes*) which can now be easily cultivated.

In Finland there are 30 commercial mushroom species, which are common species with high yields and are normally easy to recognize (Salo 1995). *Boletus edulis, B. pinophilus*, *Suillus luteus* and *Cantharellus cibarius* are considered to be the best edible mushrooms in Finland, Sweden, Norway, Denmark and Iceland. Good edible mushrooms that inhabit conifer and mixed forests include *Lactarius deterrimus, Cantharellus tubaeformis* and *Craterellus cornucopioides*. There are many other mushrooms such as ceps, *Russula* spp. and *Lactarius* spp., which are good edible mushrooms in the Nordic countries (Salo 1995). In the good mushroom year of 2003 Finland exported 12.5 million USD (currency exchange rate in July 2005) (Salo, K., unpublished data) of *B. edulis* and *B. pinophilus*, mainly to Italy. In Poland 34 mushroom species are officially admitted for sale. *C. cibarius* is the most harvested species, but *Boletus* spp., *S. luteus* and *Tricholoma equestre* are also largely harvested (Barszcz 2005). In North America edible

wild mushrooms are also popular, such as porcini (mostly *B. edulis*), chanterelles (*Cantharellus* spp.), truffles, morels, and American matsutake (Alexander and others 2002). It has been estimated that as many as thirty-six species of fungi are traded commercially but *Boletus*, chanterelles, morels, and American matsutake make up the bulk of the trade (Blatner and Alexander 1998).

Table 1. Number or main species of edible mushroom species collected from the forest in different parts of the world (additional to Boa 2004)

Region/Country	Edible mushrooms collected	Source
Armenia	150 species but only three widely collected	Ter-Ghazaryan and Ter-Ghazaryan (1998)
Arkhangelsk region, Russia	At least 13 species, but mainly *Lactarius deliciosus, L. torminosus*	Lukin and Gushchin (1999); Lukin & Demidova (1999)
Belarus	Mainly chanterelles and bull mushrooms	Ollikainen (1998)
Former USSR	More than 200 species	Cherkasov (1988)
Bhutan	Most common spp. – *Auricularia auricula*, *Calvaria* spp., *Clitocybe odora*, *Cantharellus cibarius*, *Polyporus* spp., *Tricholoma matsutake.*	Vantomme and others (2002)
Cambodia	5 main species (only local names given)	Vantomme and others (2002)
China Guangdong Province Hunan	375 species, at least 4 species exported. 208 species 33 species	Vantomme and others (2002) Bi and others (1993) Härkönen (2002)
Czech Republic	Mushrooms picked and important for household consumption, species not mentioned	Sisak (2005)
Estonia	300 species, 30 well known, chanterelles major export product	Paal and Saastomoinen (1998)
Finland	2000 macrofungi species, of which 200 species edible, 30 commercial mushrooms, widely used. *Boletus* spp. major export species.	Saastamoinen and others (1998) Salo (1995, 2002)
Guyana	11 species used by indigenous Patamona Amerindians	Henkel and others (2004)
Hungary	169 species	Albert and others (1995, 1997)
Japan	More than 240 species	Hongo and others (1994)
Lao PDR	Mushrooms popular, no further data	Vantomme and others (2002)
Latvia	Mushrooms popular, no further data	Vilkristie in Lund (1998)
Lithuania	15-25 species	Rutkauskas in Lund and others (1998)
Malaysia		

Sarawak	52 species collected by Iban and Kelabit communities	Christensen (2002)
Peninsular Malaysia	43-49 species collected by Iban communities At least 36 species collected by Semai community	Sather (1978); Chin (1981, 1988) Lee, S.S., unpublished data
Mexico -		
Cofre de Perote region, Veracruz	14 species using 26 common names	Jarvis and others (2004)
Tlaxcala	48 species with 65 Nahuatl names	Montoya and others (2003)
Myanmar	Edible mushrooms collected seasonally, no further data	Vantomme and others (2002)
Papua New Guinea	*Lentinus edodes*	Vantomme and others (2002)
Poland	34 species officially admitted for sale, chanterelles most important. Also *Boletus* spp., *Suillus luteus* and *Tricholoma equestre.*	Kalinowski (1998) Barszcz (2005)
Sri Lanka	Several types collected	Vantomme and others (2002)
Tanzania	28 species	Härkönen and others (2003)
Thailand	98 species	Thaithatgoon and others (2004)
Vietnam	Several species, e.g. *Lentinus edodes*, *Auricularia auricular*, *Ganoderma lucidum*	Vantomme and others (2002)
Washington, Oregon, Idaho, U.S.A.	More than 25 commercially valuable species	www.forest.learn.org/consumer/comsume4.htm

In the Pacific Northwest of the United States, research on wild edible fungi has focused on wild edible mushroom ecology and management of wild mushroom harvests (Liegel and others 1998a, 1998b; Pilz and others 1998; 2001). Blatner and Alexander (1998) outline prices for some of the most significant commercially harvested fungi in the Pacific Northwest. The average per-pound price paid to harvesters in the Pacific Northwest from 1992 to 1996 was 5.69 USD for *Boletus*, 3.26 USD for chanterelles, 5.04 USD for morels, and 14.08 USD for American matsutake. Recently, chanterelle prices have declined to an average of 1.25 to 1.75 USD per pound. The size of the wild mushroom market in Washington, Oregon and Idaho was estimated at 21.5 million USD in 1985 (McRobert 1985), 38.6 million USD in 1989, and 41.1 million USD in 1992 (Schlosser and Blatner 1995). Russell (1990) estimated that exports of American matsutake from British Columbia were worth 9 to 10 million USD in 1989. Mushroom buying may represent the largest cash-based legal commerce in North American society. According to Japanese trade records, between 1989 and 1997, American matsutake exports to Japan from the United States climbed from 2.5 to 9.5 million USD. In 1997, more than 275 metric tons were exported to Japan (Alexander and others 2002). Most wild mushrooms exported to the European Community from the US come from the Pacific Northwest and are shipped from Seattle. Values for chanterelles exported to Europe may be eight to ten times greater per unit of weight than commercially grown *Agaricus* mushrooms and twice the value of chanterelles coming from

major producer countries in Europe such as Lithuania and Poland (Weigand 2000). In fiscal year 2000, the US Department of Interior Bureau of Land Management issued permits in the west coast states for 52,240 pounds of fungi, with permit sales totaling 15,185 USD. The US Department of Agriculture Forest Service issued permits worth 226,205 USD. Although for some species and in some areas, compliance with permit regulations is relatively high, this total still represents far less than the total western mushroom trade. In Europe research on wild edible mushrooms has been actively conducted in Finland since the late 1940s concentrating on the picking of mushrooms and their yields (Salo 1984, 1985, 1995). Recently there has been a surge of interest in the cultivation of gourmet edible mycorrhizal mushrooms, such as matsutake, chanterelles and truffles (Hall and others 1998). Less research has been conducted in Asia and Africa, with the exception of countries like Japan and China where researchers are working on many aspects of both edible and medicinal mushrooms. Boa (2004) compiled a summary of global wild fungi use and trade, with a comprehensive bibliography. There are several studies that focus on wild edible fungi and their uses in Africa. Lowore and Boa (2001) studied the rapidly expanding markets for wild edible fungi in Malawi, finding strong evidence of untapped demand in the region's urban centers. Härkönen and others (2003) report that most people in Tanzania collect and consume wild edible fungi. The rain forests of southern Cameroon are an important source of wild edible fungi harvested as integral parts of long-standing traditional and cultural practices (van Dijk and others 2003). Van Dijk and others found that the Bantu diet of mainly saprophytic fungi, with a limited number of ectomycorrhizal fungi, differs from the diet of people living in the dry woodlands of central and east Africa where most edible mushrooms belong to ectomycorrhizal fungal genera (Buyck 1994; Rammeloo and Walleyn 1993; Van den Berb and Biesbrouck 2000).

Honey

Wild honey is an important edible forest product in many developing countries where it is mainly collected for local consumption, subsistence and rural income generation. Research on various aspects of bee keeping and honey production have been conducted in many Asian countries but data is difficult to obtain as the results are mainly reported in internal publications, reports written in the local language, or in grey literature. Honey is frequently mentioned as a non-timber forest product (Chakravarti and Verma 1991; Economic Commission for Europe 1993; Midwest Research Institute 1992), and honeybees pollinate a variety of common agricultural crops and native plants. Honey is one of several NWFP being marketed in The Gambia, in West Africa, as a part of community-based enterprise development (FAO 2005). Some Near East countries are significant producers of honey from *Acacia* and *Eucalyptus* species. Turkey is a major producer (Sabra and Walter 2001). Beekeeping in the US and Canada is not a large industry, but the products and services provided by beekeepers are an integral part of American agriculture (Delaplane 1996). Although honeybees are an introduced species in North America, they are an integral part of the food chain due to their pollination services. Honeybees are the pollinators of choice in North American agriculture because of their availability throughout the seasons, because they pollinate a wide variety of crops, and because they can be concentrated in large numbers as needed (Alexander and Alexander 2002).

BUSHMEAT AND OTHER EDIBLE ANIMAL PRODUCTS

Numerous species of fish, frogs, shrimps, soft-shelled fresh water turtles, crabs, mollusks, and other aquatic animals are significant, if not the most important sources of protein in many countries. Terrestrial wildlife is also an important protein source in many rural areas. Terrestrial wildlife including insects, are exploited for protein in many countries to supplement the diet of the rural people. In Asia, edible insects include the weaver red ant (*Oecophylla smaragdina*), bamboo borer and wasp larvae. Mexico is seeing resurgence in interest in edible insects, long a traditional food in Latin American countries.

Birds' nests or salanganes built by two species of cave-dwelling swiftlets, *Collocalia fuciphaga* and *C. maxima* are collected in Malaysia and Thailand for sale in local and international Chinese markets (Vantomme and others 2002). Birds' nests are highly prized by the Chinese as a nutritious health food supplement and command astronomically high prices. Malaysia is the major producer and exporter of bird nests and the lucrative market has encouraged enterprising businessmen to set up special buildings, sometimes in urban areas, for the nesting swiftlets.

Many animal species face serious threats due more to habitat loss than to over-hunting and poaching. There is little research on wildlife consumption as much of the research concerning animals is focused on conservation efforts. The composition and configuration of wildlife habitat is fundamentally affected by land use activities. Changes in land use affect changes in wildlife populations and harvests. Land use changes most likely to significantly affect wildlife populations and harvests include the increase in urban and built-up land, the retirement of cropland acreage into reserves, changes in forest successional stages, extensive loss of grassland habitats, and the continued loss of wetland habitats. Based on these changes, Flather and others (1999) expect increase in species in the US that tolerate intensive land use activities, increases in species associated with agricultural habitats, decreases in species associated with grasslands and early successional stages of forest habitats (especially in the north), and general declines in species dependent on wetlands. These trends are being seen in many other countries as urbanization and land use changes take place.

ISSUES AND STATUS OF RESEARCH

There is already a vast body of scientific knowledge on non-wood forest products but a lot of it is specific to localities, products or groups of people. Pérez and Arnold (1996) point out that this does not allow for the prediction of future trends or the elaboration of policy to promote sustainability to enhance the welfare of people dependent on the products. The main issues concerning NWFP research raised in their publication are still valid nearly a decade later and still relevant to research on edible forest products today. Many government and non-government organizations worldwide support research on NWFP, including the Royal Roads University Centre for Non-Timber Resources in Victoria BC, Canada; the United Nations Food and Agriculture Organization; the US Department of Agriculture Forest Service; Natural Resources Canada Forest Service; the International Union of Forest Research Organizations (IUFRO); among others.

Edible Wild Plants, Fruits and Nuts

Information on edible wild plants can be found scattered in varied publications on NWFPs (e.g. various FAO publications, PROSEA publications, articles in a host of different journals).

Many studies on the nutritional value of wild edible plants have been conducted (e.g. Ogle and others 2003, Olvera-Fonseca 2004, Sundriyal and Sundriyal 2004b) but many species still remain to be studied and there is limited understanding of the added benefit of regular dietary intakes in low concentrations of wild plants with known phytochemical properties (Ogle and others 2003). In addition the nutritional and food security roles of wild plants as well as the indirect nutritional advantages of continued multiple uses of many species need to be brought to the attention of the policy makers.

The need for the multiplication, domestication, cultivation and management of numerous promising edible wild plants has been highlighted in various articles and papers. Improved opportunities for integrated cultivation and in traditional agroforestry systems also need to be explored so as to reduce pressure on natural forests and for the economic benefit of poor farmers. Wild stocks face destructive harvesting practices and poor forest management due to population pressure and increased demand for edible wild plants. Therefore suitable conservation practices and policies need to be developed and put in place for the conservation of plants in the wild. In Sarawak Christensen (2002) recommends the establishment of communal forests around the communities as many species thrive in forest-like ecosystems. Botanical gardens can be established focused on useful locally used species to serve as gene banks, banks of ethnobotanical knowledge, and as education centres for ethnobotanical knowledge. This recommendation would be equally applicable in other rural communities dependent on the forest for their subsistence and livelihood.

Berries

In the Nordic countries and some former states of the Soviet Union, annual inventories of wild berry production and yields have been conducted for many years, in some places going back to the 1930s. However, research on the management and development including collection, storage, transportation, and integrated processing of berries, and the marketing of berry resources is still lacking. An integrated plan for forecasting and harvesting is also needed. As with wild mushrooms studies on the effects of forest harvesting on the sustainability of berry production are also needed as are studies on the effects of damage caused by berry collectors on the forest. Research also needs to be carried out on the breeding and domestication of species with high quality and production.

Forecast system in Finland - A forecast system and an inventory of wild berry yields in Finland started in 1998 was based on a national observation network, consisting of 440 forests and peatlands including 2200 permanent sample plots. One hundred and twenty to 140 research assistants (personnel of the Finnish Forest Research Institute (FFRI) and research stations of universities and young adults and advisers of 4H organization) have been engaged in this annual forecast of wild berries (Salo 1999). Data collected in different parts of Finland are sent in electronic form via internet, phone or fax to Joensuu Research Centre of FFRI and processed using a special berry information system (MASI), which consists of databases and a geographical information system. Finns are informed about the timetable for wild berry flowering, development of unripe and ripe berries throughout Finland, factors affecting yields (frosts, pollination, drought) and levels of berry yield (very abundant, abundant, average, fairly poor and poor) through various means of communication. Annually three to four notes or reports are published during the growing season and theme maps are publicized over television and local

radio broadcasts, and in newspapers. The yield levels of berries are based on the numbers of flowers, unripe and ripe berries on an average of five permanent sample plots (each one square meter in size) in every forest and peatland (Salo 1999).

Mushrooms

Further ethnomycological studies need to be conducted among rural communities, in particular those who live in or close to the forest, to stem the loss of traditional forest related knowledge (TFRK) due to deforestation, land conversion, integration and migration to urban areas, and lack of interest among the younger generation. Studies conducted in Peninsular Malaysia have shown that while the urban population had little knowledge of edible wild mushrooms, rural indigenous communities were much more knowledgeable (Lee, S.S. unpublished data). However, the tropical mycota are still poorly known and much work needs to be done to identify the many undescribed and yet to be discovered mushrooms. Information on abundance, fruiting season, habitat, morphology, recipes, eating preferences, and cultural values of edible mushrooms is still lacking in Mexico (Montoya and others 2003) and probably also elsewhere. Basic research on the biology and ecology of edible mushrooms needs to be carried out for effective management of this resource. Several countries have research programs of various sizes focusing on wild edible fungi. As an example, in the Pacific Northwest of the United States, the Pacific Northwest (PNW) Research Station has a comprehensive edible forest mushroom research programme encompassing at least eight topics ranging from development of efficient and practical sampling procedures for inventory and monitoring of sporocarp production to specific projects for matsutake, morel and chanterelle mushrooms (www.fsl.orst.edu/mycology/poster). Similar research needs to be carried out elsewhere but this can only happen where there are sufficiently well trained personnel and funding is available to conduct such research.

There are significant gaps in the information on subsistence uses of edible fungi and their importance to rural people in developing countries. The status of the resources and production statistics need to be updated to improve utilization and conservation. The identification of species, nutritional status, mycorrhizal partners and storage have been identified as priorities for wild edible mushroom research (Boa 2004). Research also needs to be conducted on the effective management of wild edible fungi not only for sustainable production but also in the integration of their management and sustainable production as part of multiple use forests. There are concerns about the impact of forest management practices and commercial harvesting (Love and others 1998, McLain and others 1998). There is also much potential for expansion in the commercial trade of some of the more highly prized edible wild mushrooms, e.g. matsutake, chanterelles, porcini, and morels, but there are also many challenges (Hall and others 2004).

CONCLUSIONS

Crook and Clapp (2002) believe that at its best, commercial NWFP harvesting in tropical forests contributes to forest dwellers livelihoods, but even then, it can only support a low population density. They state that there are perils in drawing lessons from the experiences of tropical forests in developing countries to the temperate regions of developed countries, where ecological and institutional conditions are different. Globally, basic social and biological data about the importance of NWFP harvesting at the household and community levels is woefully

incomplete. In most, if not all countries, the harvest of wild products such as fruits, nuts, bushmeat, mushrooms, and medicinal plants is a viable, if not thriving, cottage industry involving thousands of people. Love (2002) states that it is both more extensive and intensive than most professional or lay people recognize. NWFP harvesting is a poorly understood way of life, since it is largely inconspicuous, if not deliberately hidden. Access issues and harvest tenure rights need further exploration, particularly in countries where NWFP harvesters have few legal and/or traditional access or tenure rights. Long-term multi-generational NWFP harvesters, from Amazonian rubber tappers to Canadian mushroom gatherers, have often devised local management strategies that may well be sustainable. On-the-ground investigation is clearly needed to identify and strengthen appropriate harvest practices. Harvest techniques and consequent environmental impacts are poorly understood. NWFP species cover every phylum, so it is difficult to make generalizations about suggested inventory and monitoring protocols, regional harvest suggestions, or land management to optimize production of all species. Research in biology, use, trade, sustainable harvest, policies, access and tenure rights; all need to continue for NWFP. Research in developing countries is often more comprehensive than in developed countries, but research needs to continue in both the developing and the developed world.

ACKNOWLEDGEMENTS

We would like to thank Jim Chamberlain for initiating the idea for this paper and for his help in preparing this paper.

LITERATURE CITED

Albert, L., Locsmándi, C. and Vasas, G. 1995. Ismerjük fel a Gombákat! Gabo, Hungary. 191 p.

Albert, L., Locsmándi, C. and Vasas, G. 1997. Ismerjük fel a Gombákat! 2. Gabo, Hungary. 191 p.

Alexander, S.J., McLain, R.J. and Blatner, K.A. 2001. Socio-economic research on non-timber forest products in the Pacific Northwest. Journal of Sustainable Forestry 13(3/4): 95-103.

Alexander, A.G. and Alexander, S.J. 2002. Native US plants in honey and pollen production. Pp. 223-236 in: Nontimber Forest Products in the United States E.T. Jones, R.J. McLain and J.F. Weigand, eds. Lawrence: University Press of Kansas.

Alexander, S.J., Weigand, J.F. and Blatner, K.A. 2002. NonTimber Forest Products Commerce. Pp. 115-150 in: Nontimber Forest Products in the United States. E.T. Jones, R.J. McLain and J.F. Weigand, eds. Lawrence: University Press of Kansas.

Alhojärvi, P. 1998. International trade and restrictions of non-wood forest products. Pp. 171-178 in: Sustainable Development of Non-Wood Goods and Benefits from Boreal and Cold Temperate Forests. H.G. Lund, B. Pajari and M. Korhonen, eds. EFI Proc. No. 23.

Awono, A., Ndoye, O., Schreckenberg, K., Tabuna, H., Isseri, F., and Temple, L. 2002. Production and marketing of Safou (*Dacryodes edulis*) in Cameroon and internationally: market development issues. Forests, Trees and Livelihoods. 12: 125-147.

Barszcz, A. 2005. An overview of the socio-economics of non-wood forest products situation in Poland. Pp. 1-20 in: Non-wood forest products and poverty mitigation: Concepts, overviews and cases. Proceedings of a project workshop in Krakow, 2004. C. Lacuna-Richman, M. Turtiainen and A. Baeszcz, eds. Research Notes 166. Faculty of Forestry, University of Joensuu, Finland.

Bi, Z., Zheng, G. and Li T. 1993. The Macrofungus Flora of China's Guangdong Province. The Chinese University Press. Hong Kong. 734 pp.

Blatner, K.A.and Alexander, S. 1998. Recent price trends for non-timber forest products in the Pacific Northwest. Forest Products Journal 48(1):28-34.

Boa, E. 2004. Wild edible fungi: a global review of their use and importance to people. Non-wood Forest Products 17. Food and Agriculture Organization of the United Nations, Rome, Italy.147 p.

Breen, W.M. 1990. Nutritional and medicinal value of specialty mushrooms. Journal of Food Protection 53:883-894.

Buyck, B. 1994. UBWOBA: Les champignons comestibles de l'Ouest de Burundi. AGCD, Rue du Trône, 4-1050, Bruxelles. Publ. Agricole #34. 123 p.

Chakravarti, I. and Verma, R. 1991. Marketing of minor forest products in tribal subplain area through cooperatives in Rajasthan. Indian Journal of Economics 71:311-320.

Cherkasov, A. Ph. 1988. Classification of non-timber resources in the USSR. Acta Bot. Fennica 136:3-5.

Chin, F.H. 1981. Edible and poisonous fungi from the forests of Sarawak. Part 1. The Sarawak Museum Journal 29:211-225.

Chin, F.H. 1998. Edible and poisonous fungi from the forests of Sarawak. Part II. The Sarawak Museum Journal 60 (new Series) 39:195-201.

Christensen, H. 2002. Ethnobotany of the Iban and Kelabit. A joint publication of the Forest Department Sarawak; NEPCon, Denmark; and University of Aarhus, Denmark. 384 p.

Crisan, E.V. and Sands, A. 1978. Nutritional value. Pp. 137-168 in: The Biology and Cultivation of Edible Fungi. S.T. Chang and W.A. Hayes, eds. New York, USA, Academic Press.

Common Fund for Commodities (CFC). 2002. International workshop on processing and marketing of shea products in Africa. CFC Technical Paper No. 21. Amsterdam, the Netherlands. 217 p.

Crook, C. and Clapp, R.A. 2002. The paradox of market-oriented conservation: lessons from the tropical forests. Pp. 163-179 in: Nontimber Forest Products in the United States. E.T. Jones, R.J. McLain and J.F. Weigand, eds. Lawrence: University Press of Kansas.

Delaplane, K.S. 1996. Honey bees and beekeeping: a year in the life of an apiary. Athens: University of Georgia/Georgia Center for Continuing Education, Cooperative Education Service. 138 p.

Dogan, Y., Balsar, S.Ay.G. and Mert, H.H. 2004. The use of wild edible plants in Western and Central Anatolia (Turkey). Economic Botany 58(4):684-690.

Economic Commission for Europe. 1993. The forest resource of the temperate zones: the UN-ECE/FAO 1990 forest resource assessment. Vol. 2, Benefits and Functions of the Forest. New York: United Nations. ECE/TIM/62 (Vol. II). 268pp.

Emery, M.R. 2002. Historical overview of nontimber forest product uses in the Northeastern United States. Pp. 3-25 in: Nontimber Forest Products in the United States. E.T. Jones, R.J. McLain and J.F. Weigand, eds. Lawrence: University Press of Kansas.

FAO. 2005. Empowering communities through forestry: Community-based enterprise development in the Gambia, by Almamy Dampha and Kanimang Camera. Rome, Italy. Working Paper No. 8. 72 p.

Flather, C.H., Brady, S.J. and Knowles, M.S. 1999. Wildlife resource trends in the United States: a technical document supporting the 2000 USDA Forest Service RPA Assessment. Gen. Tech. Rep. RMRS-GTR-33. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 79 p.

Forestry Yearbook of China. 1995-1997. ed. Ministry of Forestry, China. China Forestry Publishing Service.

Garcia-Serrano, C.R. and del Monte, J.P. 2004. The use of tropical forest (agrosystems and wild plant harvesting) as a source of food in the Bribir and Cabecar cultures in the Caribbean Coast of Costa Rica. Economic Botany 58(1):58-71.

Hall, I.R., Buchanan, P.K., Wang, Y. and Cole, A.I.J. 1998. Edible and Poisonous Mushrooms: An Introduction. Christchurch, New Zealand Institute for Crop and Food Research Limited. 248 p.

Härkönen, M. 2002. Mushroom collecting in Tanzania and Hunan (Southern China): inherited wisdom and folklore of two different cultures. Pp. 149-165 in Tropical Mycology, Vol. 1, Macromycetes. R. Watling, J.C. Frankland, A.M. Ainsworth, S. Isaac and C.H. Robinson, eds. CAB International. Wallingford.

Härkönen, M., Niemelä, T., and Mwasumbi, L. 2003. Tanzanian mushrooms; edible, harmful, and other fungi. Norrlinia 10: 1-200.

Henkel, T.W., Aime, M.C., Chin, M. and Andrew, C. 2004. Edible mushrooms from Guyana. Mycologist 18(3):104- 111.

Hongo, T. and Izawa, M. 1994. Mushrooms. Yama-kei Field Books. Yama-kei Publishers Co. Ltd., Tokyo, Japan.383 p.

INBAR 2002. Bamboo and rattan statistics. China Customs.

Jarvis, M.C., Miller, A.M., Sheahan, J., Ploetz, K., Ploetz, J., Watson, R.R., Ruiz, M.P., Villapan, C.A.P., Alvarado, J.G., Ramirez, A.L. and Orr, B. 2004. Edible wild mushrooms of the Cofre de Perote Region, Veracruz, Mexico: an ethnomycological study of common names and uses. Economic Botany 58(Supplement):S111-S115.

Johnson, D.V. 1997. Non-wood forest products: tropical palms. Non-wood Forest Products 10. RAP Publication 1997/10. Food and Agriculture Organization of the United Nations. Bangkok.

Jiang, C., Chen, B. and Zhu, Z. 1998. Non-wood forest products in the cold temperate area of China: the case of *Vaccinium* spp. Pp 75-78 in: Sustainable Development of Non-Wood Goods and Benefits from Boreal and Cold Temperate Forests. H.G. Lund, B. Pajari and M. Korhonen, eds. EFI Proc. No. 23.

Jones, E.T., McLain, R.J. and Weigand, J.F. eds. 2002. Nontimber Forest Products in the United States. Lawrence: University Press of Kansas. 424 pp.

Liegel, L., Pilz, D. and Love, T. 1998a. The MAB mushroom study: background and concerns. Ambio Special Report No. 9:3-7.

Liegel, L., Pilz, D., Love, T. and Jones, E. 1998b. Integrating biological, socioeconomic, and managerial methods and results in the MAB mushroom study. Ambio Special Report No. 9:26-33.

Love, T. 2002. Extractive reserves for the United States? Lessons from the Amazonian experience. Pp. 180-188 in: Nontimber Forest Products in the United States. E.T. Jones, R.J. McLain and J.F. Weigand, eds. Lawrence: University Press of Kansas.

Love, T., Jones, E. and Liegel, L. 1998. Valuing the temperate rainforest: wild mushrooming on the Olympic Peninsula Biosphere Reserve. Ambio Special Report No. 9:16-25.

Lowore, J., and Boa, E. 2001. Bowa markets in Malawai: Local practices and indigenous knowledge of wild edible fungi. Report prepared for The Miombo Edible Fungo Project, DFID, Forest Research Institute Malawi and CABI Bioscience. 27 p.

Lukin, I. and Demidova, N. 1999. Location and accessibility of major non-wood forest products in Arkhangelsk, Russia. Pp. 92-108 in: Research Approaches to Support Non-Wood Forest

Products Sector Development: Case of Arkhangelsk Region, Russia. A. Niskanen and N. Demidova, eds. EFI Proceedings No. 29.

Lukin, I and Gushchin, V. 1999. Non-wood forest products, their harvested volumes and household consumption in Arkhangelsk Region, Russia. Pp. 81-90 in: Research Approaches to Support Non-Wood Forest Products Sector Development: Case of Arkhangelsk Region, Russia. A. Niskanen and N. Demidova, eds. EFI Proceedings No. 29.

Lund, H.G., Pajari, B. and Korhonen, M. eds. 1998. Sustainable Development of Non-Wood Goods and Benefits from Boreal and Cold Temperate Forests. EFI Proc. No. 23.

Mbile, P., Vabi, M., Meboka, M., Okon, D., Arrey-Mbo, J., Nkongho, F., and Ebong, E. 2005. Linking management and livelihood in environmental conservation: case of the Korup National Park Cameroon. Journal of Environmental Management 76: 1-13.

McLain, R.J., Christensen, H.C. and Shannon, M. 1998. When amateurs are the experts: amateur mycologists and wild mushroom politics in the Pacific Northwest, USA. Society and Natural Resources 11: 615-626.

McRobert, G. 1985. A walk on the wild side. Oregon Business. October: 105-106.

Midwest Research Institute. 1992. Honey. MRI Technical Paper, Kansas City, MO. 9 p.

Montoya, A., Hernandez-Totomoch, O., Estrada-Torres, A., Kong, A. and Caballero, J. 2003. Traditional knowledge about mushrooms in a Nahua community in the state of Tlaxcala, Mexico. Mycologia 95(5):793-806.

Murray, G., Boxall, P.C., and Wein, R.W. 2005. Distribution, abundance, and utilization of wild berries by the Gwich'in people in the MacKenzie River Delta Region. Economic Botany 59(2): 174-184.

Ndoye, O., Pérez, M.R., and Eyebe, A. 1998. The markets of non-timber forest products in the humid forest zone of Cameroon. Rural Development Forestry Network paper 22c, Winter 1997/98. ODI, Portland House, Stag place, London SW1E 5DP, UK. 20 p.

Ngo Mpeck, M.L., Asaah, E., Tchoundjeu, Z., and Atangana, A.R. 2003. Strategies for the domestication of *Ricinodendron heudelotii*: evaluation of variability in natural populations from Cameroon. Food, Agriculture and Environment 1(3&4): 257-262.

Nilsson, S. and Shvidenko, A. 1998. Is sustainable development of the Russian forest sector possible? IUFRO Occasional Paper No. 11.

Non-Wood News. 2005. An information bulletin on Non-Wood Forest Products 12:12.

Ogle, B.M.; Ho Thi Tuyet, Hoang Nghia Duyet; Nguyen Nhut Xuan Dung. 2003. Food, feed or medicine: the multiple functions of wild edible plants in Vietnam. Economic Botany 57(1): 103-117.

Ollikainen, T. 1998. Belarus forestry strategic plan and the non-wood forest products. Pp. 159-162 in: Sustainable Development of Non-Wood Goods and Benefits from Boreal and Cold Temperate Forests. H.G. Lund, B. Pajari and M. Korhonen, eds. EFI Proc. No. 23.

Olvera-Fonseca, S. 2004. Evaluation of the bromatological potential of seeds and fruits of *Sabal mexicna* Mart. (Arecaceae). Economic Botany 58(4): 536-543.

Paal, T. and Saastamoinen, O. 1998. Non-wood plant products in Estonian forests. Pp. 109-117 in: Sustainable Development of Non-Wood Goods and Benefits from Boreal and Cold Temperate Forests. H.G. Lund, B. Pajari, and M. Korhonen, eds. EFI Proc. No. 23.

Pattanayak, S.K. and Sills, E.O. 2001. Do tropical forests provide natural insurance? The microeconomics of non-timber forest product collection in the Brazilian Amazon. Land Economics 77(4): 595-612.

Pérez, M.R. and Arnold, J.E.M. eds. 1996. Current issues in non-timber forest research. Proceedings of the workshop "Research on NTFP", Hot Springs, Zimbabwe, 28 August-2 September 1995. CIFOR, Bogor, Indonesia. 264 p.

Pilz, D., Molina, R. and Liegel, L. 1998. Biological productivity of chanterelle mushrooms in and near the Olympic Peninsula Biosphere Reserve. Ambio Special Report No. 9:8-13.

Pilz, D., Molina, R. and Amaranthus, M.P. 2001. Productivity and sustainable harvest of edible forest mushrooms: current biological research and new direction sin federal monitoring. Journal of Sustainable Forestry 13 (3/4):83-94.

Pilz, D., Alexander, S.J., Smith, J., Schroeder, R., and Freed, J. 2006. Nontmber forest products opportunities in Alaska. Gen. Tech. Rep. PNW-GTR-671. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 79 p.

Pollak, H., Mattoa, M., and Uhl, C. 1995. A profile of palm heart extraction in the Amazon estuary. Himan Ecology 23(3): 357-385.

Rammeloo, J. and Walleyn, R. 1993. The edible fungi of Africa south of the Sahara: a literature survey. Scripta Bot. Belg. 5: 1-62.

Rukayah Aman. 1998. Rare and wild fruits of Peninsular Malaysia and their potential uses. In: Sustainable management of non-wood forest products. Proceedings of an International Workshop held at Universiti Putra Malaysia, Serdang, 14-17 October 1997. M.N.B. Nair, Mohd. Hamami Sahri and Zaidon Ashaari, eds. Serdang, Universiti Putra Malaysia Press.

Russell, K. 1990. Manufacturing, marketing, and regulatory considerations: forest fungi. Remarks presented at the Special Forest Products Workshop, 8-10 February 1990. Portland, OR. 9 p. On file with: Kenelm Russell, Washington Department of Natural Resources, Olympia, WA 98504

Rutkauskas, A. 1998. Non-wood forest resources and their utilization in Lithuania. Pp 93-101 in: Sustainable Development of Non-Wood Goods and Benefits from Boreal and Cold Temperate Forests. H.G. Lund, B. Pajari and M. Korhonen, eds. EFI Proc. No. 23.

Saastamoinen, O., Kangas, J., Naskali, A. and Salo, K. 1998. Non-wood forest products in Finland: statistics, expert estimates and recent development. Pp 131-146 in: Sustainable Development of Non-Wood Goods and Benefits from Boreal and Cold Temperate Forests. H.G. Lund, B. Pajari and M. Korhonen, eds. EFI Proc. No. 23.

Sabra, A., and Walter, S. 2001. Non-wood forest products in the Near East: a regional and national overview. Working Paper FOPW/01/2. Food and Agriculture Organization of the United Nations, Rome, Italy. 120 p.

Salo, K. 1984. Joensuun ja Seinäjoen asukkaiden luonnonmarjojen ja sienten poiminta v. 1982. English summary: The picking of wild berries and mushrooms by the inhabitants of Joensuu and Seinäjoki in 1982. Folia Forestalia 598:1-21.

Salo, K. 1985. Luonnonmarjojen ja sienten poiminta Suomussalmella ja eräissä Pohjois-Karjalan kunnissa. English summary: Wild-berry and edible-mushroom picking in Suomussalmi and in some North Karelain communes, Eastern Finland. Folia Forestalia 621:1-30.

Salo, K. 1995. Non-timber forest products and their utilisation. 117-155 in Hytonen, M. (ed.) Multiple-use forestry in the Nordic Countries. The Finnish Forest Research institute. Gummerus Printing. Jyvaskyla.

Salo, K. 1999. Principles and design of a prognosis system for an annual forecast of non-wood forest products. Pp. 35-44 in: Research Approaches to Support Non-Wood Forest Products Sector Development: Case of Arkhangelsk Region, Russia. A. Niskanen and N. Demidova, eds. EFI Proc. No. 29.

Salo, K. 2002. Keräilytuotteet. (In Finnish). Pp. 278-288 in Tapion Taskukirja. T. Hyvämäki, ed. Kustannusosakeyhtio Metsalehti, Gummerus Printing, Jyvaskyla.

Sather, C. 1978. Iban folk mycology. The Sarawak Museum Journal 47: 81-102.

Saulei, S.M. and Aruga, J.A. 1994. The status and prospects of non-timber forest products development in Papua New Guinea. Commonwealth Forestry Review 73.

Schlosser, W. and Blatner, K. 1995. The wild edible mushroom industry of Washington, Oregon and Idaho: a 1992 survey of processors. Journal of Forestry 93(3):31-36.

Sisak, L. 1998. Importance of main non-wood forest products in the Czech Republic. Pp. 79-85 in: Sustainable Development of Non-Wood Goods and Benefits from Boreal and Cold Temperate Forests. H.G. Lund, B. Pajari and M. Korhonen, eds. EFI Proc. No. 23.

Sisak, L. 2005. Socio-economic importance of main non-wood forest products for the inhabitants of the Czech Republic. Pp. 21-36 in: Non-wood forest products and poverty mitigation: Concepts, overviews and cases. Proceedings of a workshop in Krakow, 2004. A. Lacuna-Richman, M. Turtiainen and A. Barszcz, eds. Research Notes 166, Faculty of Forestry. University of Joensuu, Finland.

Sundriyal, M. and Sundriyal, R.C. 2004a. Wild edible plants of the Sikkim, Himalaya: marketing, value addition and implications for management. Economic Botany 58(2):300-315.

Sundriyal, M. and Sundriyal, R.C. 2004b. Wild edible plants of the Sikkim, Himalaya: nutritive values of selected species. Economic Botany 58(2):286-299.

Ter-Ghazaryan, G. and Ter-Ghazaryan, K. 1998. Non-wood forest products in Armenia. Pp. 163-165 in: Sustainable Development of Non-Wood Goods and Benefits from Boreal and Cold Temperate Forests. H.G. Lund, B. Pajari and M. Korhonen, eds. EFI Proc. No. 23.

Thaithatgoon, P., Thaithatgoon, B., Boonkemthong, C., Tanticharoen, M., and Jones, E.B.G. 2004. Edible mushrooms. Pp. 241-251 in: Thai Fungal Diversity. E.B.G. Jones, M. Tanticharoen and K.D. Hyde, eds. BIOTEC, Thailand.

Van den Berb, J. and Biesbrouck, K. 2000. The social dimensions of rainforest management in Cameroon: issues for co-management. Tropenbos Cameroon Series 4, 1-99.

Van Dijk, H., Onguene, N.A., and Kuyper, T.W. 2003. Knowledge and utilization of edible mushrooms by local populations of the rain forest of south Cameroon. Ambio 32(1): 19-23.

Van den Eynden, V., Cueva, E. and Cabrera, O. 2003. Wild foods from Southern Ecuador. Economic Botany 57(4):576-603.

Vantomme, P., Markkula, A. and Leslie, R.N. 2002. Non-wood forest products in 15 countries of Tropical Asia: an overview. Information and analysis for sustainable forest management: linking national and international efforts in South and Southeast Asia. EC-FAO Partnership Programme (2000-2002) Tropical Forestry Budget Line B7-6201/1B/98/0531 Project GCP/RAS/173/EC in collaboration with Forestry Department Headquarters, FAO, Rome, Italy. 188 p.

Verheij, E.W.M. and Coronel, R.E. eds. 1991. Plant Resources of South-East Asia No. 2. Edible fruits and nuts. Pudoc, Wageningen. 446 p.

Walter, S. 2001. Non-wood forest products in Africa: a regional and national overview. EC-FAO Partnership Programme. Project GCP/INT/679/EC “Data Collection and Analysis for

Sustainable Forest Management in ACP Countries Linking National and International Efforts", Project GCP/RAF/354/EC "Sustainable Forest Management Programme in African ACP Countries". Forestry Department Headquarters, FAO, Rome, Italy.

Weigand, J.F. 2000. Wild edible mushroom harvests in North America: market econometric analysis. Pp. 35-43 in: Les champignons forestiers: récolte, commercialization et conservation de la resource, J.A. Fortin and Y. Piché, eds. CRBF, Université Laval, Québec, 22 et 23 février 1999.

Xu, Y., Tao, G., Liu, H., Yang, K. and Dao, X. 2004. Wild vegetable resources and market survey in Xishuangbanna, Southwest China. Economic Botany 58(4):647-667.

Youngblood, D. 2004. Identification and quantification of edible plant foods in the Upper (Nama) Karoo, South Africa. Economic Botany 58(Suppl.):S43-S65.

Zamora-Martines, M.C. and Pascual-Pola, C.N.d. 1995. Natural production of wild edible mushrooms in the southwestern rural territory of Mexico City, Mexico. Forest Ecology and Management 72:13-20.

THE ROLE OF INDIGENOUS KNOWLEDGE IN FORESTRY ASSESSMENT AND MONITORING IN UGANDA

ROBINAH K. NANYUNJA[1] AND TIMOTHY BAGUMA[1]

Abstract--The study, which was funded by UNDP/GEF Cross-Border Biodiversity Project in Uganda and implemented on behalf of MUIENR, was carried out in the communities living in Moroto forest reserve and those living adjacent to the forest reserves of Sango Bay area in northeastern and southern parts of the country, respectively. It was meant to identify, select indicators for forest assessment and monitoring, and determine their trends since 1950 to 2001. The criteria for selection of indicators based on the following resource categories: resources whose alternatives cannot be obtained from outside the forest; medicinal and food plants; resources facing considerable pressure from the people; sources of income; rare resources and large mammals. The major output was a forestry assessment and monitoring framework, which indicated a loss of forest resources based on the selected categories during the studied timelines, due mainly to change in peoples' livelihoods, over-harvesting, policy and institutional failures.

INTRODUCTION

Most of Uganda's biodiversity can be found in the natural forests, but a considerable amount is found in open waters, wetlands, and dry/moist savannah. Uganda's major biodiversity ecosystems include, forests, woodlands, savannah, wetlands and aquatic biodiversity (NEMA 2000/2001). The biodiversity hotspots in Uganda include Mgahinga Gorilla and Bwindi Impenetrable National Parks, Rwenzori Mountain National Park, Sango Bay wetlands and forest ecosystem, Kibaale National Park, dry mountains of Karamoja (Napak, Morungole, Kadam, Timu and Moroto), Lake Victoria and papyrus swamps of Lake Edward, George and Bunyonyi (NEMA 2000/2001).

Uganda has a comprehensive system of protected areas under the management of the forestry department and Uganda Wildlife Authority (Pomeroy and others 2002). Despite this, the report on the state of Uganda's Biodiversity 2000 showed that the rate of biodiversity loss was high, estimated at 1% per year.

A value and threat analysis conducted by UNDP/GEF Cross-border biodiversity project in the Sango Bay forests showed that the people were aware of the threats they impose on the forests. The following are some of the communities' perceived threats to the Sango Bay forests: cutting young trees for poles and firewood, poor harvesting of palm leaves, debarking trees for medicines, over-harvesting of timber, selective harvesting of tree species, over-harvesting of palm leaves, over harvesting of *Marantochloa spp*. for baskets and poor pastoral practices (Nabanyumya and others 1999).

[1] Research Scientists, Assessment of Impacts and Adaptations to Climate Change Project PO Box 22500 Kampala Uganda East Africa; tels: +256-77-508-970; +256-77-496-546; E-mails: rhobink@yahoo.com; bagumatim@yahoo.co.uk respectively

Biological diversity, the variability among living organisms from all sources is of critical value to the world. It forms the basis of our food supplies and provides raw materials for our pharmaceuticals and a growing number of industrial products (Tamanga and Bhattachan 1999). Unfortunately, biodiversity is being lost at unprecedented rates through the destruction of habitats and ecosystems for short-term economic gain. Concern about this has led governments, multilateral organizations, scientists, environmentalists, and others to look for ways to promote the conservation of biodiversity.

As concern about the loss of biodiversity has risen, so has the appreciation for the knowledge of the indigenous peoples about the natural resources they have lived with for centuries. This knowledge has an important scientific and strategic value. The majority of the worlds' people rely on indigenous knowledge of plants, animals, insects, microbes and farming systems for either food or medicines. Eighty percent of the world's-population depends on indigenous knowledge to meet their medicinal needs (Tamanga and Bhattachan 1999). It is therefore likely that the people closely watch and know how the resources are consumed and change. Rural indigenous people are often knowledgeable about plant and animal species, including their identification and ecology (Hellier and others 1998).

Since the rate of biodiversity loss in Uganda is very rapid, methods by which trends in biodiversity may be assessed rapidly and efficiently are urgently required (Burley and Gauld 1994.). This need has led to the development of rapid biodiversity assessment approaches such as PRAs which aim to provide information on biodiversity suitable for use in conservation planning and environmental monitoring, in situations where detailed taxonomic investigations of the species concerned are not necessarily available (Oliver and Beattie 1993).

STUDY OBJECTIVES

- To identify and select indicators for forest assessment and monitoring.
- To determine trends in abundance of the indicators since 1950 to 2001.
-

MATERIALS AND METHODS

Study Areas

The study areas were Mt. Moroto Forest Reserve in the northeastern part of Uganda and Sango Bay in the southern part of Uganda (Figure 1).

Selection of indicators for assessing biodiversity loss

A study carried out by Makerere University Institute of Environment and Natural Resources (MUIENR) and funded by UNDP/GEF Cross-Border Biodiversity Project in Uganda designed criteria for selection of biodiversity indicators for monitoring and evaluation in Moroto and Sango Bay cross border biodiversity sites (Nanyunja 2001). The current study adopted some of these criteria and made some modifications to suit its objectives. They included the following resource categories (not necessarily mutually exclusive):

- Medicinal plants

- Food plants;
- Plants
- Resources facing considerable pressure from the people;
- Sources of income; rare resources
- Large mammals.

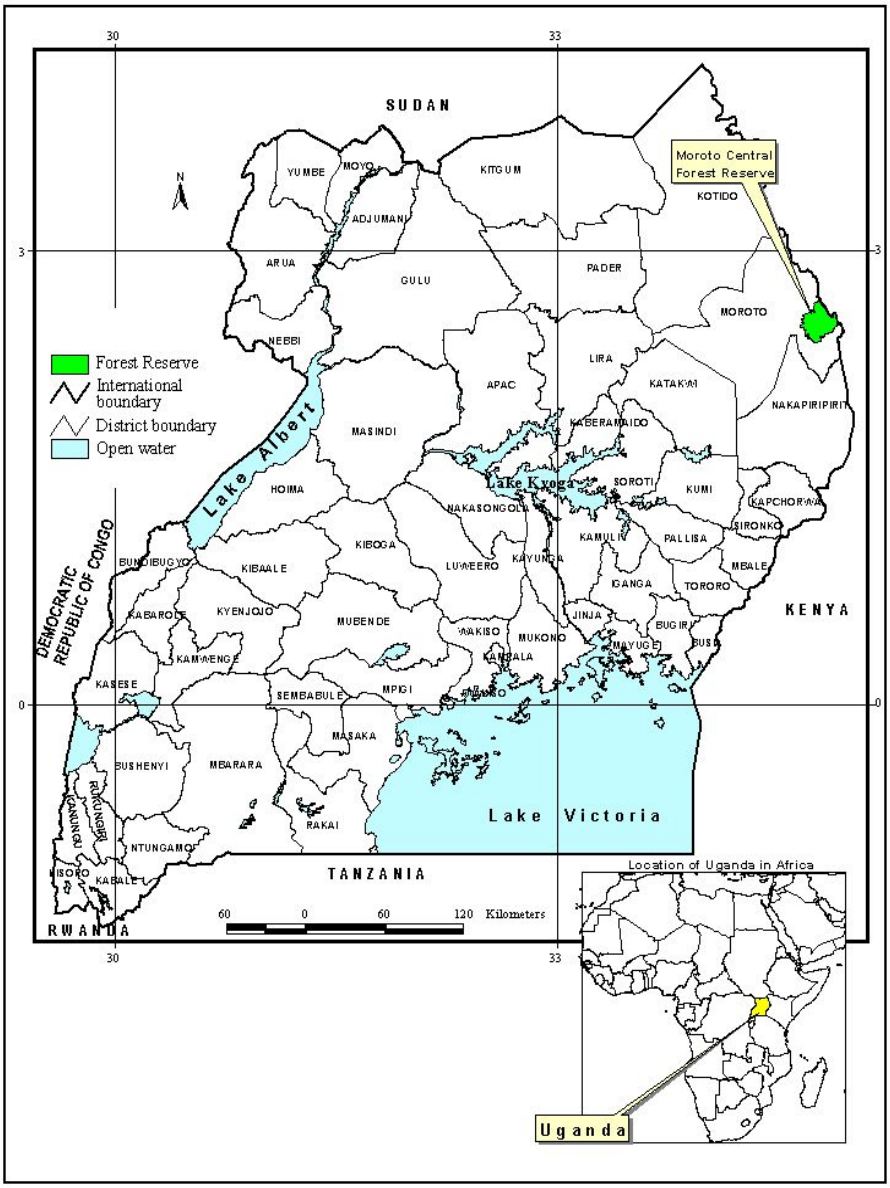

Figure 1-- Map of Uganda showing study sites

Sampling procedure and data collection

Participatory Rural Appraisals (PRAs) tools have become established procedures for investigating indigenous resource management systems (Webber and Ison 1994). It is defined as an "intensive, systematic but semi-structured learning experience carried out in a community by

a multidisciplinary team which includes community members" (Theis and Grady 1991). One of the main advantages of PRA's is that they help provide a holistic vision from the perspective of the end-user, and makes use of their experience, which is integrated with that of the researchers, in order to broaden the common knowledge-base (Chambers 1994a, 1994b).

A PRA technique can include rapid surveys of local knowledge as tools for investigating human perceptions to biodiversity loss. In this study, group interviews were used as information gathering tools for assessing trends in biodiversity loss (changes in abundance and changes in the use of indicator species from 1950 to 2001). These tools were earlier designed and used to develop a biodiversity monitoring and evaluation framework for Moroto, Napak and Sango Bay cross-border biodiversity sites in Uganda (Nanyunja 2001). The PRAs consisted of local histories/time lines, resources rankings and abundance scores.

In the Sango Bay area, three parishes were surveyed. These were; Bukora, Kanabulemu and Minziro. The people in Bukora were predominantly pastoralists while those in Kanabulemu and Minziro were predominantly cultivators. In Moroto Forest Reserve, two parishes were surveyed.

One PRA was carried out in each of the parishes surveyed, which comprised of a group of 15–20 men and women participants of age range between 20-80 years. Community mobilization and the selection of participants for the PRA's were done with the help of the community forest officers.

Local histories/time lines tap participants' memories to recall local important historical events to help date other changes, such as changes in the environment in this case (Nabasa and others 1995). I used this method to collect information on trends of indicator species use, and changes and reasons for those changes in species frequency from 1950 to 2001. Elders were very much involved and played a large role in providing this historical information. Old people possess most of the indigenous knowledge and therefore provide the best information (Basemera 2002), hence the exercise included elders and long-term residents.

Resource rankings -- During the discussions, the participants were asked to list about 10 to 15 resources (plant or animal species) in each category. Among these, I asked them to choose the 5 key resources. One person would suggest a resource name, and this would be subjected to debate. The people in support of it would then put up their hands. If the number supporting it exceeded the others, then we would accept it as a key resource. Indicator species and abundances were established in a similar manner.

Abundance scores —These reflect the availability of indicator species during periods from 1950 to 2001. I asked the participants to score the availability of an indicator species. The scores ranged from 0 to 2 where: 0 reflected none or nearly none; 1 a few or some; and 2 many or readily available (Nanyunja 2001). Comparing these scores between time periods would reflect a trend in change in biodiversity.

The data collected in the form of scores were entered and analysed, and graphed in Microsoft Excel by use of descriptive statistics. These illustrations show the trends of the biodiversity categories (Figs 2-5). The abundances of all the indicator species for a corresponding year (e.g. 1950) were summed and averaged across parishes for each site.

RESULTS

Figure 2 shows trends in abundance of medicinal plants. These are decreasing more rapidly in Moroto Forest Reserve than in the Sango Bay.

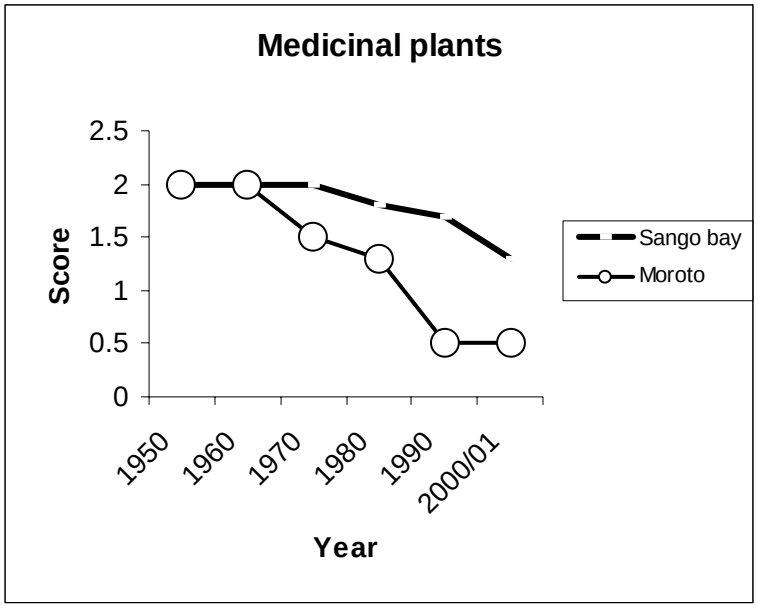

Figure 2. Trends in abundance of medicinal plants

Figure 3 shows trends in abundance of sources of income. These are decreasing more rapidly in Moroto Forest Reserve than in the Sango Bay.

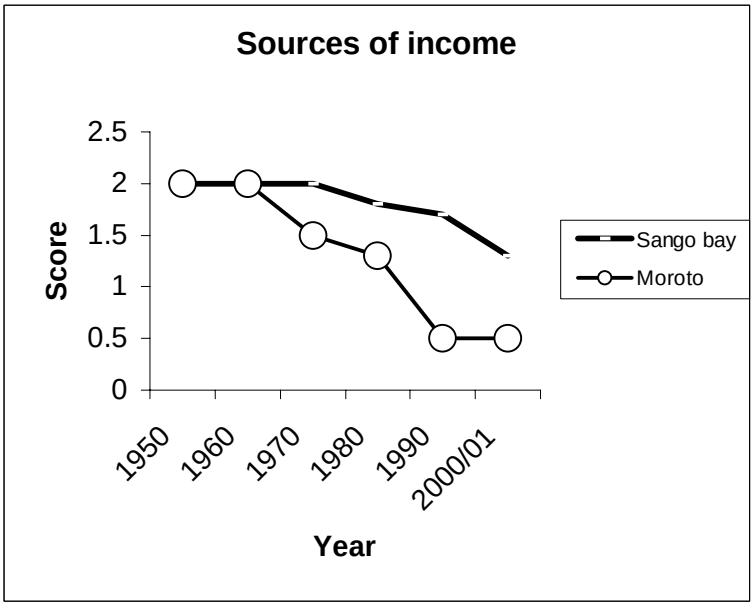

Figure 3. Trends in sources of income

Figure 4 shows trends in abundance of wild food plants. Plants that people use as wild foods are being lost more rapidly in Moroto than in Sango Bay.

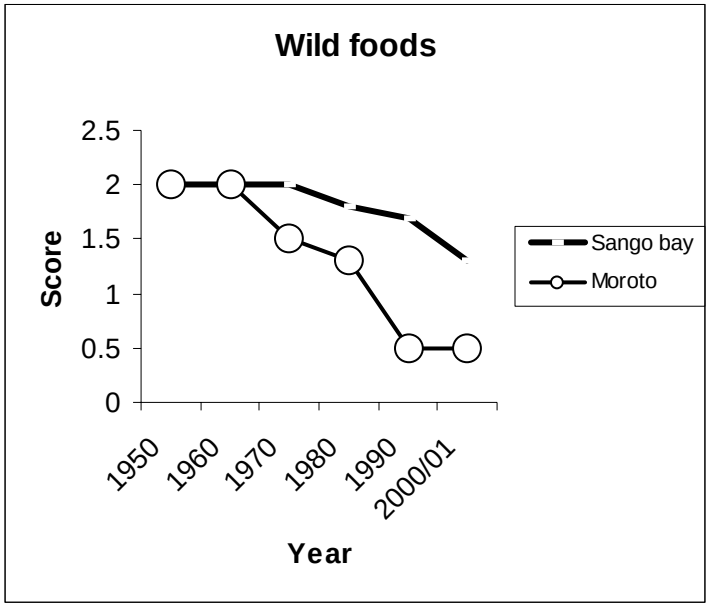

Figure 4. Trends in abundance of wild food

Figure 5 shows trends in abundance of wildlife. In Moroto, wildlife is decreasing more steadily than in Sango Bay.

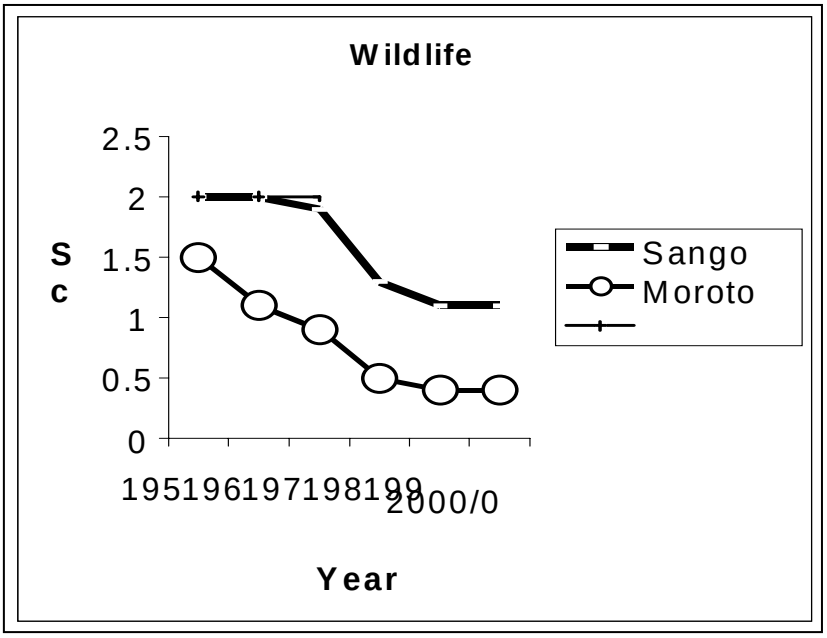

Figure 5. Trends in wildlife

The results, therefore clearly show that Moroto Forest Reserve is more degraded in terms of the studied biodiversity than in Sango Bay Forest Reserves.

DISCUSSION

The trends in biodiversity loss as identified by human perceptions are illustrated in Figures 2 to 4. A general trend of biodiversity loss is found in both sites. However, the magnitude of change varies within sites, and considerable variation is found between the study sites. The reasons for the change across the sites are related to land use changes and changes in land status as discussed below.

The medicinal plants in Moroto Forest Reserve were being lost faster than in Sango Bay. The rapid loss in Moroto Forest Reserve can be related to the fact that there are communities living within the forest reserve, whereas in Sango Bay Forest Reserves, people are living adjacent to the forests. The need for charcoal for fuel, and land for settlement and expansion of agriculture has contributed to the clearance of vegetation within Moroto Forest Reserve.

The medicinal plants, in both study sites, besides performing their medicinal roles, perform multiple roles as timber trees, fuel wood trees and building poles. The diversity of roles these plants perform exposes them to a higher harvesting pressure.

The plants being used as sources of income are also declining more rapidly in Moroto Forest Reserve than in Sango Bay. These plants are mainly trees, used for commercial purposes for timber, charcoal, firewood and building. Like the medicinal plants, the diversity of roles these plants perform exposes them to a higher harvesting pressure. Furthermore, as mentioned earlier, medicinal plants perform other roles as sources of income, and many of them fall under this category.

During the 1960s and 1970s, the market for wood products was very selective. High value tree species such as Mvule (*Melicea exelsa*), Mahoganies (*Khaya anthotheca - Meliacea*), Elgon olive (*Olea capensis welwitschii- Oleacea)* and *Lovoa spp*. were depleted from the natural forests through selective logging. Large volumes of what at the time were considered ‘undesirable’ or ‘weed’ species were cleared using the charcoal refining method. The government policy allowed people to select the undesirable tree species for charcoal burning. The logged areas were later enriched with desirable tree species. Much biodiversity was lost through this process of exploitation. Uncontrolled harvesting and poor harvesting methods from the 1960s to the mid 1980s also contributed to biodiversity loss although estimates of such losses have not been documented (NEMA 2000/2001).

Pressures on biodiversity from habitat loss, climate change and other causes are particularly high in East Africa (Groombridge and Jenkins 2002). Globally, the living planet index (WWF 2002) shows a decline of 37% of biodiversity from 1970 to 2000, with the rate per decade at about 15% in the 1980s and 1990s.

Wild food plants are being lost more rapidly in Moroto Forest Reserve than in Sango Bay. Although Moroto is a Forest Reserve, there are people living inside it. When the government gazetted this forest, there was difficult to evict the communities who were living inside, so they were left to live inside. Wild food plants make a significant contribution to their food security. In contrast, the communities adjacent to the Sango Bay area do not depend on wild food plants for

food; they cultivate theirs in their gardens. The difference in the land management status of the two sites, explains the difference in the changes in biodiversity.

Through domestication and direct harvesting from the wild, Ugandans derive food, medicines and a wealth of raw materials from plants. The importance of biodiversity to Ugandans is therefore not confined to natural ecosystems but includes agro-biodiversity especially in altered or anthropogenic ecosystems such as Rubaale (NEMA 2000/2001). Meanwhile, human settlements are encroaching on protected areas such as national parks, forest reserves and wetlands. Uganda's population is growing very fast, at about 2.5% per annum, and this population is largely rural. Increased demand for food is resulting in new land being cleared for agriculture. Hence, large tracts of land are deforested annually (NEMA 2000/2001).

The numbers of wildlife species have been declining more rapidly in Moroto Forest Reserve than Sango Bay. The factors, which have led to the significant reduction of wildlife in Moroto Forest Reserve, include:

- Increased hunting for meat which supplement food sources
- The clearance of forests, woodlands, bush and swamps, which had been habitat for wild animals, for expanded agriculture and settlement; and,
- Massive killing of animals for the safety of settlements.

Within wildlife-protected areas, poaching for both subsistence and commercial trade has been responsible in the past for the drastic reduction in wildlife populations. Fines for various wildlife offences are insufficient to act as effective deterrents, and the enforcement of the wildlife protection laws is weak (NEMA 2000/2001).

The loss of wildlife has been significant in Uganda. Although wildlife management was relatively efficient up to 1970, thereafter particularly during the 1970-1986 period, the status of wildlife was seriously undermined through indiscriminate poaching. This resulted in major reductions in the number of species and populations, for example, between 1960 and 1998; Uganda lost 71% and 76% of its antelope and other large mammals (UWA 1999).

Although wildlife and wild plant resources in Uganda constitute a great asset, the country risks losing them altogether. Uganda's biodiversity decline is being experienced at the ecosystem, species and genetic levels. For example, both the northern white and the black rhino have been hunted for commercial purposes to extinction. Biodiversity is also being lost through the disappearance or alteration of habitats, and the introduction of alien species (NEMA 2000/2001). Examination of a composite index of biodiversity (1970=100) revealed that Uganda's biodiversity richness declined steeply from the 1960s to the 1990s (NEMA 2000/2001). Losses of biodiversity have been registered in forests and woodlands, wildlife-protected areas, wetlands, and aquatic ecosystems.

The role of indigenous knowledge in forestry assessment and monitoring cannot be underestimated; the people are more knowledgeable about the natural resources they have lived and interacted with for centuries. The methods used in the study are important tools for monitoring and assessing change in biodiversity based on indigenous knowledge. However, there is a need to use a unified knowledge system involving biodiversity inventories, both ground

truthing and aerial surveys, to supplement data obtained by indigenous knowledge, in order to achieve more effective sustainable biodiversity assessment and monitoring.

CONCLUSIONS AND RECOMMENDATIONS

The results of this study of changing biodiversity based on indigenous knowledge reveals a decline in all biodiversity categories across the study sites, with Moroto being more degraded than Sango Bay. To counteract this, tree-planting programmes may be initiated in the study areas with immediate attention being given to Moroto Forest Reserve. Trees of high interest to the community, such as those that are used as sources of income or medicine, could be prioritised.

ACKNOWLEDGEMENTS

I wish to thank the local leaders of Sango Bay and Moroto Forest Reserves, for the commendable effort they made for me to access the study population. Finally, yet importantly, many thanks are extended to UNEP/GEF/LUCID Project and MUIENR for funding and executing the project respectively.

LITERATURE CITED

Basemera, P. 2002. The use of indigenous knowledge in the conservation of biological diversity in Sango Bay. MSc thesis, Makerere University. Kampala Uganda.

Burley, J., Gauld, I. 1994. Measuring and monitoring forest biodiversity. In Boyle T and B. Boontawee (eds). Measuring and monitoring biodiversity in tropical and temperate forests, pp 19-46. CIFOR, Bogor.

Chambers, R. 1994a. *Participatory rural appraisal (PRA):* analysis of experience. World Dev. 22(9), 1253-1268.

Chambers, R. 1994b. *Participatory rural appraisal (PRA):* challenges, potentials and paradigm. World Dev. 22(10). 1437-1454.

Groombridge, B., Jenkins, M.D. 2002. *World atlas of biodiversity*. UNEP/WCMC. University of California Press, Berkeley, USA.

Hellier, A., Goan, S.O. and Newton, A.C. 1998. *Use of indigenous knowledge for rapidly assessing trends in biodiversity*: A case study from Chiapas, Mexico.

Nabanyumya, R.., Mupada, E. and Kabesiime, E. 1999. A site plan for the conservation of the Sango Bay forest/wetland ecosystem and development of the adjacent communities, Rakai. UNDP/GEF cross-border biodiversity project. Kampala Uganda.

Nabasa, J., Rutwara, G., Walker, F. and Were, C. 1995. *Participatory rural appraisal: Principles and practicalities*. Natural Resources Institute, Catham UK.

Nanyunja, R.K. 2001. Biodiversity Monitoring and Evaluation Report for Sango Bay, Moroto and Napak cross-border biodiversity sites. MUIENR/UNDP-GEF Cross-borders Biodiversity Project, Kampala. Uganda.

NEMA. 2000/2001. State of Environment Report for Uganda 2000/2001. NEMA, Kampala Uganda.

Oliver, I. and Beattie, A.J. 1993. *A possible method for the rapid assessment of biodiversity*. Conservation biology 7: 562-568.

Pomeroy, D., Mwima, P., Nanyunja, R. and Chapman, L. 2002. *The State of Uganda's Biodiversity 2002*. NBDB- MUIENR, Kampala Uganda.

Tamanga, P. and Bhattachan, K.B. 1999. *Proceedings of the Asian Regional Conference on Reasserting Indigenous knowledge system* (November 1-3 1997 Nepal). Indigenous knowledge programme, Asia indigenous peoples' pact and Nepal federation of nationalities.

UWA. 1999. Wildlife Protected Area System Plan for Uganda, draft 2, April 1999. Kampala, Uganda

Theis, J. and Grady, H.M. 1991. *Participatory rapid appraisal for community development:* a training manual based on experiences in the Middle East and North Africa. International Institute for Environment and Development. London, UK.

Webber, L.M. and Ison, R.L. 1994. *Participatory rural appraisal design*: conceptual and process issues. Agric. Syst. 47, 107-131.

WWF. 2002. *Living planet report*. WWF, Gland Switzerland.

ABSTRACTS

Variations in Selected Anatomical and Physical Properties of Five Rattan Species from West Africa

Emmanuel Ebanyenle (ebanyele@forig.org) and Andrew A. Oteng-Amoako (oamaoko@forig.org)
Forestry Research Institute of Ghana, Kumasi, Ghana

Selected anatomical and physical properties in the stem of five rattan species from West Africa including *Calamus deeratus, Eremospatha hookeri, Eremospatha macrocarpa, Laccosperma acutiflorum* and *Laccosperma secundiflorum* from the natural forest of Ghana were investigated. Fiber lumen diameter, double fiber wall thickness and proportion of fibers exhibited more definite pattern of variation within and between all the five species. Generally, proportion of fiber and double fiber wall thickness decreased whereas fiber lumen diameter increased from base to top. Initial moisture content increased consistently from the base to top internodes whilst relative density decreased in the same direction. *E. macrocarpa,* the species in the highest demand by processors had higher relative density, lower moisture content, uniform vascular bundles with evenly distributed fiber sheath. On the other hand, *C.deeratus,* the least preferred species has lower relative density and proportion of fibers, higher moisture content, larger fiber lumen, thinner fiber wall and non-uniform distribution of vascular bundles. Simple regression analysis of physical on anatomical properties, revealed that fiber lumen diameter, double fiber wall thickness and proportion of fibers were the most important parameters likely to influence initial moisture content and relative density along the stem.

Fallow-Based Non-Timber Forest Species of Southern Cameroon

Martine Ngobo (m.ngobo@cgiar.org) and Stephan Weise (s.weise@cgiar.org)
Sustainable Tree Crops Program, IITA, Yaoundé, Cameroon

Due to the loss and degradation of natural forests, the importance of fallow systems as sources of non-timber forest products is increasingly acknowledged in the humid forest zone of southern Cameroon. A survey was conducted that aimed to ascertain whether differences in resource use intensification in the area were reflected in the type, distribution and abundance of plant species that local farmers value across different fallow classes. Of specific interest was local farmers' identification of key useful fallow species and their various uses. Farmers identified more than 170 useful species of various life forms on farm lands of various age, from which about 58% are found in fallow lands of less than 10 years old (long fallows providing approximately 48% of plants used by farmers in the region). Although various other uses were reported, farmers mostly make use of fallow species in traditional medicine. Although the human utilization of plant species varied between areas and fallow types, the results of this study demonstrate the importance of fallows, and particularly of short fallows in the socio-economic and cultural lives of small-scale rural farmers. These findings provide the major rationale for identifying fallows as individual land use systems with high potentials.

Homma's Model and Non-Timber Forest Extraction

Vag-Lan Borges (borges@estrondo.com.br)
Brazil

This article is an effort of refutation of the known model of Alfredo Homma for the analysis of the extractive forest economy of the Amazonia. In the first part it explains the theoretical backgrounds of the Homma's model. In the second part, it describes the model formulated for Homma to arguing that the extractive forest economy is not viable in long-term and that is doomed to disappear. And it concludes that once as a silvicultural and agricultural model, that theoretical framework cannot be used to explain forestry in native tropical forests.

Eaglewood in Papua New Guinea

B.V. Gunn (Brian.Gunn@csiro.au), P. Stevens (Peter.Stevens@csiro.au), M. Singadan (Nalish Sam @fri.pngfa.gov.pg), L. Sunari, P. Chatterton (pchat@wwfpacific.org.pg)

CSIRO Forestry and Forest Products, Australia
PNG Forest Authority, Papua New Guinea
WWF South Pacific Programme, Madang, Papua New Guinea

Papua New Guinea is arguably one of the last frontiers in the world where the exploitation of natural stands of eaglewood is possible. The trade in eaglewood first commenced in the late 1990s. Prior to the demand for export of eaglewood, the tree species had not been regarded as having any cultural or commercial importance. Taxonomic work has indicated that there are two species of eaglewood, Gyrinops ledermannii and a second unconfirmed species within the genus Aquilaria. The eaglewood trade in Papua New Guinea is in its infancy resulting in major gaps in information about the tree, its product and the trade. This paper presents information on eaglewood in Papua New Guinea covering current taxonomic knowledge, natural distribution and habitat. Information is also provided on the resource owners and their links with the trade. Recommendations are made on practical plans for scientifically-based management and conservation of eaglewood in the country.

Wildfood Fruits Processing in the Cordillera Administrative Region

Anthony Victor B. Lopez (erds-car@mozcom.com) and Helen A. Maddumba
Department of Environment and Natural Resources, Philippines

The Philippines is known for its diverse plant species. Many of these plants which abound in the forest are considered wildfood thriving under various ecological conditions. The importance of

properly exploring these plants hold much promise in providing additional food requirements for the country's growing population aside from promoting their conservation for future generations. During peak season, it was observed that much of these fruits are being wasted. To avoid wastage, it is imperative that these fruits be properly utilized and processed. The appropriate processing techniques of some of the most abundant wildfood fruits in the Cordillera were tested. These fruits could be processed into different consumable products such as wine, vinegar, candies, jellies and pickles. Acceptability of these products was assessed through taste tests conducted to different types of clienteles such as professions, non-professionals and students. Taste tests revealed the acceptability of all wildfood processed products. Possible markets for the products were noted during trade fairs and other occasions wherein the processed products were displayed.

Impact Assessment of Harvesting NTFP on Resource Base and Promoting Sustainable Harvesting

Narasimha Hegde (hegdenrm@yahoo.com)
India

Non Timber Forest Products are gaining importance globally. The relevance of NTFP in contributing to the rural development and conservation of nature is also considered recently. A number of studies over the period revealed that they are not minor in any sense of the word. It is suggested that NTFP harvesting is less damaging to bio-diversity and other environmental values than harvesting the timber. What it is important is to understand the impact of commercial harvesting of the product on bio-diversity and forest ecology. The assumption that the forest will remain standing and more or less biologically intact under sustained harvesting of NTFP.

The work aims to study the threats and harvesting pressure on certain NTFP and its impact on forest ecology and bio-diversity. To arrive at a sustainable harvesting practices and promotes propagation through planting and regeneration. Facilitate policy changes towards sustainable harvesting. Field observations, standard vegetation analysis techniques, PRAs series of workshops on sustainable harvesting to NTFP harvesters, Forest Department and NGOs are carried out in this regard.

Product Obtaining with Aims of Biological Activity of the Foliage of *Pinus douglasiana* Martinez and *Pinus oocarpa* Schiede, of the Western Mountain range of Mexico

Sandra Luz Toledo (sltg@cencar.udg.mx); Agustín Galllegos (gra09526@cucba.udg.mx); Hector Guillermo Ochoa (hochoa@dmcyp.cucei.udg.mx); Ynocente Betacourt (ecordero@af.upr.edu.cu); Elena Cordero (ecordero@af.upr.edu.cu), and; Uvaldo Orea (orea@af.upr.edu.cu).
University of Guadalajara, Mexico and University of Pine of the River, Cuba

The present economic situation forces that the developing countries, try to take advantage of its natural resources to the maximum, in the optimal use of the remainders of the forest activity. Activity lumber in Mexico is industry that produces great amounts of volumes of foliage, which they contain, once processed an important group of substances that can be considered with aims of biological activity. The potentialities that the biomass of the foliage of forest species like the pines offers, later to the cutting of the trees, as source of raw material in the product obtaining such as: Essential oils, clorofilina of sodium, paste chlorophyll carotene, waxes, forager remainder, concentrated provitaminic and concentrated of fatty acids and resinous; it has great importance for the forest industry, offering alternative for his use in the product obtaining of high added value. The foliage of the pines has been used empirically with medicinal and nutritional aims by the rural communities as much in Mexico as in other countries. With this work the technological foundations will be laid to establish in the region, an Extractive Company from the biomass of pines.

Annual Forecast and Inventory System of Wild Berry Yields in Finland

Kauko Salo (kauko.salo@metla.fi)
Finnish Forest Research Institute, Joensuu Research Centre

A forecast and an inventory system of the most economically and most popular berry species, cowberry (*Vaccinium vitis-idaea*) and bilberry (*V. myrtillus*) inhabitating various forest site types and cloudberry (*Rubus chamaemorus*) growing on mires, bogs and fens, started in 1997. The research project is based on a nationwide observation network, consisting nowadays of 220 forests and peatlands including 1100 permanent sample plots. 100 observers sent the collected information in electrical form to the Joensuu Research Centre, where the data were processed and sent as reports and theme maps to the television, radio, newspapers and internet. In a good crop year 1997 the biological bilberry yield was 270 mill. kg and 84 mill. kg. in a poor year 2004. Correspondingly, the cowberry yield was 227 mill. kg in 1997 and 103 mill. kg in 2002. The citizens of Finland have the right of free access to outdoor areas, where they can pick wild berries and mushrooms. Two million people, 40 % of Finnish population, picked berries and mushrooms as a very popular hobby, but picking also provides supplementary income for many people in rural areas. So there is a considerable demand for the forecasts and theme maps. Via media reports and theme maps the Finns were informed of the timetables of ripening berries, factors affecting the yields, sites where the main yields occur and levels of berry yields. Income earned from the sales of wild berries and mushrooms is tax-free in Finland. The value of wild berries picked on mineral forests and peatlands was calculated to be 70 mill. euros (84 mill. USD) and mushrooms 32.5 mill. euros (39 mill. USD) in good crop year 2003.

Sustainable Cultivation as a Strategy for Restoration and Conservation of Natural Populations of *Aquilaria agallocha* Roxb. in Natural Forests of Assam, India

G.U. Ahmed (giasuddinahmed@hotmail.co)

Department of Biotechnology, Gauhati University, Assam, India

Agarwood or gaharu and agar oil are two extremely valuable NTFP extracted from diseased trees of *Aquilaria agallocha* Roxb.(= *A. malaccensis*) which grows naturally in Assam and six other northeastern states of India. The plant has a long history of exploitation in this region and over harvesting since 1980s has almost completely removed the natural population from the wild. The plant is rarely sighted in the forests except in some inaccessible pockets in Bhutan and Nagaland. The plant is now domesticated and low to medium quality agar products are produced from plantation grown biomasses.

Unfortunately no innovative measures have been initiated to rehabilitate the plant in its natural habitats nor is there any attempt to conserve the plant *in-situ.* In this paper a plan has been suggested to increase the population of agar tree in natural forests in Assam by large-scale planting of seedlings and broadcasting of seeds collected from wild trees. Large-scale plantation with elite variety seedlings in private land, especially in the fringe areas of forests inhabited by local communities, will be the major source of biomass for producing agarwood and oil. Artificial induction of agarwood, to be done only in plantation grown trees at young stage (5 – 7 years old trees), will make all the trees productive at relatively young stage (11 to 14 years). On the other hand, plants rehabilitated in natural forest areas (Reserved Forests and Protected Areas) will not be subjected to artificial inducement process, so that only 20-25% of the population will be productive after 20-30 years of natural growth. The main objective is to produce alternative source of productive agar tree biomass to sustain the local agar industry and trade and to lessen the pressure on natural population.

Local communities involved in agar cultivation and trade will be made aware of the various aspects of agar tree culture, plantation management, identification of proper tree for harvesting, selection of mother plant for elite variety seedling production, sustainable harvesting, international trade and conservation of germplasms through target specific awareness programme. A large section of the rural community in every district may benefit with creation of new avenues for income generation. Harvesting of agar trees in RFs and PAs under the rehabilitation programme will be restricted at least for 20 years during which its population is expected to rise significantly. Sustainable harvesting of mature and productive trees in RFs and PAs may be planned by the State Forests Authority involving the local communities under a set of mutual agreement.

Propagation and Conservation of NTFP: Medicinal Plants through *In Vitro* Culture

Shyamal K. Roy, Pinaki Sinha (pinakiju@yahoo.com), and A.K.M. Sayeed Hassan
Department of Botany, Jahangirnagar University, Bangladesh

We established protocols for mass propagation of NTFP: three endangered medicinal plants, *Rauvolfia serpentina, Gloriosa superba,* and *Smilax zeylanica* through *in vitro* shoot tip culture.. For shoot induction in *R. serpentina* and *S. zeylanica* MS basal medium supplemented 1.5 mg/l BAP + 0.5 mg/l NAA and 1.5 mg/l BAP + 0.2 mg/l NAA were required, in which 95% and 92%

cultures regenerated shoots with 3.9 and 6.1 shoots per culture, respectively. Where as for *G. superba,* B_5 basal medium with 0.5 mg/l BAP + 0.5 mg/l Kn + 0.2 mg/l NAA was needed, in which 82% cultures regenerated shoots with 4.4 shoots per culture. Repeated subcultures in the same nutrient medium mentioned above, resulted in rapid shoot multiplication with 25 shoots per culture. For further development of the medium, casein hydrolysate (CH) (50-200 mg/l) and coconut milk (CM) (5-20%) were added individually or simultaneously to the medium for all the three species. *In vitro* raised shoots rooted on half strength MS medium with auxin. The survival rate of regenerants of *G. superba* was 42%, where as those of other two species were 85-90%. The technique described here may be a promising method for propagation as well as for sustainable use and conservation.

Indigenous Knowledge and Utilization of Edible Mushrooms in Southern Ghana

Apetorgbor, M. M.; A. K. Apetorgbor and M. Obodai
Forestry Research Institute of Ghana, Kumasi, Ghana; Department of Biological Sciences, KNUST, Kumasi; Food Research Institute, Accra

Indigenous knowledge on edible fungi is limited mostly to rural folks. Edible mushrooms are collected from forest reserves, off reserves and fields under fallow. However, with the current rate of bush burning and deforestation, collection of edible mushrooms from the wild is threatened. A survey was carried out in Southern Ghana to gather information on local knowledge and utilization of edible mushrooms. Mushroom collectors, consumers and traders were interviewed using structured questionnaires in local markets, homes and along roadsides. Thirty different mushrooms with their vernacular names were listed by correspondents. The commonest species collected for consumption are *Volvariella volvacea* (Bull: Fr) Singer, *Termitomyces letestui* (Pat) Heim, *T. macrocarpus* (Berk. & Br.) Heim, *T. schimperi* (Pat) Heim, *T. robustus* (Pat) Heim and *Coprinus micaceus* (Bull: Fr) Fr. Among the local people, names of edible mushrooms are based on the substrates on which they grow, their association with insects, and unrelated taxa are given collective names. The rural folk believe mushrooms have medicinal values and can serve as blood tonic, reduce obesity and lower blood pressure in hypertensive patients among others. Mushroom consumption is however, low among the rural folks since mushrooms collected are rather exchanged for more money to buy fish which is often less expensive. Women are much involved in mushroom collection on which they have extensive knowledge and derive huge income.

State of knowledge Concerning Bamboo Construction Materials

Jinhe Fu (jfu@inbar.int)
International Network for Bamboo and Rattan, China

Bamboo is the most important construction material from NWFPs. Due to its easy availability and good mechanical properties, traditionally raw bamboo has been widely used for construction

materials in tropical and subtropical regions for long time, for example, house, bridge, scaffolding, fence. It has been studied for bamboo durability, joint, and design etc.

Nowadays thanks to last two decades' modern bamboo industrial development and the shortage of timber, bamboo is more and more applied in construction materials such as concrete form, flooring, moulding, ceiling, wall, door, window etc. Now in China bamboo concrete from takes up one third of the total concrete form market and is exporting to neighboring countries, possibly also to Europe. Bamboo concrete form has advantages such as high strength, high elastic modulus, good durability and lost cost etc. Bamboo flooring has good properties like hardwood flooring and has been accepted by consumers both in Asian, Europe and America. This paper will review both the traditional bamboo construction material and the modern bamboo construction material.

Flowering Time and Frost Damage Risk to *Vaccinium myrtillus*, the Common Blueberry, in Finland 1898-2000

Jaakko Heinonen (jaakko.heinonen@metla.fi) and Risto Häkkinen (risto.hakkinen@metla.fi)
Forest Research Institute, Finland

In some years spring frost damage of the flowers of the Blueberry, one of the most important wild berries in Finland, reduces the yield considerably. The data for this study are the phenological observations that have been gathered systematically in Finland for more than a hundred years. The time series of blueberry flowering in different parts of Finland and the temperature records of the Finnish Meteorological Institute were used to analyze changes in the flowering time and in the risk of frost injury over the years 1898-2000. A model based on the threshold value of the temperature sum adequately explains the differences in flowering time in consecutive years. The monthly mean spring temperatures increased almost linearly during the study period. The increasing rate of temperature accumulation causes the average threshold value of flowering to be reached, at the end of the period, more than one week earlier than at the start of the period. However, the threshold value of blueberry flowering increased during the study period and there was no trend in observed flowering dates. The risk of frost damage to flowers was higher if flowering took place early in spring, but there was no trend in the risk.

Indigenous Knowledge: Challenges for knowledge management in forest sector in India

Rajiv Kumar Garg (rajivshobhit@hotmail.com) and Atul Jindall (atjindal@yahoo.com)
Uttar Pradesh Forest Department, India

In India, since ancient times, people have been using forest products not only for food but also for health and beauty care. Invasion of science though helped in giving a scientific outlook to the management and conservation of forest resources but took its toll in the form of vanishing indigenous knowledge. Indigenous knowledge is generally limited to a group or section of

people and is usually passed on from one generation to next without proper documentation and records. In the regime of Intellectual Property Right (IPR) forest dependent communities and other stakeholders have to play a greater role in protecting, eliciting, and institutionalising indigenous knowledge for the benefit of the sector as a whole. Communities possessing indigenous knowledge need to be brought in the main stream for effective knowledge management in the sector. The paper presents the status of indigenous knowledge and proposes mechanism for knowledge sharing in the era of global concern for IPR. The case study conducted in the southern region of the state of Uttar Pradesh in India tries to find out the issues related to the sharing of indigenous knowledge, testing and documentation, protecting rights of the communities, encouraging innovation, and building institutional memory.

Anti-Inflammatory Agents from *Vitex negundo*

Rasadah Mat.Ali (rasadah@frim.gov.my), Farediah Ahmad (farediah@utm.edu.my), Wong, C.L (Wong@utm.edu.my), and P. Mazura (mazura@frim.gov.my)
Forest Research Institute Malaysia; University Technology Malaysia

The anti-inflammatory activity of the leaf extracts of *Vitex negundo* was investigated on the Platelet activating factor (PAF) receptor binding activity. Bioassay- guided chromatographic fractionation of active fraction led to the isolation of luteolin and 3-4-dihydroxybenzoic acid. The percentage of inhibition exhibited by luteolin was almost equivalent to the standard, cedrol.

Livelihood Improvements through using Selected NTFP in Northern Vietnam

Karin Hilfiker (sfsp_field@hn.vnn.vn), Ruedi Luethi (sfsp_rl@hn.vnn.vn)and Claudia Zingerli (claudia.zingerli@env.ethz.ch)
Extension and Training Support Project, Vietnam, Swiss Federal Institute of Technology, Switzerland

The currently high market demand for specific NTFP, found in the uplands of northern Vietnam, indicate a potential to enhance livelihoods of subsistence farmers. This aspect was investigated in a recent study that focuses on the availability and market situation of NTFP in two upland villages in Hoa Binh province. The two villages are inhabited by Muong people, among whom poverty rates are relatively high. A market chain analysis of selected bamboo, medicinal plant and orchid species should reveal the contribution of NTFP for their livelihoods improvement. The analysis shows that the studied species generally experience a high customer demand at provincial and national level. However, the monetary contribution of the selected NTFP for local producers often remains low due to underestimated effective product value and inappropriate or absent processing methods. In addition, the wild forest species show declining availability related to lacking sustainable resource management and legal regulations. The study helps elucidating the NTFP situation and formulates recommendations regarding domestication, marketing, sustainable management and regulatory aspects to improve upland livelihoods in Hoa

Binh province. It further points out the importance for knowledge transfer, the willingness to take credit and to stabilise future market demand.

Stem Oleoresin Tapping of Chir Pine (*Pinus roxburghii* Sargent) Using Borehole Method

Kulwant Rai Sharma (krai@yspuniversity.ac.in) and Y.S. Parmur,
Department of Forest Products, University of Horticulture and Forestry, Solan, INDIA

The oleoresin industry in Himachal Pradesh (India) is based on suitable and renewable pine resources and the various operations are labour intensive which offers employment to the rural people. At present, only chir pine (*Pinus roxburghii* Sargent) is being tapped but there is also a great potential to tap other indigenous or exotic pines. The exudation of resin is substantially influenced by various physical and technical factors and a score of scientific experiments have been conducted to develop a suitable approach in tapping of trees. The only need is the application of all scientific principals in the field without any deviation. The basic rules should be followed whileadopting the tapping methods otherwise, repercussions in the form of great loss to pine forests are to be faced.

The availability of adequate number of mature pine trees is the fundamental requirement for smooth running of the oleoresin tapping work and thereby, the dependent industries. The plantations are to be raised solely for the oleoresin production by exploiting the existing variability in the nature. In general, high temperature, greater diameter, bigger crown etc. are conducive for higher resin yield therefore, the areas chosen for high resin yielding plantations should be hot and productive. The fluctuations in oleoresin yield invite import, which ultimately disturb the economy of the country. India has become importer of both rosin and turpentine because of the shortfall in production due to the damage done to trees by the use of incorrectly applied methods.

In the present investigations, the trees having diameter of 30-40 cm were selected for tapping. In each tree one hole was drilled on main stem of tree approximately 10 cm above the ground using hand drills (Girmits) of different diameters viz. 1.25cm(0.50”), 1.875cm (0.75”), 2.50cm(1.00”) and 3.125cm(1.25”).

The studies conducted on the influence of borehole diameter and chemical stimulants on oleoresin yield in chir pine exhibited significant effect. It showed increasing trend with the increase in borehole diameter and depth. The maximum oleoresin yield was obtained in 2.50cm borehole diameter having 10 cm depth. Spraying of mixture of 10 per cent ethaphon and 20 per cent sulphuric acid recorded highest oleoresin yield and no spray observed the lowest yield. Freshening at monthly interval also exhibited significant enhancement in the oleoresin yield. The highest oleoresin yield was obtained in the treatment started from 0.75 inch diameter holes followed by freshening with higher diameter at monthly interval upto the 1.25 inch diameter of holes.

Impact of Consumption of Non Wood Forest Products (NWFPs) on the Nutriture of *Pahadi Korwa* Primitive Tribal Group – A Study from Sarguja District of Chhattisgarh

A K Bhattacharya and Krishna Patra
Indian Institute of Forest Management, India

The paper deals with the relationship between the Primitive Tribal Group (PTG) and the Non Wood Forest Products (NWFP) used for their nutritional fulfillment in the forests of central India, with special reference to the *Pahadi Korwa* PTG of Surguja District of Chattisgarh. The study area, methodology and the village demographics have been discussed. The consumption pattern of NWFP has been examined. Thirty eight major NWFP species are consumed by the villagers of the study area. Nutritional assessment of the NWFP indicates that 77% people (49% male and 51 % female) have been found to be underweight .The chemical analysis of the species reveals that the values of the nutrient contents of species vary significantly as compared to those prescribed by the ICMR (taken as standard). The species that have high nutritional value and also consumed in sufficient quantities include Achar (*Buchanania lanzan*), Dumar (*Ficus glomerata*), Mahua (*Madhuca latifolia*), and Pihari (*Psalliota campestris*). Based on the results and the analysis, recommendations for better utilisation of NWFP have been made. There should be adequate emphasis on the traditional management and conservation methods of NWFP along with proper concern at national, state and local levels.

Solutions for Improvement of Star Anise Plantations in Vietnam

Hoang Van Chieu (hoangvanchieu@yahoo.com)
Central Forestry Vocational Technical School No. 1, Vietnam

Income from Star Anise fruits (a species of genus *Illicium*) is the main source of cash income of many ethnic minority people (mostly Nung and Tay ethnic groups) in the mountainous province of Lang Son, Vietnam.

Most of the current Star Anise plantations were established decades ago. So, people now mainly benefit from the existing plantations transferred from their grandparents, while they do not have much experience to improve the harvest. At the same time, they also wish to establish more plantations and replace the too old stands. However, many people do not have knowledge and experience in planting and tending this species, whereas the local relevant agencies have not shown a clear role in assisting people to develop Star Anise plantations. In addition, market for Star Anise fruits from producers in Vietnam is not stable, while people here are not active in finding promising markets for their products. At the same time, authorities have not paid much attention to assisting people selling this product. For these reasons, there needs to be programs for improving outcomes of Star Anise plantations implemented, with assistances of national and international organisations and donors.

Failure Mode and Microscopic Failure of Dendrocalamus asper (Bamboo: Buloh Betong) Loaded in Tension and Compression

Mansur Ahmad (mansur628@salam.uitm.edu.my), Shahril Anuar Bahari, and Mohd. Ariff Jamaludin
Faculty of Applied Science, Universiti Teknologi MARA, Malaysia.

Mode of failure of the small clear specimens in relation to strength properties of *Dendrocalamus asper* (Bamboo: Buluh Betong) loaded in tension and compression parallel to grain were investigated. Comparison of the mode of failure at different culm portion and between internodes and nodes were carried-out. The modes of failure were identified through visual examination of the tested sample and were further examine under microscope. Both tension and compression tests exhibited 2 modes of failure. In tension, the modes of failure were in brash tension and splintering tension, while the test in compression exhibited a mode of pure compression. The strength properties related to the modes in tension and compression were not significantly different between the portion (Bottom, middle and top). The strength properties in relation to the fracture modes between the nodes and internodes were found to be significantly different. When observed for microscopic failure at the internodes, the failure occurred primarily at parenchyma region especially at radial direction. However, failure at nodes occurred in both vascular bundles and parenchyma region.

The State of Global Research on the Role of Medicinal Plants in Rural Livelihoods

Carsten Smith Olsen (cso@kvl.dk) and Madhav Karki (mkarki@idrc.org.in)
The Royal Veterinary and Agricultural University, Centre for Forest, Landscape and Planning, Denmark and International Center for Integrated Mountain Development, Nepal

Hundreds of million of people rely on, or choose to use, medicinal plants to cover all or part of their health care needs. In many parts of the world, medicinal plants also play an important role in income generation, food and nutrition security. Medicinal and associated plant resources currently form the supply source for a global demand for botanical medicines valued at USD 40-60 billion, with an annual growth rate of 10-15%. Thousands of species are used by dozen or so traditional and complementary systems of medicines and medicinal usage may constitute the most common human use of biodiversity. Almost 90% of the supply is from wild collected by mostly poor people drawing up to 50% of their household income from medicinal and other similar products in some developing countries. High poverty and rampant biodiversity loss are closely related and research is needed to find out strategic balance between wise conservation and optimised rural development. This paper reviews global knowledge and wise practices of the role of medicinal plants in rural livelihoods. The review is used to identify major knowledge gaps and makes recommendations on priority research areas.

Herbicidal Potential of Lemon-Scented Eucalypt (*Eucalyptus citriodora*) Volatile Oil against Forest Weeds

Harminder P. Singh (hpsingh_01@yahoo.com or harminderpal@yahoo.com), Daizy R. Batish (daizybatish@yahoo.com), Shalinder Kaur (kaur_shalu@yahoo.com) and Ravinder K. Kohli (rkkohli45@yahoo.com)
Centre for Environment, Department of Botany, Panjab University, India

World over large amounts of synthetic herbicides are used to manage weeds. However, due to their residual activity and the linked toxicological and environmental concerned, efforts are being made to search for novel products with herbicidal activity. In this context, natural plant products offer a great choice, as they possess new and unknown target sites of action that are different from synthetic herbicides thereby helping in overcoming the problem of increasing herbicidal resistance among weed species. Among natural products, volatile oils possess a wide spectrum of biological activity including phytotoxicity that can be exploited. In this direction, volatile oil from lemon-scented eucalypt (*Eucalyptus citriodora*), known for their insecticidal activity, was evaluated for possible herbicidal potential against invasive forest weeds *viz. Ageratum conyzoides Lantana camara*, and *Chromolaena odorata* that are threatening the natural structure and dynamics of forest ecosystems in northwestern Himalayas. Volatile oil was observed to have a profound effect on the growth, development and photosynthetic ability of the target weed species. These caused visible injury on the plants such as necrosis or chlorosis gradually leading to their complete death. The action of the oils was similar to that of herbicide glyphosate. Based on these observations it is concluded that eucalypt oils possess weed-suppressing ability and can be used as a bioherbicide for the management of weeds.

A Research Vision for NTFP certification to Sustain JFM Initiatives India

S Sindhi (sumitasindhi@yahoo.co.in) and P R Choudhury (choudhury@sancharnet.in)
Freelance NRM professional, India and CS&WCR&TI, Research Center, Orissa, India

Non-timber forest products (NTFP) are socio-culturally linked to Indian livelihood and have a vast economic potential. But unfair trade practices, deteriorating conditions of poor gatherers and growing vulnerability of forest ecosystems have made the NTFP scenario quite gloomy. Joint Forest Management (JFM) in India is promoted as a socially responsible sustainable forest management tool. However, its limited options for wood harvest leave returns from NTFP as the major incentive for forest protection. Reducing return from NTFP has been eroding the success of JFM movement. Fair trade options through NTFP certification can streamline considerable social and economic benefits towards these communities to encourage them for sustainable protection. This could be a socially benign, ecologically desirable and economically viable alternative management system for Indian forests. However, novelty of this approach and intricacies involved in the process poses roadblocks. Blending the global experience with regional perspectives, this paper tries to delineate the research needs for launching this option in India. The starting points could be preparation of NTFP inventory and production forecast models for eco-regions; development of NTFP silviculture and sustainable harvesting protocols;

exploration of trade channels and product processing apart from standardization of the process and products. There is an urgent need to reduce transaction cost through formation of cooperatives and federations, policy level interventions or by widening margins from developed markets. While developing the research vision, the paper also dwells upon the existing infrastructure, perceptions of stakeholders and policy receptiveness as preparatory platforms in some enterprising states of India. The situation points to a strong and urgent need for further research and also to ensure coherence and professionalism in the process.

Economic Viability and Ecological Sustainability of Kalazeera Bunium persicum (Boiss) Fedtsch- A niche crop for High Hill Dry Temperate Region of Northern Himalayas

Rajesh Uppal (uppalr@hillagric.org)

Agricultural University, Department of Agroforestry and Environment, India

Bunium persicum (Boiss) Fedstsch, Black caraway a perennial, aromatic spice and medicinal umbellifer (Apiaceae), growing naturally in dry temperate regions (1850-3100 m alms) of Northern Himalayas is one of the overexploited, economically important plant in the cold deserts of Western Himalayas. The unscientific exploitation has drastically reduced its population in nature. Recognizing the need for the conservation of this plant from overexploitation and to meet the ever increasing demands, the plant has been studied in cold deserts of Himalayas where it is being grown as a niche crop and recently brought under domestication,. It is highly priced (400-600/Kg) low volume and non perishable commodity, straw and seed of which yield cumin oil (1-1.25 and 5.5-14.3%) rich in cuminaldehyde and p-menthadienals. Kalazeera is seed propagated perennial plant; it takes four years to produce seeds after seeding. The average productive life of bulbs vis-a-a vis plant is 10-12 years and can accommodate about 1.5 lakh plantsper hectare each such plant has a potential to yield about 3-4 gms seed per crop season with an average yield of 5-6 quintals per ha. The available literature on the cultivation of zerera crop is scanty and do not have adequate information on its economic viability.

Exploitation of Wood Fodders in the Protected Forests of Wari-Maro, Benin Republic

Brisso, N (mrhouinat@yahoo.fr); M. Houinata; C. Adandedjan and B. Sinsin
Ecole Polytechnique d'Abomey-Calavi and Faculté des Sciences Agronomiques,, Université d'Abomey-Calavi, Bénin

A study carried on the woody fodders in the classified forest of Wari-Maro (Benin Republic), revealed that many plant species are exploited by cattle farmer during the dry season. Among these plant species, there was a severe pression on *Khaya senegalensis*, *Afzelia Africana*, and *Pterocarpus erinaceus*. The estimated number of exploited individuals was in average 30. Exploitation followed a defined chronology and technique was mainly pruning. There is a relation between diameter classes and biomass yielded by each fodder tree. Tree fodder

productivity varied according to species and decreased with the dry season length. Tree fodder cutting as indicative of pressure varied significantly.

Streamlining Local Traditions for Sustainable Livelihoods through Certification of Non-Wood Forest Products in Tropical Forests of Central India

Yogesh D. Jadhav (yogeshdjadhav@yahoo.com)
India

About 72.2% of India's population is dependent on agriculture and nearly 50% of them are economically benefited from non-wood forest products (NWFPs). Apart from timber, forests provide several NWFPs like gums, resins, medicinal plants, flowers, and fruits, among others. These contribute to nearly 50 percent of the average annual income of about 30 percent of rural populations in the country. But a systematic framework for sustainable management, harvest and marketing from the grassroots level to the level of export to international markets does not exist. These NWFPs remain undervalued due to lack of knowledge of commercialization and certification, unsustainable harvests, wasteful processing, inefficient storage procedures, disorganized markets and inadequate entrepreneurial capacities. If appropriate initiatives for nurturing entrepreneurial capacities are adopted at the policy level and implemented at the grassroots, the livelihoods of the communities can be improved to a large extent.

The study is based on NWFP availability in central Indian forests, which are being jointly managed by Joint Forest Management Committees. Using resource survey questionnaires, focused group discussions and secondary data, the study tries to explore the possibilities of sustainable livelihoods through NWFP certification and traditional enterprise development.

NTFP Market and Business Development: Obstacles to and opportunities for ensuring that NTF resources are sustained

A. L. Hammett (himal@vt.edu)
College of Natural Resources, Virginia Tech, USA

Programs developing non-timber forest products-based businesses have been common, but primarily focused on identifying profit making opportunities through increasing markets (especially overseas), and determining avenues for increasing livelihoods. These programs seem less likely to include considerations for NTFP resource management and sustainable utilization. Balancing local economic development needs with sustainable NTFP resource management is a continual dilemma. However, this increasingly heavy focus on non-timber forest products needs to shift away from narrow focus on economics and incomes and livelihoods to one that is more integrated with resource management and equity issues. A review of lessons learned from several NTFP-based economic development projects including those from Nepal, Bolivia, India, and Russia reveals the need for a more integrated approach. Knowledge of ecology, resource

management needs, and harvest planning appears critical but often forgotten. Increased appreciation for plant ecology, the location and assessment of NTFP resources, and knowing cultural and traditional uses are critical to maintaining resources that will support continued harvest and utilization long after local development program goals have been met. Planning for harvesting and proper management will lead to product development and marketing opportunities that will sustain enterprises that make meaningful contributions to local economies.

Involving Local Communities in the Management of NTFPs: A comparison of avenues to achieve sustainability in cases from Bolivia and Cameroon

Roncs Ese-Etame (roncse@vt.edu) and A. L. Hammett (himal@vt.edu)
Department of Wood Science, Virginia Polytechnic Institute & State University, Virginia USA

To find key attributes needed to sustainably managing non-timber forest products (NTFPs) the authors will examine two projects - one in Cameroon and the other in Bolivia. Without the involvement of local people NTFP resources cannot be sustained. Future NTFP conservation relies heavily on understanding indigenous communities' rights, traditions, and cultures, and how they will be incorporated. Involving local communities in program decisions is relevant efforts of local governments and policy makers, economic development officials, NGOs concerned with improving social and economic well being. If local people are involved, then access to indigenous knowledge of NTFPs and opportunities for their sustainable management can be assured.

In Bolivia the absence of market planning and marketing skills, optimizing processing technologies (quality control, etc.), marketing technologies (handling, transport, storing, and packaging), and promotion to regional and export markets limit the economic development of NTFPs. In Africa constraints on communication and education activities compound NTFP conservation efforts. Research is needed both on the managing the resource (i.e., how much can forest lands produce on a sustainable basis), processing (efficient conservation and use of resources i.e., curbing waste), and marketing (i.e., size and needs in distant markets).

Domestication of Ground Hemlock (*Taxus canadensis*) into an NTFP Nursery Crop for Production of Pharmaceutical Compounds

Stewart Cameron (scameron@nrcan.gc.ca) and Ron Smith (rosmith@nrcan.gc.ca)
Natural Resources Canada, Canadian Forest Service, Fredericton NB

Ground hemlock or eastern yew (*Taxus canadensis*) is a woodland understory species occurring in the northeastern USA and throughout eastern Canada from which the anti-cancer drug paclitaxel (Taxol®)and other useful taxanes may be extracted. In 1997, CFS-AFC initiated a multi-disciplinary domestication project for eastern yew. Progress to date in each element of the *Taxus* domestication project is described. As a model for the domestication of *Taxus* and other

NTFP species, we propose a modular domestication framework, consisting of the components of: cultivar selection using quantitative genetics; propagation (e.g., rooted cuttings, tissue culture etc.); cultivation practices (fertility, spacing etc.); biotic and abiotic elicitation to enhance product yield; phytochemical analysis methods; and finally economic analysis and commercial market evaluation. We also propose that that elements of this generic framework, which is a hybrid of tree improvement and agricultural crop methods, can be mixed and matched to produce other NTFP crops according to the scale of biomass requirements and the chosen method or intensity of cultivation (e.g., field crop or agroforestry production). The need to conserve the woodland species, and how benefits cans be shared among varied stakeholders, as part of the overall domestication strategy, are also discussed.

Indigenous Knowledge for Potential Drug Screening and Commercialized Products

Dr. I. Faridah-Hanum (fhi81@yahoo.com)
Faculty of Forestry, Universiti Putra Malaysia, Malaysia

Modern society is so engrossed with information technology, biotechnology and nanotechnology that the remaining indigenous knowledge began to dissipate with the disintegrating forests in Malaysia. Ironically there is a growing trend of resorting to natural products including traditional medicines and the increased awareness of the harm of synthetic materials to man and his environment. The remaining forests in Malaysia cannot cope with the tangible needs of her people in the long run hence there is a need for simulating these natural products commercially. A study was conducted in Ayer Hitam Forest, Selangor to extract the indigenous knowledge of the dwelling indigenous people from the Temuan tribe on the use of plants around them before the tribe disappears with their knowledge as this forest slowly disappears. A total of 98 plant species with 140 uses were recorded and they were grouped into seven methods of application namely drink, eat, chew, poultice, rub, bath and shampoo. Most of the species were the major sources of drugs for the indigenous community in the forest and they could be potential leads for drug screening and the development of pharmaceutical products. Many species form the minor ingredients of a decoction of a wider curative concept. Other potential uses include the development of cosmetic and nutraceutical products.

Developing Needs Based Inventory Methods for Non-Timber Forest Products (NTFPs)

P.Shanmughavel (Shanvel_99@yahoo.com)
Department of Botany, Bharathiar University, India

This paper discusses the importance of computer aided database for non timber forest products (NTFPs) in India. The database is developed using Visual Basic 6.0 as the front end and Oracle as the backend tool to support and enhance public information on tropical non timber forest resources for sustainable forest management. Also useful to continuously access information requirements and provide solutions to National and International community users. Indian forests

are abound with a large set of medicinal and economically important plant/tree species. It yields various products such as gums, resins, bio-pesticides, under-utilized food and fodder plants. The broad areas covered by the inventory are taxonomy, systematics, distribution, vernacular names, uses, producers, processes and economically important biochemical components. The salient features of the inventory are also discussed.

The Economics of Non-Timber Forest Products – A Case Study of Tribals in a Protected Area in India

K.N. Ninan (ninankn@yahoo.co.in)
Institute for Social and Economic Change, Bangalore, India

This study analyses the economics of Non Timber Forest Products (NTFP) and the economic values appropriated by tribals in a protected area in India. Using primary data covering a cross section of tribals in the Nagarhole National Park, South India the study notes that the economic values appropriated by the tribals are quite high. Excluding external costs (i.e. wildlife damages costs and defensive expenditures to protect against wildlife attacks) the Net Present Value of NTFP benefits derived by the tribal households was over Rs 31,172 per household (at 12% discount rate for cash flows summed over 25 years) and over Rs 30,378 per household when external costs are also included. The tribals also have a positive attitude towards biodiversity conservation in general and wildlife protection. Asked to justify and rank the reasons why biodiversity needs to be conserved, the tribals emphasized their livelihood and ecosystem functions. Using contingent valuation method, the study notes that those with income from coffee estates and forest employment, and those residing in the core zone of the national park are less willing to accept compensation and relocate outside the national park. The study suggests improving the incentive structure in order to obtain the support and participation of tribals in biodiversity conservation strategies.

Alaskan Non-Timber Forest Product Opportunities

Susan J. Alexander (salexander@fs.fed.us), David Pilz, Robert Schroeder, Jerry Smith, and Jim Freed
USDA Forest Service Alaska Region, Department of Forest Science, Oregon State University, Forest Resource Enterprises, LaPine OR, and Washington State University, Olympia WA

Nontimber forest products have been harvested from southern Alaska for millennia as resources vital to the livelihoods and culture of Native Alaskans, and more recently, as subsistence resources for the welfare of all citizens. Many of these products are now being sold, and Alaskans seek additional income opportunities through sustainable harvest and manufacture of such forest resources. We discuss the unique legal, regulatory, land tenure, and environmental context that southern Alaska presents for marketing nontimber forest products; summarize the various species and types of products being harvested; and consider the marketing challenges

and opportunities new entrepreneurs will encounter. The information and resources we provide are intended to enhance income opportunities for all Alaskans, while sustaining the organisms harvested, respecting traditional activities, and ensuring equitable access to resources.

Mushrooms Trees, and Money: Value Estimates of Commercial Mushrooms and Timber in the Pacific Northwest (USA)

Susan J. Alexander (salexander@fs.fed.us), David Pilz and Nancy S. Weber
USDA Forest Service Alaska Region and Department of Forest Science, Oregon State University, Corvallis OR

Some information exists about the value of commercially harvested wild edible fungi in the Pacific Northwest. Prices for wood products are well documented. Little information exists, however, about the joint production of, and values for, wild edible fungi and other forest resources such as trees. There is also little known about the value of recreational mushroom harvesting. Case studies illustrate the information needed to determine production and values for three commercially significant wild mushroom species in various ecoregions in the Pacific Northwest, and present net values for wild edible fungi and timber in different management regimes are outlined. These values are site specific. In addition, values for recreational harvest of wild edible fungi in south-central Washington state are also discussed. Economic comparisons of the value of timber and mushrooms are sometimes used as arguments for whether or not forests should be logged. Rarely is the answer obvious from simple comparisons of these two forest products. Production economics is concerned with choices about how much and what to produce, with what resources. Values for joint production of forest resources are sensitive to assumptions about changes in forest management, yields for mushrooms and trees,

---

Sustainable Bark Harvesting for Medicinal Use: Experimental strip harvesting from the southern Cape forests, South Africa

Vermeulen, W.J. (wesselv@sanparks.org) and Geldenhuys, C.J. (cgelden@mweb.co.za)
South African National Parks, South Africa and (ForestWood cc, South Africa

In South Africa bark harvested from selected tree species in forest and woodland is a commonly used traditional medicine. This practice became highly commercialized due to increasing urbanization, resulting in the over-exploitation of some target species and posing a major challenge to forest managers. An experimental bark-harvesting project was initiated in 2000 in the southern Cape forests to develop yield regulation systems and best practices for bark harvesting. *Ocotea bullata*, *Curtisia dentata* and *Rapanea melanophloeos* were selected for the study as they are highly in demand and well represented in the southern Cape forests. During mid-summer and mid-winter, vertical strips of bark, 1m in length and of different widths, were removed from trees of size classes ≥ 10 cm DBH. Recovery rates through edge and sheet growth, presence of pinholes, fungi, and crown dieback were recorded every six months. The results

showed a differential response of the species, with good recovery from *O. bullata* through edge growth, fair recovery from *C. dentata*, through sheet growth, but little response from *R. melanophloeos*. The project has since been expanded to other forest and woodland species in Southern Africa. Management strategies need to be different for the different species.

Exploitation of Indigenous Knowledge on Underutilized Plant Species: A Case Study from Western Ghats, Tamilnadu, India

V.S Ramachandran (vsrbot@yahoo.co.in)

Bio-Diversity conservation is a protective measure taken to prevent the loss of genetic diversity of the species, to save their extinction and to protect the ecosystem. The tribal living in the Western Ghats of Peninsular India, not only have a fair accumulated knowledge about the plants, which is acquired through their ancestral lineages and environmental advantages but also possess details about the current happenings in their field. The willingness amongst them to cope up with the current life style, drive them to deviate from their usual life to adopt new methods, which may result in loss of ethnic knowledge and usage of biodiversity. The aim is for the proper utilization of underutilized plants that would help in food security, income generation, health and non-material benefits for the tribal and the society. With reference to this, a study was conducted in Coimbatore District (10˚.10' and 12˚.00' N and 76˚40' and 78˚00' E, Tamilnadu) of India. And it yielded a fair amount of information on the utility of these plants, categorized as Food, Leafy vegetables, Edible fruits, Medicinal plants, Wild relatives of cultivated plants, miscellaneous purposes, Rare and endangered plants. The result obtained will help to a great extent in eliminating poverty, generating an honourable income for the tribal. The indigenous knowledge is important in order to appreciate and enhance the non-material benefits and a wide range of underutilized plant species, with well known nutritional and medicinal properties have the potential for further promotion. Promoting underutilized plant species - basically to enable poor people to stabilize the basis of their livelihood – to diversify for biodiversity and environmental benefits for the society.

Sustainable Management of NTFP – Forests in the Balance

CP Oberai (shivamfp@vsnl.com)
South & East Asian Countries NTFP Network (SAENN)

India has rich biodiversity, one of the 12 mega biodiversity hot spots of the world. It has 16 major forest types, ranging from the coastal tidal forests to high altitude Alpine pastures. Here we also have arid dry forests and wet evergreen forests that have unique biodiversity. Such forests have rich variety of NTFP that has become part of our tradition and socio-cultural ethos.

Tribal, aborigines, primitive tribes live happily in perfect symbiosis with forests. Over generations, they have lived on forests and understand the language of trees, climbers and plants.

These communities use NTFP for bows &arrows, fishing rafts &canoes, huts and shelters. They even have totems & oracles woven around forests. When Tsunami struck terror in Andaman Islands, most of the aborigines moved to safe upland forests after observing peculiar behavior pattern of animals, birds and fish. Thus they could brave even the strong natural calamity.

Women in India, like many developing countries manage the home, while men folk are out on wage earning or other jobs. They need firewood to cook food and keep the household warm in winters. They also collect forest fruits, nuts, tubers and herbs and make some income by collection of NTFP and mat weaving, basket making, bidi rolling, cleaning, sorting and packing of NTFP.

Our people have been using herbal medicines since ages. They have worked hard to learn and such herbal products. Ayurveda, Yunani, Sidha, & Homeopathy systems of medicine use herbal, plant based medicines to treat most of the health problems. Such medicines are economical and effective, with no side effects.

NTFP from India's forests yield raw materials that sustain several industries. Fibers and flosses, essential oils, oilseeds, tans &dyes, gums &resins, drugs, spices, poisons, bio insecticides, edible wild plants are some of the NTFP industries that generate good income & trade activities.

India is a great country with many religions and cultures. All faiths preach reverence for plants, animals and other forms of life. We use many plants and NTFP for performing rituals. Some common articles are coconut, lotus, Bael (*Eagle marmelos*), Pipal (*Ficus relegiosa*) Champa (*Michelia champaca*) Palash (*Butea monosperma),* Mahua (*Madhuca latifolia*) Kadam (*Amthocephelus kadamba*), Haldi, Madar(*Calotropis sp*.), Tulsi (*Ocimum santum*), Chandan (*Santalum album*), mango(*Mangifera indica*) etc.

NTFP based activities help conservation of biodiversity, gene pool and high forests. Rising spiral of biotic pressure, both human and animal, have pushed the natural forest resources to the wall. It is time that the focus shifts to NTFP in stead of timber and other major products. Technology can play vital role in optimizing benefits of NTFP, thereby conserving the core biodiversity.

Institutional Support to Link Livelihood and Management of NWFPs

Belcher, B. (b.belcher@cgiar.org)
CIFOR, Indonesia

New emphasis on rural poverty alleviation has given new impetus to efforts to understand and improve local livelihood benefits from forest management. Experience with commercialization and market development of NTFPs has yielded important lessons about the potential and the limitations of such approaches. There is increasing realization that local institutions and social organization - through property rights, producers' organizations, forest management committees and so on - are important in determining the success of local management initiatives, in both environmental and economic terms. Moreover, there is now a rich experience in many countries

with devolved forest management rights and responsibilities, with new forms of community management institutions, and with new forest-product marketing approaches. This paper summarizes the lessons learned and recommends approaches for governments, donor and development agencies to support livelihood improvement through forest-related interventions.

Collaborative Institutional Arrangements to Advance Research on NWFPs

Chamberlain, J.L. (jachambe@vt.edu).
USDA Forest Service, Blacksburg, Virginia, USA

Over the last decade, non-wood forest products have started receiving a great deal of attention by individuals and institutions concerned about sustainable forest management, rural development, social justice, and biological diversity. The interest and concern about these products and the resources from which they originate has increased tremendously. Recognizing that many groups had started developing research on non-timber forest products, the UN FAO, IUFRO and CIFOR formed, in 2002, an informal partnership to explore the multitude of issues that affect efforts to integrate NTFPs into forest management. Over a four month period, the three organizations facilitated an e-consultation that served as a foundation for a side event to the 2003 World Forestry Congress. The full-day side event provided a forum for some 30 organizations from around the world to highlight the importance and need for increased actions to better integrate NWFPs into forest management. The ensuing "Quebec Declaration on Strengthening Global Partnership to Advance NWFPs" identified key actions that could be taken by international institutions to help incorporate these products into forest management. This presentation will examine the issues, recommendations and developing framework that could help efforts to get NTFPs into forest management.

NTFP Geography of Nepal: An analysis of Regional Distribution of NTFP Based on Government's Record for a Five-year (1997-2002) Period

Gautam, K.H. (khgautam@yahoo.com).
Nepal

Nepal's diverse ecological niches host a relatively large number of plant species, many of which are known, traditionally, at the local level for their economic, environmental or spiritual value. Inadequate appreciation from the decision-makers has led to inadequate management efforts for NTFP resources. Patterns of specific NTFP's value may differ with locations, and within a location by socio-economic group. Only large-scale assessment can investigate the varied values of NTFP in different locations, and this information is required to allocate resources for research and development. As NTFP contribute significantly to the rural livelihoods in Nepal, studies focusing on them are warranted. Government policies assert control over all forest resources including NTFP; theoretically, the harvest, use and trade of all forest products need government's permission. Thus the record maintained at the forestry offices give the information

on NTFP availability in the respective regions. Based on the permits issued from all the 75 districts during the period July 1997 to July 2002, the present paper analyses availability of NTFPs and their trends for different geographical and ecological regions. The findings are crucial for allocating research and development priorities to any NTFP.

Gender Issues in Collection, Processing and Marketing of Non-Timber Forest Products: An Economic Study in Western Ghats region of Karnataka, India

Girish, M.R. (mrgirish2000@yahoo.co.in), Girish, M. (mamathagirish@yahoo.com)
University of Agricultural Sciences, India

The collection of NTFPs by tribal people in the past was primarily for meeting their domestic requirements. As time passed, these NTFPs have become a major source of cash income for the tribal households. They collect a number of NTFPs, which have both use and an exchange value. The present paper addresses the gender issues in collection, processing and marketing of NTFPs by tribal households in the Western Ghats region of Karnataka State, India. With regard to the collection of NTFPs, men collected more quantity than women in the case of all NTFPs except bamboo, fuelwood, greens and mushrooms. Women played a dominant role in the collection of NTFPs and their high subsistence value. The method of collection and the type of value (use or exchange) embodied in the NTFPs, influenced the gender-wise involvement in collection of NTFPs. In the case of processing, women processed the maximum quantity of the total quantity processed in the case of all NTFPs except bamboo and teak seeds. Regarding marketing of NTFPs, men marketed more quantity than women, except for *Terminalia chebula*. The role of children in processing and marketing of NTFPs was negligible.

Medicinal Plant Conservation and Economic Development

Karki, M. (mkarki@idrc.org.in), Rawat, R.B.S. (ragahubir22@hotmail), Johari, R. (radijo_2000@yahoo.com).

IDRC, India, Medplants Board, University of York, Canada

Medicinal Plants (MPs) are attracting increased attention for multiple eco-economic functions and potential contributions in improving livelihoods of rural communities. MAPs are an integral source of income, food, medicine, dyes, tannins, and nutrition for poor people. MPs - traditionally used for home remedies, subsistence purposes and small-scale trading by rural communities - are increasingly in demand by industry and global trade – estimated around 63 billion US$. Studies show that certain plants or groups of species are being destructively extracted, unethically traded, overused and their ecosystem degraded. The reasons for this are multiple and complex but principally include the lack of economic incentives, poor level of knowledge, old and inappropriate practices, outside control over these resources, acute rural poverty, increasing pressures of market demand, and changing lifestyles and food habits.

Unfortunately, while demand rises, inequitable trade practices have meant that only a small margin of the profits trickle down to the collectors and harvesters. Highly developed illegal trading networks in almost all the countries control and operate the bulk of trade in raw materials. However, despite the huge market potential, local communities are not gaining the economic benefits of this sector's phenomenal growth for which livelihood-oriented research is urgently needed.

A Product Approach for Developing Institutional Capacity

Lobovikov, M. (mlobovikov@inbar.int)
International Network for Bamboo and Rattan (INBAR) and Common Fund for Commodities (ICB CFC), China

International Network for Bamboo and Rattan (INBAR) is an international organization with the main mission to improve well-being of producers and traders of bamboo and rattan – the two major non-wood forest products (NWFP). History of INBAR is 25 years old. Originally it was established as a primarily research-based organization and gradually changed its focus to development issues. In 1997 INBAR was officially inaugurated as an international organization with the headquarters in Beijing (China) and currently it has 28 member countries. INBAR has built its program structure and institutional capacity using a product approach unlike "process" approach used by many other development organizations and NGOs with broader missions. The same approach was successfully used to develop institutional capacities of the INBAR project partner institutions in the member countries. The product approach for developing institutional capacities is practiced directly (through developing the new products and supply chains) and indirectly (through improving the commodities' business environment). A qualitatively new phase in the product approach development started in October 2000 when INBAR became an International Commodity Body of the Common Fund for Commodities - a UN financial instrument. The product approach has been used to shape a new commodity strategy of the organization.

Informing Decision-Making for Successful NTFP Commercialisation: Research Findings & Policy Implications from Mexican and Bolivian Case Studies

Marshall, E. (Elaine.Marshall@unep-wcmc.org), Newton, A. (ANewton@bournemouth.ac.uk)
UNEP-WCMC, University of Bournemouth, UK

Whilst interest in NTFP commercialization as a rural development option continues to grow, initial enthusiasm is increasingly being tempered by a growing realization that many attempts fail to deliver the expected benefits. There is therefore a growing need for information and tools to support the decisions being made by a wide range of stakeholders, including local communities, development and conservation agencies, government agencies, NGOs, and the private sector institutions involved in trading and marketing forest products. Objectives need to

be set on what criteria constitute "a success" and information is needed to guide the selection of NTFPs for development, and how and where investments should be targeted. Our multidisciplinary, multi-stakeholder research project has developed a decision support tool in the form of a Bayesian Belief Network that represents the different processes involved in commercialization of a typical NTFP. These include production, collection, processing, storage, transport, marketing and sale. The factors influencing the probability of success at each stage of the chain are represented in the model, enabling their relative impacts to be evaluated. Success in this context can be defined in a variety of ways, including positive impacts on poverty alleviation, gender equity and access to and conservation of forest resources.

Analysis of Policies and Regulations Governing Non-Timber Forest Products (NTFPs)

Razal, R.A., Peralta, E.O. (eoperalta@yahoo.com), Villanueva, M.M.B. (lyn_bvillanueva@yahoo.com), Dolom (bldolom@yahoo.com), P.C., Camacho, S.C. (sonny@laguna.net)
UPLB College of Forestry and Natural Resources, Philippines

This study assesses existing policies and regulations that govern the country's NTFPs. Problems, issues, and conflicts of policies are solicited from the NTFP permit holders and key stakeholders. Lessons and experience learned about propagation, production, harvesting, processing and marketing are compiled by using structured questionnaires. Eighteen permit holders and 18 stakeholders from five regions of the country were interviewed. NTFPs studied were almaciga resin, pili resin, buri, rattan, bamboo, anahaw, hinggiw and honey. Study sites were selected based on the availability of permits in the area. The study found that: a) there is no comprehensive inventory of NTFPs, therefore locations of NTFPs and possible revenue to the government cannot be determined; b) lack of a program on insuring sustainable yield, like replanting and assisted natural regeneration may contribute to the loss of more NTFPs; c) too many checkpoints entails additional cost on the part of the licensees; d) existing policies on NTFPs need to be revised; e) there is lack of DENR personnel to man NTFP areas; and, f) there are conflicts in the implementation of policies by DENR and LGUs.

Challenges and Constraints to Building Government – Private Sector Partnerships in NTFP Research

Smith, R. (rosmith@nrcan.gc.ca) and Cameron, S. (scameron@nrcan.gc.ca).
Natural Resources Canada

Government and academic scientists are increasingly encouraged to seek private sector funding. The factors and potential conflicts that may constrain or limit the formation of effective partnerships, may include, but are not limited to: a) Intellectual property (IP) rights - the industrial need for confidential IP for commercial advantage may be at odds with the government/academic mandate to publish the research. B) Agency mandates - research for the

public good may conflict with research which must demonstrate an immediate or short-term economic benefit to the industrial partner. C) Markets - the time required to complete scientifically credible studies is typically too long to accommodate the partners' new needs that arise from changes in markets and or product lines. D) Science and technology transfer – rapid, effective technology transfer to the industrial partner sometimes must be provided before complete answers are available. E) Commitment to the partnership – changes in the priorities and/or policies of government and academic institutions may make it difficult for the researchers to continue R&D efforts on a project and still stay within institutional mandates. This paper will discuss the above factors, citing examples from the CFS and others whereby logistical, policy and priority differences have been reconciled to produce successful NTFP partnerships.

The Impact of Cross-Sectoral Policies and Institutional Aspects of NWFPs

Vantomme, P. (Paul.Vantomme@fao.org)
FAO, Italy

Despite the reference to "forest" in its term, Non-Wood Forest Products (NWFPs) are increasingly being (commercially) produced outside "forests" and by people more linked to farms then to "forests". NWFP are traditionally considered to be a "forestry" issue and are supposedly governed by "forestry" institutions and regulations. This approach may have been more or less appropriate and technically feasible in the past from a silvicultural, environmental and socio-economic point of view. However, it becomes less and less applicable today and might become even counterproductive in the future. The growing cross-sectorial impacts on forests and NWFP in particular, such as the increasing globalization of production and liberalization of trade (in agriculture products, and which includes NWFP!) on the one hand, combined with the rapidly growing awareness and initiatives to protect global (forest-based) biodiversity (and related indigenous knowledge/livelihoods) on the other hand, result in a conflicting "development versus conservation" status-quo for many NWFP species. NWFPs do cover a wide range of different products for different uses, such as food, medicines, fibers or recreation, and as such, their development and conservation agenda requires a wide range of inter-disciplinary skills and approaches much beyond the institutional capacity and mission of forest agencies in many countries.
