How can Collection of Wild Edible Fungi Contribute to Livelihoods in Rural Areas of Nepal?

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Abstract

Collection of wild edible fungi is important for livelihoods in rural areas of Nepal and neighbouring countries. Only very few species of fungi are being exported from Nepal, and compared to neighbouring countries there is still a potential to be exploited. However, a system of quality control and training of local people must be considered to use this potential. Also, a better understanding of the ecology and management of the wild edible fungi is necessary for the development of a sustainable use of the resource.

Key words: export, mushrooms, NTFP, sustainability

INTRODUCTION

In the last decades there has been a rising worldwide attention on the use of wild edible fungi (FAO 2004). A few species of wild edible fungi dominate the world market with an estimated value of more than two billion US$ (Wang and Hall 2004). Several recent publications emphasise the importance of wild edible fungi for rural livelihoods in developing countries in terms of collection of wild edible fungi for local markets and the significant contribution of nutrients to the diet (FAO 2004; Chen 2004; Wang and Hall 2004).

In Nepal, the most important species of wild edible fungi collected for export at present are morels (mainly *Morchella conica*). The estimated export is 1.7 to 6.5 tons per year with a total value of 105,000 to 400,000 US$ (Olsen 2004), and in several areas morels have become the main source of cash income for the poorest households (Subedi 2001). However, morels are not the only edible fungi found in the forest of Nepal. Several species are of great importance as a local food source especially in the mountain region. In the neighbouring countries of Bhutan, India, China, and Pakistan collection of wild fungi plays an important role for the economy in rural areas. In parts of Tibet and the Yunnan province of China, it is estimated that more than half of the cash income in some rural areas comes from collection of fungi exported to Japan and Europe (Chen 2004; Winkler 2004).

Wild edible fungi in Nepal are a potential source of income in terms of both increased local trade and export of other species than morels. However, the use of fungi is not without problems. About 50 of the fungi species in Nepal are toxic and digestion of at least 10 of them can be fatal. Every year several accidents of poisoning are reported from Nepal and the annual mortality caused by poisonous fungi may be as high as 15-30 persons (Adhikari 2000). Additionally, concerns of over exploitation of wild edible fungi are being raised in several of the neighbouring countries (Chen 2004; Wang and Hall 2004).

This paper reviews current information on the use of wild edible fungi in Nepal and neighbouring countries. Based on this information and the experience of the authors the potential for further exploitation of the resource is discussed.

CURRENT USE OF WILD FUNGI IN NEPAL AND NEIGHBOURING COUNTRIES

In Nepal morels are the only wild edible fungi, which are exported, in larger quantities. They are mainly found in pine forest between 2000 and 3500m and are most abundant in the western part of Nepal. In Jumla, Humla, Mugu, and Dolpa Districts commercial picking has been carried out for decades. Most of the morels are exported to Europe, especially France and Switzerland, but also Germany, Belgium, and the Netherlands. Many species of fungi are used for local consumption and

traded on local markets. Adhikari (2000) found about 26 species of fungi at markets in Kathmandu Valley, and it is our estimate that more than 50 species of wild edible fungi are commonly used and sold on markets in Nepal. Adhikari (2000) listed the presence of more than 110 wild edible species, which potentially could be used for food supply in rural areas. That number will probably rise, as the Nepalese mycoflora is further investigated. Collection and consumption of fungi are often restricted to disadvantaged people and certain ethnic groups. However, in mountain areas (Mustang, Jumla, etc.) collection and consumption of fungi seem to be much more accepted by a broader group of people. According to their religion, Brahmins are not allowed to eat fungi, but this is not respected by many of them (Adhikari 2000).

The potential for increased collection of wild edible fungi in Nepal can be assessed through comparison with neighbouring counties. In China, collection of wild edible fungi has a long history and the use of fungi has been taking place for more than 2000 years. Today especially *Tricholoma matsutake* and *Boletus edulis* is widely collected and exported. Many other species of fungi are collected and used both for the local Chinese market and for export. In certain rural areas, collection of wild edible fungi provides up to 62% of annual cash incomes of local farmers (Chen, 2004). Fungi are also a significant source of nutrition in rural areas of China (FAO 2004), and many species are consumed and traded locally, e.g. *Thelephora ganbajun*, *Termitomyces* spp., *Lactarius* spp., *Suillus bovinus*, *Boletus* spp. and *Russula* spp. (Chen 2004; FAO 2004). Similarly, in Tibet wild fungi have been collected for centuries and several species are collected and used commercially.

In Bhutan, *Tricholoma matsutake* was discovered in 1988 and since then there has been a rapid increase in the commercial use of fungi (Namgyel 2002). Also the use of other species of wild fungi has recently been addressed by projects.

In Pakistan, *Morchella conica* and *M. esculenta* dominate the market for wild edible fungi. Almost all the morels are exported to Europe. The collectors get between one-half and two-thirds of the export price (Sabra and Walter 2001).

India, like Pakistan, produces a considerable amount of morels, which are mainly exported to Europe (Prasad *et al.* 2002). The information on collection of other wild edible fungi in India is scant. However, FAO (2004) states that fungi are an important nutrient source in rural areas of India, and that collected species include *Termitomycetes heimii* and *Russula delica*.

POTENTIAL FOR LOCAL ECONOMY

Even though some areas in Nepal have a long tradition of collecting wild edible fungi, there are very few which are used commercially. Except from morels only *Auricularia auricula-judae* has been exported (Adhikari 2000). The international market for wild edible fungi is large and the demand is rising (Wang and Hall 2004) and Nepal has the ability to produce some species, which are commonly traded on the world market.

Information on market prices of fungi is difficult to find, and the available information varies greatly according to supply area and quality of collection. It is our estimate from information provided by buyers and sellers on the internet (e.g. www.alibaba.com; www.ec21.com; www.ectrade.com; www.chinesetruffle.com; www.auiswisscataloque.com) as well as other sources (e.g. Chen 2004, Adhikari 2000), that market margins to collectors in Nepal, China, Pakistan, and India for morels and other fungi exported to Europe are approximately 20% of the retail price, 25 – 35% of the selling price of the European wholesale company, and about 50% of the local export price. Good quality collections of species like *Boletus edulis*, *Cantharellus cibarius* and *Craterellus cornucopioides* will, if this price structure is extrapolated, be able to fetch between 100 and 200 Nrs. per kg fresh weight or 1000 to 2000 Nrs. per kg dried fungi. This is significantly higher than the prices of these fungi on the open Kathmandu market of 50 to 60 Nrs. (Adhikari 2000), but access to the world market and the competition from especially China will be challenging.

Adhikari (2000) estimates the potential harvest of various types of wild edible fungi in the areas around Kathmandu to be 2-15 kg fresh weight in one day during the season. Studies from India and Pakistan estimate that on an average a person can collect 100-300 fruit bodies of morels in one day, equal to 1-3 kg fresh fungi and 100-300 g dried (Prasad *et al.* 2002; Latif *et al.* 2004). But the potential amounts to be collected are highly dependent on the species, and the size and frequency of fruit bodies. With a labour cost of 150-250 NRs. per day in Nepal, fungi can at least in the season be a potential alternative to other sorts of manual jobs. Calculation of labour costs of collection of fungi are complicated by the fact that collection of fungi is often made as a supplementary activity to gathering fodder, fuel wood, or while shepherding.

The fruiting of fungi is very sensitive to precipitation and temperature, and this fluctuation is highly problematic for both the local collectors who will have great fluctuations in their potential income, and for the marketing of the product at the export market. For building reliable business contacts to wholesale companies in Europe and Japan a rather stable delivery is important. Generally, the great variation in climatic conditions in Nepal must give some advances for this if the trading is organised sufficiently at the export level. Fluctuations in prices are another problem to be faced, but fluctuations in per kg prices of fungi are somewhat compensated for by a direct correlation between abundance and unit value (Winkler 2004).

Fungi are considered non-timber forest products (NTFPs), and their collection is, therefore, nominally regulated by the Nepalese forest authorities. Fungi are collected from national forests, protected areas, and community forests, but the collection is rarely included in community forestry operational plans (Subedi 2001), meaning that any collection taking place is not regulated by officially endorsed rules. Informal rules on collection may locally be in place in Nepal.

Collection of fungi in Nepal, possibly with the exception of morels, does not provide high returns to labour at present (Adhikari and Adhikari 1997). Thus it can be hypothesised to be an activity typically undertaken by people in rural areas who are in need of cash, and who have few other alternatives. To assess the potential of fungi to contribute to rural livelihoods, it is necessary to understand better who the actual collectors are (whether they are among the relatively poor or better-off in rural communities, and whether they belong to disadvantaged groups or not), how much in absolute and relative terms they derive from collection and sale of fungi, and what the consequences would be for them of an increased focus on collection and sale.

THE IMPORTANCE OF QUALITY

Quality is an important issue for the fungi. The condition and stage of the fruitbodies as well as the drying, transport, and storage are important for the value of the end-product. Chen (2004) gives examples for *Tricholoma matsutake* in Yunnan where grade 1 is sold for 250 to 370 US$ per kg, whereas the lowest quality is sold for 6 US$ per kg. In most cases the grading is made already by the harvester depending on the size, maturity, and general condition of the fruitbodies.

Drying is often the easiest and cheapest conservation of fungi. Often fungi are collected in mountain areas where the infrastructure makes the weight-value ratio very important and export of fresh fungi is impossible due to the transportation time. Dried fungi, however, have very high values per kg compared to other potential product from these areas. It is important to dry most fungi immediately after harvest and the drying procedure will typically be managed by the collector. Fresh fungi contain a large amount of water and it is very important that the drying is done relatively fast, while high temperatures must be avoided. In many areas drying in the sun is the best and easiest way, and the drying can be done in 4 to 5 days. In more moist areas where sun-drying is not possible, alternative drying methods must be developed to produce output of high quality. Drying by open fire will damage the quality of the fungi and lead to lower market value. A taste of smoke will also reduce the market value for fungi to export. Dried fungi should not be stored for a long period and should be used within a year. For export, less than one month of transportation time must be aimed at and the dried fungi must be kept under cool conditions in closed boxes or bags. Handling and transport of

dried mushrooms must be done carefully without breaking them. Latif *et al*. (2004) estimated a loss up to 60% during transport to local markets for morels in Pakistan.

QUALITY CONTROL AND DESSIMINATION OF KNOWLEDGE

Currently few species of fungi are commonly consumed in Nepal, and there is great potential to develop the national market for edible fungi like in China, for example. This would provide obvious benefits in terms of increased income to collectors and traders, but important barriers would have to be overcome. For example, currently a probable factor deterring the consumption of wild edible fungi is the fear of poisoning, although the threat of poisoning by fungi is often overstated (FAO 2004). Another example is that people simply do not have the tradition of eating fungi, and therefore do not consider whether species found in the wild are edible or not. To overcome such obstacles it would be important to collect information on the fungi occurring in Nepal, and to disseminate such knowledge on poisonous and edible species through e.g. posters at public places.

To overcome the fear of poisoning and to provide credibility to fungi as a consumable good, a certification system as known from e.g. Europe could be implemented in Nepal. Local experts of fungi are examined and provided a licence, and these can then issue certificates of valid identification of fungi for sale.

CAN PRODUCTION OF WILD EDIBLE FUNGI BE SUSTAINABLE?

Forests in the midhills and mountains of Nepal provide few marketable products. Commercial timber production is not viable partly due to transport, and forest production is largely meant to satisfy local needs of timber, fuel, and fodder. An increased emphasis on collection of commercial wild edible fungi could supplement commercial collection of other NTFPs.

Collection of fungal fruitbodies does generally not pose problems for future production as long as spores have been dispersed by some fruitbodies. However, it seems that very intensive collection of certain mycorrhizal species can be problematic. In Japan, there has been a dramatic decline in the collected amount of *Tricholoma matsutake* (Wang and Hall 2004). The same trend seems to be starting in some areas of very intensive collection in Yunnan (Chen 2004). Lu (1998) also reports a decrease in the yield of *Tricholoma matsutake* in Tibet, but there is at present no scientific evidence that harvesting rates are either sustainable or unsustainable (Winkler 2004). Based on a concern for decline of *Tricholoma matsutake*, some local governments in Tibet have initiated a harvest rotation system where locals can collect only once in three years (Lu 1998).

Until now experiences from collection of morels in Nepal has not shown negative impacts on the resource as long as the quality of the forest is maintained, i.e. fires and overgrazing is prevented (Subedi 2001). From our point of view there should be no concern in Nepal at this moment. However, to anticipate potential over exploitation, it is important to implement a reliable local monitoring system where the amount of different species of fungi collected annually are stated. Where the forests have been handed over to community forest user groups, this responsibility will best be handled by them. In areas where collection of wild edible fungi is or becomes important, it is also recommendable that this resource should be listed and quantified in the forest operational plans.

The collection technique can also influence the production of wild edible fungi. In China, a practice of removing the litter from the forest floor while searching for *Tricholoma matsutake* changes the microclimate and damages the mycelium (Chen 2004). More careful methods must be recommended. Also, collection of immature fruitbodies can be problematic for the sustained production of fungi. A survey on a market in Yunnan shows that 35% of the fungi where immature and often sold to a very low price compared to mature fruitbodies (Chen 2004). It must be recommended only to collect fruitbodies, which are in a stage where they can be sold for the highest price – this is probably related to the tenure of the resource. To obtain good collection practices training and education of collectors must be recommended.

Undertaking forest management can also be important for increased production of fungi. Generally, clear-cutting must be avoided and heavily thinning can also have a negative impact on the production of fungi due to more rapid wetting and drying of the forest floor (FAO 2004). Compaction of soil from logging operations can also reduce productivity of fungi. Forest fires will in many cases enhance the growth and yield of *Morchella* for some years (Pilz *et al*. 2004), but generally fire in the high-altitude *Pinus wallichiana* forests cannot be recommended due to destruction of the forest regeneration.

Most fungi, which are collected from the wild, cannot easily be cultivated due to mycorrhizal symbiosis. However, experiences from truffle (*Tuber melanosporum*) production in France and Italy can be used in experiments with inoculation of mycelium together with planting of seedlings in suitable areas. Until now there has been only little research in this field and often the results cannot be evaluated before several decades after the establishment.

CONCLUSIONS

A number of wild edible fungi in Nepal has unexploited export and local market potentials. This resource potentially provides opportunities especially for low-income households in rural areas of Nepal. Experiences from neighbouring countries show that collection of wild edible fungi can provide substantial contributions to rural livelihoods in areas with limited income generating possibilities. Challenges to exploiting this potential include export market access, local marketing, and training of collectors and local experts.

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REFERENCES

Adhikari, K.S and M.K. Adhikari. 1997. Collection and Consumption of Wild Edible Mushrooms Sold in Kathmandu Valley, Nepal: An Economic Appraisal. *The Geographer's Point* Vol 1-2 (1996-1997)

Adhikari, M.K. 2000. *Mushrooms of Nepal*. P. U. Printers, Kathmandu, 236 pp.

Chen, Y.L. 2004. Song Rong (Tricholoma Matsutake), A Valuable Forest Mushroom from China: Consumption, Development and Sustainability. In: **Kuster, K. and Belcher, B. (eds.)**. *Forest Products, Livelihoods and Conservation: Case Studies of Non-timber Forest Products Systems*, Vol 1 – Asia. CIFOR, Indonesia, 365 pp.

FAO. 2004. Wild Edible Fungi: A Global Overview of Their Use and Importance to People. *Non-Wood Forest Products 17*. Rome.

Hamayun, M. and M. A. Khan 2004. Studies on Collection and Marketing of *Morchella* (Morels) of Utror-Gabral Valleys, District Swat, Pakistan. *Ethnobotanical Leaflets 2004.*

Namgyel, P. 2002. The Story of the Buddha Mushroom – Tricholoma Matsutake. FAO *NWFP-Digest*-L No. 8/02.

Neumann, R.P. and E. Hirsch. 2000. *Commercialisation of Non-timber Forest Products: Review and Analysis of Research*. CIFOR (Bogor).

Larsen, H.O. 2002. Commercial Medicinal Plant Extraction in the Hills of Nepal: Local Management Systems and Sustainability. *Environmental Management* 29(1): 88–101.

Larsen, H.O. and P.D. Smith. 2004. Stakeholder Perspectives on Commercial Medicinal Plant Collection in Nepal. *Mountain Research and Development* 24(2): 141–148.

Latif, A.; Z.K. Shinwari and S. Begum. 2004. Potential and Market Status of Mushrooms as Non-Timber Forest Products in Pakistan. *Ethnobotanical Leaflets 2004.*

Lu, R. 1998. Enterprises in Mountain-specific Products in Western Sichuan, China. *Mountain Enterprises and Infrastructure (discussion paper)*, 98/7. ICIMOD, Kathmandu, 51 pp.

Olsen, C.S. 2004. *Quantification of the Trade in Medicinal and Aromatic plants in and from Nepal*. Acta Horticulturae (in press.)

Prasad P.; K. Chauhan; L.S. Kandari; R.K. Maikhuri; A. Purohit; R.P. Bhatt and K.S. Rao. 2002. Morchella Esculenta: Need for Scientific Intervention for Its cultivation in Central Himalaya. *Current Science*, 82: 1098–1100.

Pilz, D.; N. S. Weber; M. C. Carter; C. G. Parks and R. Molina. 2004. Productivity and Diversity of Morel Mushrooms in Healthy, Burned, and Insect-damaged Forests of Northeastern Oregon. *Forest Ecology and Management* 198: 367–386.

Sabra, A. and S. Walter. 2001. Non-wood Forest Products in the Near East: A Regional and National Overview. *Working paper* FOPW/01/2. Rome, FAO. 120 pp.

Subedi B. P. 2001. Plant Profile: Morel Mushrooms. *Himalyan Bioresources 5*. ANSAB, Kathmandu.

Wang Y. and I. R. Hall. 2004. Edible Ectomycorrhizal Mushrooms: Challenges and Achievements. *Canadian Journal of Botany* 82(8): 1063-1073.

Winkler, D. 2004. Forest Use and Implications of the 1998 Logging Ban in the Tibetan Prefectures of Sichuan: Case Study on Forestry, Reforestation and NTFP in Litang Country, Ganzi Tap, China. In: **Z. Jiang, M. Centritto, S. Liu and S. Zhang (eds.).** *The Ecological Basis And Sustainable Management Of Forest Resources.* Informatore Botanico Italiano 134 (Supplemento 2), (in press)