RESEARCH ARTICLE

Can environmental income from wild medicinal plants contributes to annual household income: a case study from Makawanpur district in Nepal

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Abstract: This paper examines the environmental income comes from wild medicinal plant collection and selling, and how does it contributes to total annual household income. The study was carried out during March and April 2012 in Daman Village Development Committee (VDC) of Makawanpur district in Nepal. The data were collected through social science methods such as questionnaire survey, semi-structured interview, focus group discussion and participatory rural appraisal tools to achieve the objective. From the study it was found that many of the households in the study area rely on this resource as it is readily available. About 71% out of 82 households surveyed collected medicinal plants; 68% for own consumption, 24% (21 households) for selling and 8% for healing practice, respectively. The study shows that the villagers have income from collection and selling of medicinal plants where about 24% of the households were involved in the collection of such for selling purpose and this is a good support of their total annual household income. Therefore, the medicinal plants collection and selling was found to constitute an integrated part of household annual income, contributing from 8 to 35% (19% on average) to the total annual household income in the study area.

Keywords: Daman VDC; environmental income; household; household annual income; medicinal plants; Nepal.

Introduction

Nepal is an important source of indigenous medicinal plants in the world where more than 1950 species of plants are identified and used as traditional medicine (Bhattarai and Karki 2006, Ghimire 2008, Shrestha et al. 2000). Majority of such valuable plants grow in wild conditions as natural component of vegetation in different regions from tropical to alpine climate in Nepal. The various plant parts of these wild medicinal species are collected and selling by rural poor especially in the mid hills and mountains since ancient times (Rawal et al. 2009). Economically, Nepal is one of the poorest countries in the world and comparatively, poverty is very high in remote hills and mountainous areas (Ghimire et al. 2001). In Nepal, the non-timber forest products (NTFPs) including medicinal plants are recognized as an important source of income for local people livelihood in the last few decades (Chaudhary 1998, Pradip 2010). Especially in the rural areas where people are very poor and have minimal infrastructure facilities, medicinal plants are amongst the most important NTFPs and one of the main contributors of household income in Nepal (Ghimire et al. 2001). Therefore, dependency of the household needs on forest resources, particularly on medicinal plants, is a part of the socio-economic conditions of local people livelihood in Nepal (Shrestha et al. 1995).

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Medicinal plants play a vital role in Nepalese livelihood. The rural communities, especially the poor rural communities in different areas of Nepal, mostly rely on medicinal plants, as: firstly, they provide a source of income and secondly, they are important in primary health care delivery system. Thirdly, they have an important cultural value (Tiwari et al. 2004, Bhattarai et al. 2010). Around 22,000 households in seven districts at western Nepal are usually engaged in collection, cultivation, processing and trade of medicinal plants which provided about 125 US$ per annum as an additional income to the household annual income (Pradip 2010). As a result the collection of medicinal plants for trade is an important aspect of local culture in many districts of mountains in Nepal. According to Olsen and Helles (2003) reported that medicinal plants collected from the wild growing throughout the Himalayan mountain by rural households in Nepal constitute an integrated part of their livelihood strategies which contributes from 3 to 44% (average of 12%) of the annual income of households. Another study stated that in the mountain area of Nepal where almost all the rural households are involved in medicinal plants collection from wild sources which provided up to 50% of the annual family income (Ghimire 2008). In Nepal, every year 15,000 to 20,000 tons of wild medicinal plant products of more than 100 species, valued at 15 to 20 million US$, are collected and exported (Bhattarai and Karki 2006). The main market for Nepalese medicinal plants in India and 90% of such exported to India in raw form (Tiwari et al. 2004, Bhattarai and Karki 2006). Therefore, the collection and sales of medicinal plants is an important source of environmental income to the rural households and also a source of revenue to the government.

Considering the monetary aspects of wild medicinal plants collection and on the basis of empirical data, this paper analyses the economic role of medicinal plants collection and trade to the annual income at household levels in Nepal. Therefore, the present study has been undertaken to figure out the environmental income getting from wild medicinal plants trade and how much percentage it contributes to the total annual household income in Nepal.

Material and methods

Study area

The study was carried out in Daman VDC of Makawanpur district (shown in Figure 1). It is situated at an altitude of 2320 m and 100 km southwest of Kathmandu. It perched on a hillock and one of the most beautiful village inhabited by Chetri (44%) and Tamang (39%) tribes with almost 83% of the total population of the village. Administratively Daman VDC consists of nine wards. The total population is 7053 which includes 3615 males (52%) and 3438 females (48%). The number of households in the VDC is 1303 among which 38 households are landless. The average household size is 5.4. The literacy rate of Daman VDC is 38%. The main occupations of the villagers are agriculture (90%), 4% have private business, 3% are service holder and rest are others. The area of the VDC is 43.63 sq km and most (67%) of the area is covered by vegetation which consists of tropical to temperate in nature. There are mainly three specific forest areas viz. i) community forest, ii) whole village owned forest or national forest and, iii) private forest (Source: Daman VDC Office). The local people mainly collected medicinal plants from the community forest and national forest. In the high hills and mountains areas the predominant vegetation comprises mostly grasses and valuable medicinal plants i.e. *Swertia chirayita, Rubia manjith, Valeriana jatamansii, Bergenia ciliata, Astilbe rivularis, Taxus baccata, Gaultheria fragrantissima, Nardostachys grandiflora, Berberis asiatica, Paris polyphylla, Parmelia* sp. (Lichens) etc.

Data collection methods

Data on the economic aspects of medicinal plants at household levels were collected through a village level case study. The primary data were collected through using different methods such as household's questionnaire survey, semi-structured interviews, focus group discussion and various tools of participatory rural appraisal with villagers, collectors, traditional healers, traders, community forest chief, etc. Therefore, for the collection of information a field visit was made in the study area during March–April 2012. The methods were primarily

conducted with the help of interpreter due to language barrier. Before starting the research activities, a questionnaire format for household survey was developed and pre-tested. The format was redrafted for final household survey as per the experience from the pre-test. For the household's questionnaire survey, the sampling size was determined by using Yamane (1967) formula and total 82 households were chosen with the error of 11%. The households (nine households in each ward) were selected through simple random sampling as a convenient way. A random number generator (Anonymous 2011) was used for the sampling. Questionnaire was applied with villagers and collectors to make generalization on income, percentage of income from medicinal plants collection, how much amount of medicinal plants they collected and sold to the local traders, how much time they spend per day/week during collection season, purposes for medicinal plants collection, identify important species, selling system, market information, etc. The questionnaires were done as structured interviews followed by some informal conversations. Besides, twenty three semi-structured interviews, some focus group discussion and various participatory rural appraisals were conducted with key informants with the objective of obtaining a deeper insight into medicinal plants. For interviews, sampling was done through snowballing or identification from the questionnaire (collectors) in cases where the informant was not easy to identify.

Applied definitions

Medicinal plants

A considerable number of definitions have been proposed for medicinal plants. According to the WHO, "A medicinal plant is any plant which, in one or more of its organs, contains substances that can be used for therapeutic purposes, or which are precursors for chemo-pharmaceutical semi-synthesis" (Sharmin 2004: 7). Medicinal plants (Mps) are attracting increasing attention from development planners and environmentalists due to their multiple functions and potential to contribute to improving the livelihoods of rural and marginalised people. Medicinal plants are a source of income,

traditional medicine, food products, and cosmeceuticals, benefiting the poor and landless in mountain and highland regions (Belcher 1998, Karki 2000). In this study the medicinal plants may therefore be defined as a group of plants that are commonly used in treating and preventing diseases, and that are generally considered to play a vital role in source of income for local people.
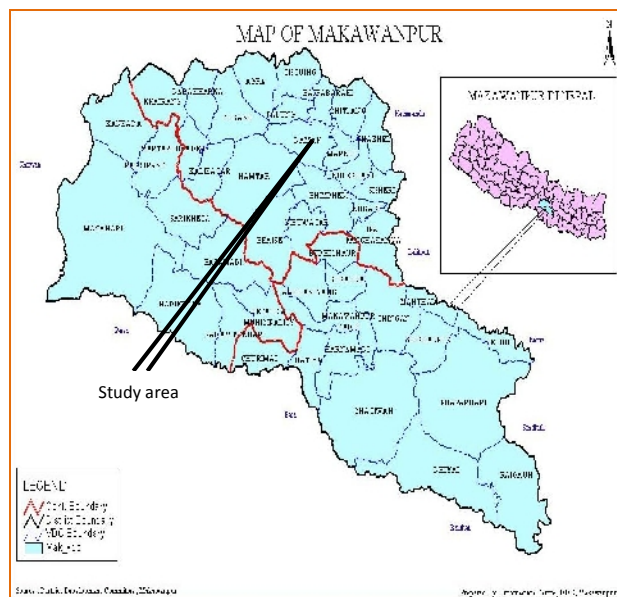

Figure 1: Map of Makawanpur district showing Daman VDC (study area) (Source: http://www.thekingdomofnepal.com/makwanpur-district-map/)

Household

Household definition is taken with inspiration from FAO definition of a household economy as "[...] the total pattern of productive, household maintenance and reproductive activities of a group of people who eat from a common pot, and share a common stake in perpetuating and improving their socio-economic position from one generation to the next (FAO 1992: 9)". Household is an economic and social unit. There can be no single definition of household, because different social groups and cultures think of the household in different terms. Some households are based on family relations others are not (Messer and Townsley 2003). In this study the definition of household means people who contribute to and benefit from the same income in the house. Households pool some of the resources, but access may differ between differ-

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ent members of the household. It is therefore important to note cooperative conflicts in the household, as Amartya Sen names different gendered preferences and access to resources (Sen 1987).

Household annual total income

Household annual total income is the sum of all outcomes, measured in income per adjusted adult equivalent unit (Cavendish 2002), of household economic activities throughout a one year period. As the measure of household annual income we have used total income, namely the sum of cash income and economic value (from agricultural production, wage job, handicraft, business, remittances, pension, miscellaneous) and environmental income.

Environmental income

In this study we mean the environmental income is that income comes from collection and selling of medicinal plants by households after their own consumption throughout a one year period.

Data analysis

The data collected from different sources were tabulated, processed and analyzed quantatively as well as qualitatively. Data from households questionnaire survey were put into excel spreadsheet for the analysis. The information was obtained by interviewing key informants about the medicinal plant species, collection, purpose, trade and income, etc. from the study area was organized, compiled and noted in Microsoft Office word document pages. The data were analyzed using the computer programme of Microsoft Office Excel and SPSS.

Results and Discussion

From the households surveyed through questionnaire, forest walked and interviews with key informants, total 76 species of medicinal plants were collected mentioned local people in the study area. Among them a list of high commercial valued medicinal species was found (as

shown in Table 1) which is also supported by Acharya (2005), and Bhattarai and Ghimire (2006) a list of the most commonly traded medicinal plants in Nepal.

Table 1: List of high commercial valued medicinal plants species in the study area.

Name of species	Local name	Parts collected
Rubia manjith	Majitho	Root
Parmelia sp.	Jhyau	Whole plant
Swertia chirayita	Chiraito	Whole plant
Astilbe rivularis	Thulookhati	Rhizome
Bergenia ciliata	Pashanved	Rhizome
Taxus baccta	Lodh salla	Leaf
Valeriana jatamansii	Sugandhawal	Rhizome
Aconitum ferox	Bikh	Root
Nardostachys grandiflora	Jatamansi	Rhizome
Delphinium dedatum	Nirmashi	Root

Most of the households in the study area are involved in the collection of medicinal plants from wild sources. From the household's survey, it is found that 58 (about 71%) out of 82 households surveyed collect medicinal plants (as shown in Table 2) from wild sources in order to fulfill their basic needs.

Table 2: Number of households collecting medicinal plants in Daman VDC

Collection of medicinal plants	Household collecting medicinal plants (no.)	Household collecting medicinal plants (%)
Yes	58	71
No	24	29
Total	82	100

Among the 58 households who collect medicinal plants, about 68% households collect medicinal plants only for their own consumption, 24% (21 households) collect as well as for sale and 8% also for healing practice (as shown in Figure 2).

During the field visit it has not been found any hawker or commercial collector[1] in the study area. During the interview with collectors, they also said that there is no commercial col-

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[1]Commercial collectors refer to those besides from the village or come from near town/city to the villages and asked local people to go to collect medicinal plants and sell it to them.

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lector in their area. There are seven traditional healers in different wards of Daman VDC.
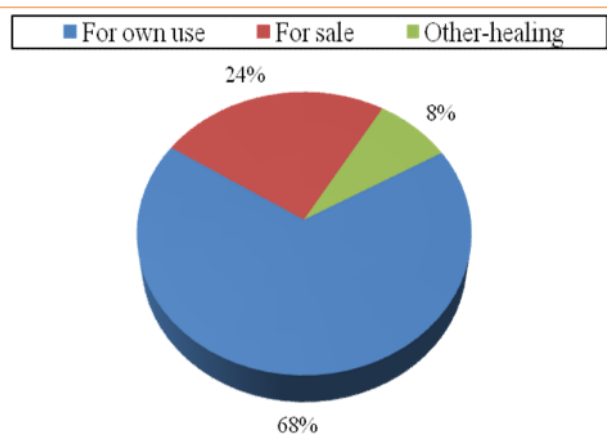

Figure 2: Purpose of medicinal plants collection in the local area.

From the questionnaire survey and interview with informants, all of them reported that the peak period for collection of medicinal plants in the local area is from July to November, during which the availability of plants is more abundant. As stated earlier there is 21 households in the study area are involved in collection of me-dicinal plants as selling purpose and they were collected mainly those species which have high commercial value. The results from question-naire survey revealed that 71% out of 21 house-holds who collect medicinal plants for selling purpose usually spend 4-6 hours per day, and the remaining 29% household spend 2-4 hours to collect medicinal plants from the forest (as shown in Table 3). The result also shows that normally each household spend on an average 3.5 days per week accordingly 14 days per month and 64 days per year, and the amount they collected for the last three years averagely 16.40 kg per week and 303 kg per year in the study area. From the collected amount they sold 90-95% of the medicinal plants and the rest of the amount they kept for their household con-sumption (as presented in Table 3). On the other hand interview with collectors, most of them said that, during the peak season of collection, they go to forests 3-4 times per week and spend 4-6 hours every time and on an average they collect 16-20 kg medicinal plants per week.

Table 3: Amount of medicinal plants collected and time spent at household level in the study area

HH	DPW	DPM	DPY	HPD	APW (kg)	APM (kg)	APY (kg)	% of selling	Selling amount (kg)
1	3	12	60	4-6	20	80	400	90	360
2	2	8	32	4-6	12	48	192	90	173
3	4	16	64	4-6	18	72	288	90	259
4	3	10	40	2-4	14	56	224	95	213
5	3	12	60	4-6	17	68	340	95	323
6	5	20	100	2-4	15	60	360	95	342
7	3	12	48	4-6	12	48	192	90	173
8	4	16	64	4-6	20	80	320	95	304
9	4	16	64	4-6	16	64	256	90	230
10	3	12	60	4-6	15	60	300	95	285
11	4	16	80	4-6	20	80	400	95	380
12	3	12	48	2-4	15	60	240	90	216
13	4	16	80	4-6	18	72	360	95	342
14	3	12	48	2-4	12	48	192	90	173
15	5	20	100	4-6	25	100	500	95	475
16	3	12	48	2-4	12	48	192	90	173
17	4	16	80	4-6	20	80	400	95	380
18	4	16	80	4-6	16	64	320	95	304
19	3	12	60	4-6	12	48	240	95	228
20	4	16	80	4-6	20	80	400	95	380
21	3	12	48	2-4	15	60	240	95	228
Average	3.50	14	64		16.40	65.50	303		283

Note: HH-Household, DAW-Days per week, DPM-Days per month, DPY-Days per year, HPD-Hours per day, APW-Amount per week, APM-Amount per month, APY-Amount per year.

Analysis of information collected from the households surveyed regarding trading of me-dicinal plants, showed that the each household could sell on an average 283 kg medicinal plants annually after their own consumption (shown in Table 3). During the survey and interviews asked to key informants about price of medici-nal plants, they said it depends on the species

because some of the species are high value and some are not. But they said that generally the average price of per kg medicinal plants in the study area could be around 60 NPR (ca. 0.75 US$). Therefore, the environmental income generated from medicinal plants collection can be calculated based on that price for every households and it has been found that, on average, each household generates an income of 16,974 NPR or 212.18 US$ annually from the selling of medicinal plants in the study area (as presented in Table 4). This result is supported by the findings of Pradip (2010) who found that around 22,000 households in seven districts at western Nepal are usually engaged in collection, cultivation, processing and trade of medicinal plants, which provided about 10,000 NPR (ca. 125 US$) annually as an additional income to the annual household income.

Table 4: Estimated generation of environmental income from medicinal plants collection and selling at household level in the local area.

HH	Amount of Mps for selling (kg)	Income from Mps (NPR)	HH income from agriculture and other (NPR)	Total income (NPR)	Income from Mps (%)	Household income from agriculture and other (%)	Total income (%)
1	360	21600	40000	61600	35	65	100
2	173	10380	80000	90380	11	89	100
3	259	15540	55000	70540	22	78	100
4	213	12780	60000	72780	18	82	100
5	323	19380	72000	91380	21	79	100
6	342	20520	93000	113520	18	82	100
7	173	10380	122000	132380	8	92	100
8	304	18240	92000	110240	17	83	100
9	230	13800	60000	73800	19	81	100
10	285	17100	60000	77100	22	78	100
11	380	22800	75000	97800	23	77	100
12	216	12960	60000	72960	18	82	100
13	342	20520	55000	75520	27	73	100
14	173	10380	100000	110380	9	91	100
15	475	28500	90000	118500	24	76	100
16	173	10380	65000	75380	14	86	100
17	380	22800	60000	82800	28	72	100
18	304	18240	60000	78240	23	77	100
19	228	13680	90000	103680	13	87	100
20	380	22800	48000	70800	32	68	100
21	228	13680	60000	73680	19	81	100
Av.	283	16,974	71,286	88,260	19	81	100

Note: HH-Household, Av.-Average, The average price per kg 60 NPR (ca. 0.75 US$) from question-naire surveyed and interviews with key informants.

On the other hand, the results from questionnaire survey has shown that, for almost all the households in the study area, the main source of income is agriculture and the collection of medicinal plants is just a part of their income. The total annual average income of households surveyed is 88,260 Nepalese rupees (ca. 1103.25 US$) presented in table 4 and among it, medicinal plants collection contributed with as much as 16,974 Nepalese rupees (ca. 212.18 US$) which was in an average 19% of the total annual average household income (as shown in Figure 3).
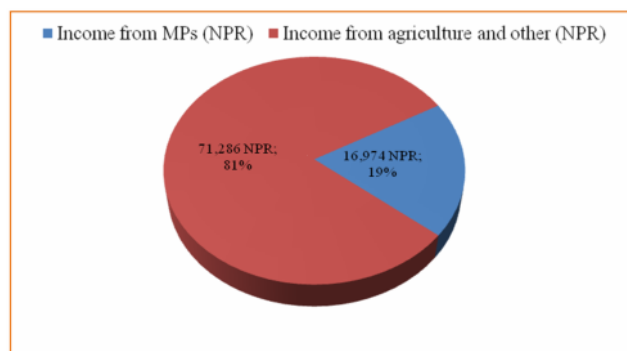

Figure 3: Percentage of contribution from medicinal plants to total annual average household income.

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The results also reveals that the collection and selling of medicinal plants contributes to the total annual income of households in the study area in a range going from 8 to 35% (as shown in Figure 4), a result that is supported by the findings of Olsen and Helles (2003), who found that wild medicinal plants collected by rural households in Himalayan mountains regions contributes from 3 to 44%, on an average 12% of their annual households income. Similar results have been found by other authors' investigation. In the mountain region of Nepal where 10-100% of rural households are involved in medicinal plants collection which contributed up to 50% of the annual family income (Ghimire 2008).
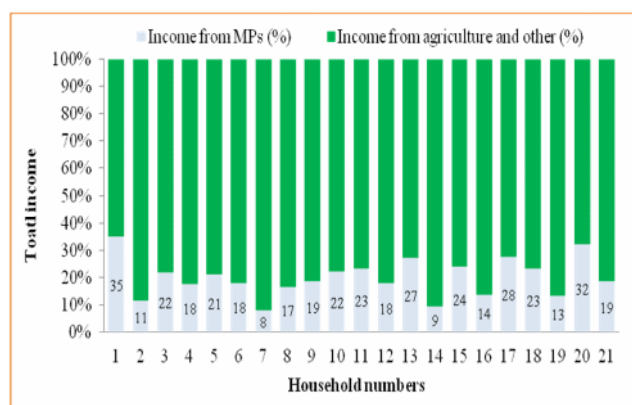

Figure 4: Percentage of individual households' annual income from medicinal plants collection.

During the interviews with traditional healers, it was asked "are you paid for your services?", All interviewed except one, said normally they do not take any money or reciprocal exchange from the clients because their community does not allow to take anything through their medical services and it is also not supported in their religion. But if people wish to give them something like gifts or clothes then they can take it. One of the traditional healers told that sometimes people give him cigarettes also. Another traditional healer said he is paid for his services. Sometimes people gave him cash or cloth or exchange materials, etc. He has other source of income but healing is the most important part of his everyday income. Every month, he earns 1000-1200 NPR (ca. 12.50-15 US$) from healing.

Conclusion

From the study it was found that majority of the villagers were collected medicinal plants from wild sources for various purposes to secure their livelihood. Although a high percentage of the surveyed households were collected medicinal plants but mostly for domestic consumption, not for sale. It appears that only a small part of the collecting households were engaged for collection and sale of such, which added a significant portion of income to their annual household total income. Therefore, it allows us to conclude that medicinal plants collection and selling as an integration of the local people farming activities, not main activities, which contributes a portion of income to the total annual household income.

Note:[1]Nepalese currency: 80 Nepalese rupee, NPR = 1 US$ (at time of study).

References

Acharya, S.P. 2005. Developing Medicinal and Aromatic Plant based Livelihood Options for Traditional Gathering Communities: A case study of Western part of Nepal-producing key recommendations for policy interventions and collaborative and comparative study across Maharashtra and TamilNadu, India. Accessed 7 May 2012. Available at: http://www.wupap.gov.np/gallery/53f7bMAPs%20Report.pdf

Anonymous. 2011. Table of random numbers. Accessed 2 February 2012. Available at: http://stattrek.com/Tables/Random.aspx

Belchar, B. 1998. A production-to-consumption systems approach: Lessons from the bamboo and rattan sectors in Asia. In:

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Int. J. Med. Arom. Plants   *Income from MPs contributes to annual household income*

Wollenberg, E., Ingles, A. (Eds.), Incomes from the forest: Methods for the development and conservation of forest products for local communities. Center for International Forestry Research (CIFOR), Bogor, Indonesia, pp. 815–822.

Bhattarai, K.R., Ghimire, M.D. 2006. Commercially Important Medicinal and Aromatic Plants of Nepal, and their distribution pattern and conservation measure along elevation gradient of the Himalayas. Banko Janakari, **16(1)**: 3–13.

Bhattarai, N., Karki, M. 2006. Community management of medicinal plants in Nepal: Practices and trends towards sustainability. Paper presented at: Workshop on assessing the sustainable yield in medicinal and aromatic plant collection; 14–17 September, 2006, ICIMOD, Kathmandu, Nepal. Accessed 2 February 2012. Available at: http://www.floraweb.de/map-pro/lectures/Bhattarai.pdf

Bhattarai, S., Ram, P.C., Quave, C.L., Taylor, R.S. 2010. The use of medicinal plants in the trans-Himalayan arid zone of Mustang district, Nepal. Journal of Ethnobiology and Ethnomedicine, **6**:14. Accessed 7 February 2012. Available at: http://www.ethnobiomed.com/content/6/1/14

Cavendish, W. 2002. Quantitative methods for estimating the economic value of resource use to rural households. In: Campbell, B.M., Luckert, M.K. (Eds.), Uncovering the hidden harvest: valuation methods for woodland and forest resources. Earthscan Publications Ltd., London, pp. 17–66.

Chaudhary, R.P. 1998. Biodiversity in Nepal (Status and Conservation). S. Devi, Saharanpur India and Telpress Books, Bangkok, Thailand.

Food and Agriculture Organization of the United Nations (FAO). 1992. Sociological analysis in agricultural investment project design. FAO Investment Centre Technical Paper No. 9. Rome, Italy.

Ghimire, S.K. 2008. Medicinal plants in the Nepal Himalaya: Current issues, sustainable harvesting, knowledge gaps and research priorities. In: Jha, P.K., Karmacharya, S.B., Chettri, M.K., Thapa, C.B., Shrestha, B.B. (Eds.), Medicinal Plants in Nepal: An Anthology of Contemporary Research. 2008. Ecological Society (ECOS), Kathmandu, Nepal, pp. 25–42.

Ghimire, S.K., Lama, Y.C., Tripathi, G.R., Schimitt, S., Aumeeruddy,T.Y. 2001. Conservation of plant resources, community development and training in applied Ethnobotany at Shey-Phoksundo National park and its buffer zone, Dolpa, Third year. WWF Nepal Program Report Series no. 41. WWF Nepal Program, Kathmandu, Nepal.

Karki, M.B. 2000. Commercialisation of natural resources for sustainable livelihoods: case of forest products'. In: Banskota, M., Papola, T.S., Jürgen, R. (Eds.), Growth, poverty alleviation and sustainable resource management in the mountain areas of south Asia. German Foundation for International Development (DSE-ZEL), Feldafing, Germany, pp. 293–320.

Messer, N., Townsley, P. 2003. Local institutions and livelihoods: guidelines for analysis. Rural Development Division, Food and Agriculture Organization of the United Nations (FAO), Rome, Italy.

Olsen, C.S., Helles, O.L. 2003. Alpine medicinal plant trade and Himalayan mountain livelihood strategies. Geographical Journal, **169(3)**: 243–254.

Pradip, M. 2010. Commercialization of Medicinal and Aromatic plants in Western Nepal. In: Jha, P.K., Karmacharya, S.B., Balla, M.K., Chettri, M.K. and Shrestha, B.B. (eds.), Sustainable Use of Biological Resources in Nepal. 2010. Ecological Society (ECOS), Kathmandu, Nepal, pp. 205–212.

Rawal, D.S., Sijapati, J., Rana, N., Prabina, R., Anjana, G., Shrestha, S. 2009. Some High Value Medicinal Plants of Khumbu Region Nepal. Nepal Journal of Science and Technology, **10**: 73–82. Accessed 5 February 2012. Available at: http://lib.icimod.org/record/14153/files/6340.pdf

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Sen, A. 1987. Gender and Cooperative Conflicts. Working Papers, 1987/18, UNUWIDER.

Sharmin, L. 2004. Cultivation prospect of medicinal plants in Bangladesh: experiences from Natore. Bangladesh Rural Advancement Committee (BRAC), Research and Evaluation Division, Dhaka, Bangladesh, pp. 1–41. Accessed 6 May 2012. Available at: http://www.bracresearch.org/reports/medicinal_plant_cultivation.pdf

Shrestha, K.K., Shah, J.P., Ghimire, S.K. 1995. Diversity and conservation strategy of potential medicinal plants in Manang (Gyasumdo valley). Report submitted to King Mahendra Trust for Nature conservation, Annapurna Conservation Area Project (ACAP), KMTNC, Kathmandu, Nepal.

Shrestha, K.K., Tiwari, N.N., Ghimire, S.K. 2000. Medicinal and aromatic plants database of Nepal (MAPDON). Proceeding of Nepal-Japan Joint Symposium on Conservation and Utilization of Himalayan Medicinal Plant Resources. Kathmandu, Nepal, pp. 53–74.

Tiwari, N.N., Ram, C.P., Yadav, U. 2004. Study on Domestic Market of Medicinal and Aromatic Plants (MAPs) in Kathmandu Valley. Accessed 3 February 2012. Available at: http://www.ansab.org/UserFiles/iDomestic MarketNov041.pdf

Yamane, T. 1967. Statistics, An Introductory Analysis, second ed. Harper and Row, New York.