Assessment of the economic contribution of non-timber forest products to rural livelihoods in Oddar Meanchey, Cambodia

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មូលន័យសង្ខេប

ក្នុងប្រទេសកម្ពុជា ប្រាក់ចំណូលពីការលក់អនុផលព្រៃឈើ (NTFPs) ដើរតួយ៉ាងសំខាន់ក្នុងចំណូលសរុបប្រចាំគ្រួសារ។ យ៉ាងណាមិញ គ្រួសារតាមទីជនបទភាគច្រើនក្នុងខេត្តឧត្តរមានជ័យរកប្រាក់តាមរយៈការលក់អនុផលព្រៃឈើទាំងនេះ ដែលផលនេះ ខុសគ្នាទៅតាមគ្រួសារផងដែរ។ គោលបំណងទីមួយនៃការសិក្សាគឺវាយតម្លៃពីការពឹងផ្អែកលើអនុផលព្រៃឈើ និងវាស់វែងពីកម្រិត ចំណូលបានពីអនុផលព្រៃឈើក្នុងចំណូលសរុបសម្រាប់គ្រួសារ រវាងគ្រួសារដែលក្រជាង និងមានជាង។ គោលបំណងទីពីរគឺដើម្បី ស្រាវជ្រាវអង្កេតថាតើលក្ខខណ្ឌសេដ្ឋកិច្ចសង្គមជាក់លាក់ណាខ្លះមានឥទ្ធិពលលើការពឹងផ្អែកនេះ។ ព័ត៌មានស្ដីពីលក្ខណៈគ្រួសារ ប្រភព ចំណូល និងការលក់អនុផលព្រៃឈើត្រូវបានប្រមូលតាមរយៈការស្ទង់មតិយ៉ាងលម្អិតលន់តាមគ្រួសារ ហើយត្រូវបានប្រើដើម្បីវាយ តម្លៃពីភាពខុសគ្នានៃលក្ខខណ្ឌសេដ្ឋកិច្ចសង្គម រវាងគ្រួសារដែលពឹងផ្អែកលើអនុផលព្រៃឈើក្នុងកម្រិតខ្ពស់ មធ្យម និង ទាប។ លទ្ធផលបានបង្ហាញថា គ្រួសារដែលក្រពឹងផ្អែកលើអនុផលព្រៃឈើខ្លាំងជាងគ្រួសារដែលមាន ដោយប្រាក់ចំណូលពីអនុផល ព្រៃឈើគឺ២៩% (គ្រួសារក្រជាង) និង២០% (គ្រួសារមានជាង) នៃប្រាក់ចំណូលសរុបក្នុងគ្រួសារៗ។ លទ្ធផលក៏បានបង្ហាញដែរថា គ្រួសារដែលពឹងផ្អែកលើអនុផលព្រៃឈើខ្លាំងជាងគឺជាគ្រួសារដែលមានសមាជិកច្រើនជាស្រ្តី មានដីកម្មសិទ្ធិតិចជាង និងមានប្រភព ចំណូលតិចជាង។ ទីតាំង និងការអប់រំគ្មានឥទ្ធិពលលើការពឹងផ្អែកអនុផលព្រៃឈើនេះទេ។ លទ្ធផលនេះអាចជាប្រយោជន៍សម្រាប់ គោលនយោបាយ ដើម្បីអភិវឌ្ឍឲ្យកាន់តែមានប្រសិទ្ធភាព និងផ្ដោតជាសំខាន់ទៅលើគ្រួសារដែលរងគ្រោះជាងគេ។

Abstract

Income from the sale of non-timber forest products (NTFPs) plays an important role in total household income in Cambodia. While most rural households in Oddar Meanchey Province generate cash from these forest products, their contributions to income differ considerably across households. The first objective of this study was to assess NTFP dependence, measured as the share of NTFP income in total household income, between poorer and richer households. The second objective was to investigate whether certain socio-economic variables condition this dependence. Information regarding household characteristics, income sources and NTFP sales was gathered through a detailed household survey and used to evaluate differences in socio-economic variables between high, medium and low NTFP-dependent households. Results show that poorer households are more dependent on forest products than richer households, where NTFP incomes contribute 29% and 20% respectively towards total household income. Highly dependent households also appear to have more female household members, smaller land holdings and fewer income sources. Location and education do not condition NTFP dependence. These results may inform policy in the formulation of more effective interventions, with a specific focus on targeting the most vulnerable households.

Keywords Cambodia, non-timber forest products, Oddar Meanchey.

Introduction

Forests play a central role in millions of people's lives. In 2004, more than 1.6 billion people depended to a varying extent on forests for their livelihoods, while 350 million people living within or adjacent to dense forests depended on them to a high degree for subsistence and income (World Bank, 2004). Since the late 1980s, non-timber forest products (NTFPs) have received significant attention from conservationists, donors and development agencies and have often been seen as a 'win-win' tool for forest conservation and sustainable development (Wollenberg & Ingles, 1998; Arnold & Ruiz-Perez, 2001). NTFPs are typically defined as all biological materials other than timber which are extracted from forests for human use (deBeer & McDermott, 1989), including fruit, nuts, honey, fibres, vegetables, medicinal plants, resins and grasses (Ticktin, 2004). In recent years however, studies have shown that NTFP harvesting is not necessarily more ecologically benign than timber logging (Peters *et al.*, 1989; Homma, 1992). Irrespectively, millions of households continue to harvest forest products (McElwee, 2008), particularly the poor who depend on them to a high degree (Neumann & Hirsch, 2000). Given the high rates of deforestation in developing countries (FAO, 2010), the importance of NTFPs for local livelihoods warrants further consideration.

NTFP exhibit several characteristics which make them attractive to the poor. Heubach *et al.* (2011) identify three major functions of NTFPs for rural households. Firstly, NTFPs act as vital cost-saving and open access forms of subsistence by providing energy, food, medicine and construction materials (Shackleton & Shackleton, 2004; Illukpitya & Yanagida, 2010). Secondly, forest products act as a safety net in times of crisis, such as income shortages or crop failures (Angelsen & Wunder, 2003). Finally, NTFPs are used as a means of cash income (Neumann & Hirsch, 2000). While NTFPs are an economic mainstay for some households, they only provide a supplementary income for others (Illukpitya & Yanagida, 2010). A meta-analysis of case studies globally indicates that, on average, forest products contribute 20–25% to overall household income (Vedeld *et al.,* 2004).

Substantial wealth differences usually exist in areas where poor people occur, and the contribution of NTFPs to individual household incomes differ accordingly. In Malawi, Kamanga *et al.* (2009) found that poorer households rely on NTFPs for 22% of their income, whereas the equivalent figure for richer households was only 9%. Other studies indicate that richer households can extract higher quantities of NTFPs and also receive greater cash returns from these (McElwee, 2008). The greater assets

and better connections of richer households may explain this (Sunderlin *et al.*, 2005). Vedeld *et al.* (2004) however found a negative correlation between the share of NTFP income and total household income. Increased absolute income reduces the relative contribution of forest products, thereby lowering household dependence upon these. It is thus clear that NTFP dependency varies across different levels of household welfare.

NTFP dependency has potential effects on the environment. Higher dependency has been found to correlate with environmental degradation (Shaanker *et al.* 2004), species composition (Vargehese & Ticktin, 2008) and ecosystem sustainability (Ticktin, 2004). Overexploitation often occurs when pressure to maximize short-term incomes exists in the absence of attendant rules and regulations. Strong local institutions such as cultural norms or harvest taboos (Colding & Folke, 2001) can also influence the degree of NTFP extraction and dependency, and understanding this variability is necessary to formulate effective conservation interventions.

The socio-economic characteristics of households can explain patterns of NTFP dependency within communities. Livelihood diversification reduces dependency on NTFPs as an income source (Ellis, 1998; Illukpitya & Yanagida, 2010) and Fisher (2004) found that NTFP dependency in Malawi decreased as income from off-farm activities increased. Emerton (2005) further maintains that richer households have more diverse income-earning opportunities due to better education and access to arable land. Additional factors influencing dependency include migration status (Lacuna-Richmann, 2002), distance to the market (Timko *et al.*, 2010) and household composition (Quang & Anh, 2006). In Vietnam for instance, households with higher numbers of females are more dependent on incomes derived from NTFPs (Quang & Anh, 2006).

As even small rural communities display such heterogeneity, further studies are needed to understand NTFP use and dependence (McElwee, 2008) and Angelsen & Wunder (2003) stressed the need for site-specific research into the role of forests at a household level in differing geographical and political contexts. Cambodia, and especially Oddar Meanchey Province, is of particular interest in this regard, as the challenges of large-scale land conversion, illegal logging and high population growth (Pfoffenberg, 2009) are placing considerable pressure on the environment. Cambodia's population is 85% rural (Kim *et al.*, 2008) and dependant on rice production, although fishing and collection of forest products also contribute substantially to rural livelihoods (Tola & McKenney, 2003). However, signs of resource deple-

tion due to unsustainable rates of extraction have already begun to show for over a decade (Sedara *et al.,* 2002).

Investigations into NTFP dependency are consequently important to determine the potential costs of deforestation and forest degradation on rural livelihoods. While the literature includes a multitude of case studies for different countries, few have been undertaken in Cambodia. Exceptions include Tola & McKenney (2003), who investigated the importance of resin extraction, Laval *et al.* (2011), who assessed the significance of medicinal plants, and Kim *et al.* (2008) who attempted to place a monetary value on NTFPs extraction in Ratanakiri Province. As rigorous studies on the importance of NTFPs for rural livelihoods are still lacking nonetheless, this study addresses the current knowledge gap by exploring NTFP dependency among different wealth groups and its relationship with household characteristics in Oddar Meanchey Province. More specifically, it examines whether the magnitude of NTFP income, as a proportion of total household income, varies between poorer households and richer households, and whether NTFP dependency is linked to socio-economic status.

Methods

Study site

The study was conducted in July 2011 in Oddar Meanchey Province, north-western Cambodia (Fig. 1). As the area formed part of the Oddar Meanchey REDD+ project, which was in the design phase at the time, understanding household dependence on forest products was important. Two villages were selected for the study: Ou Sramour and Ou Anrea in Trapeang Tav commune of Anlong Veng district. Because these were similar in terms of in-migration levels and both were within 12 km of the local market and within 25 km of the mainly evergreen community forest, their general topography and ecology were comparable. Neither village had access to piped water or electricity.

Questionnaire design

As no prior study had been carried out in the area, informal interviews and participant observations were first undertaken to provide initial information on income sources and NTFPs harvested. This was used in the development of the household survey.

Socio-economic data collected included the size of the household size, number of female and male family members, education and migrant status. Respondents were asked to recall information on household incomes

Fig. 1 Location of study site in Oddar Meanchey Province, northwestern Cambodia.

and details of NTFP collection for the previous year (one-year recall). More specifically, respondents were requested to estimate the quantity, market price and cash income of all forest products collected. Following McElwee (2008), prompts were employed when respondents had difficulties recalling NTFPs collected (e.g., "Did you collect any mushrooms in the last year?"). Additionally, if forest products or parts of a product were observed in a respondent's house and they failed to mention these, they were specifically inquired after.

Informant recall is a standard method in surveys of household living standards (World Bank, 2001). Data collection should ideally be spread over one year, with resource use and income information based on quarterly recall periods to account for seasonal differences and ensure accuracy (Cavendish, 2002). Due to practical constraints however, data collection was completed during a single month. In addition, because informant recall is imperfect, figures extracted should be considered as estimates. Respondents might also have difficulty remembering exact quantities of NTFPs harvested and sold, or may have overlooked minor products, biasing recall (Heubach *et al.,* 2011). Nevertheless, while some NTFPs of lesser importance may be under reported, those of greater significance are often emphasized.

Data collection

A structured household interview comprising closed and open questions was conducted using standard methods (Newing, 2011). This was translated into Khmer and first tested with seven households in the nearby village of

Trapean Tav. Modifications were then made to facilitate the flow of subsequent interviews.

Systematic methods were used to ensure a representative sample of households in the study villages (Newing, 2011). Twenty percent of households in each village were interviewed, such that surveys were conducted in every third house in Ou Sramour village and in every fifth house in Ou Anrea village, on both the left and right side of the main roads and side roads. This ensured all households had an equal chance of being interviewed regardless of their distance from the main road or other potentially segregating factor. Attempts were made to interview household heads and their spouse together to improve the accuracy of data. This was not always possible however and altogether, 55 households were interviewed out of 275 households in the two villages.

All wage related incomes and other income sources (e.g., monthly support from relatives) were recorded in riel (KHR) (US\$1 = KHR 4,000, July 2011). Income recorded from NTFPs was based on own-reported values (Cavendish, 2002) and information on crop production, livestock and vegetables was sought. The status of NTFP resources was assessed by asking respondents whether there had been any change in the abundance of one or more species within the past five years, and the reasons for any changes noted. A market survey was also conducted in Anlong Veng district to gather information on prices to validate respondent data. Due to seasonal fluctuations in prices, a mean price was calcuated for each NTFP, similar to other studies (e.g., Heubach *et al.*, 2011).

Data analysis

Descriptive statistics on household characteristics, NTFP collection and sustainability were calculated using SPSS (vers. 19). Data from the two villages were pooled for analysis as there were no significant differences between these (Table 1, all values of $p > 0.05$). To test the hypothesis that poorer households are more dependent on NTFP income than richer households, the sample was divided into two groups, using the Cambodia's rural poverty line (\$0.43 per capita day; World Bank, 2006) as a benchmark. Twenty-nine of the households sampled lay below this poverty line (BPL households), whereas 26 lay above it (APL households). Due to the relatively small number of households sampled, data normality was not assumed (Eagle, 2011) and a Mann-Whitney U test was used to test for significant differences between income sources between the two groups. Relationships between the share of NTFP income and total household income were

assessed using Pearson's bivariate correlation (Caruso & Cliff, 1997).

To characterise households with differing NTFP dependency, data were divided into quartiles of roughly similar sample sizes based on the share of NTFP in total household income. Excluding households with no income from NTFPs ($n = 5$), highly dependent households ($n = 16$) were defined as those where NTFPs contributed ≥28% of household income, medium dependent households ($n = 18$) where these represented 9–27% of income, and low dependent households ($n = 16$) where NTFPs contributed ≤8% of income. A Kruskal–Wallis test was employed to test for significant differences in socio-economic variables between these groups.

Results

Household characteristics and income sources

Mean household size was 4.96, with 2.42 females and 2.33 children on average. The average size of land owned was 2.08 ha, yet only 31% (17/55) of households held a secure land title. The average length of local residence was 9.62 years, and households usually had three or more different sources of income.

NTFP harvesting proved to be a major activity in the area, with 95% of households extracting these from nearby forests or fallow land and collecting at least four wild species (such as fruit, rattan or mushrooms) on average. The most frequently collected NTFP was thatch grass (Table 2), which is processed into thatch roofing and sold to Thailand through a trader. Fish, bamboo shoots and medicinal plants were also frequently collected. Thatch grass generated the most relative income, whereas wild fruit, mushrooms and bamboo shoots were the least profitable.

Although only 4% of households collected NTFPs solely for subsistence purposes, 91% were involved in NTFP commercialization (Table 3): sale of NTFPs was by far the most common source of income (50 of 55 households). This was followed by agricultural labour (37), sale of rice (19), livestock (16) and charcoal (15). The greatest income was generated from off-farm occupations such as services, government jobs or other employment (e.g., craftsmanship). Services such as tailoring, shop vendors and motorbike taxi-drivers were the most profitable, although only 11% of households reported these as an income source.

Table 1 Summary characteristics of households (HHs) in two villages of Oddar Meanchey Province.

	Ou Sramour (*n*=23)	Ou Anrea (*n*=32)	Z	*p*
NTFP income (KHR)	714,039	785,156	-0.273	0.785
Total income (KHR)	3,821,170	4,090,125	-0.102	0.918
% NTFP in total income	25	24	-0.606	0.545

Table 2 Frequency and value of NTFPs for households (HHs) studied in Oddar Meanchey Province. '-' indicates a NTFP was not sold.

NTFP	No. of HHs collecting NTFP (%)	No. of HHs selling NTFP (%)	Mean income from sale KHR yr^{-1})	Mean contribution to HH income (%)
Thatch grass	46 (84)	44 (80)	838,295	27
Frogs	22 (40)	6 (11)	220,000	16
Fish	32 (58)	7 (13)	203,429	6
Wild fruit	14 (25)	4 (7)	174,000	4
Mushrooms	14 (26)	10 (18)	104,800	3
Bamboo shoots	27 (49)	5 (9)	28,980	1
Bamboos/rattans	22 (40)	-	-	-
Wild vegetables	9 (16)	-	-	-
Medicinal products	26 (47)	-	-	-
Bushmeat	1 (2)	-	-	-
Other (e.g., snails, turtles)	2 (4)	-	-	-

Economic importance of NTFPs for household incomes

Combining the two study villages, mean yearly household income was KHR 3,977,653 (=US$ 994). Across the two villages, NTFP sales represented the largest share of total household incomes at 24%. The second largest share was represented by labour-based incomes (13%), while rice production and other income sources constituted 12% apiece. Minor income sources included vegetable sales and financial support from relatives, at 3% and 1% respectively. Other income came from government employment (10%), charcoal (10%), livestock (5%) and timber (5%) sales, and services (5%).

NTFP dependency between different wealth groups

Households below the poverty line (BPL households, *n* = 29) generated 29% of their income from NTFPs and 24% from labour, whereas households above the poverty line (APL households, *n* = 26) generated 20% and 9% from these respectively (Fig. 2). More secure income sources such as service occupations and government employment represented only 3% and 4% of incomes in BPL households, whereas APL households obtained 9% and 14% respectively. Significant differences were found in the contribution of labour and government jobs to household incomes between the two groups (Table 4). The contribution of NTFPs also differed between BPL and APL households at 29% and 20% respectively, although this difference was not statistically significant. Exclusion of households that lacked income from NTFPs (*n* = 5) from analysis widened this difference and made it almost significant, with NTFPs contributing 33% and 21% to the total incomes of BPL (*n* = 25) and APL households (*n* = 25), respectively (Mann-Whitney: Z = -1.805, *p* = 0.071). Despite the lack of significant differences, however, a positive relationship was found between NTFP income and total income (Pearson's bivariate coefficient: *r* = 0.335, *p* = 0.008). A negative relationship was also found between the contribution of NTFP income (%) and total income (Pearson's bivariate coefficient: *r* = -0.291, *p* = 0.031).

Table 3 Breakdown of household (HH) incomes across two study villages, Oddar Meanchey Province.

Income source	Mean income (KHR yr⁻¹)	No. of HH (%)
Service jobs (motor-taxi driver, shop vendor, tailor)	2,842,667	6 (11)
Government jobs (military, police, teacher)	2,706,000	9 (16)
Other employment (craftsman, village chief)	2,463,846	13 (24)
Charcoal sales	1,556,000	15 (27)
Rice sales	1,496,316	19 (35)
Timber sales	1,333,333	6 (11)
Vegetable sales	962,222	9 (16)
NTFP sales	830,958	50 (91)
Livestock sales	661,563	16 (29)
Agricultural labour	592,053	37 (67)
Support from relatives	324,286	7 (13)

Socio-economic factors influencing NTFP dependency

Excluding households with no NTFP income ($n = 5$), the number of income sources possessed by households with high, medium and low dependency on NTFPs were significantly different (Table 5). Although not statistically significant, households with higher NTFP dependency also tended to have longer periods of rice shortage each year, more female members and larger household sizes. No significance differences were found in any other socio-economic indicators between households.

Sustainability of NTFP harvesting

Most respondents (62%) stated that they had noticed a decline in species, including mushrooms, bamboo shoots and thatch grass. The remaining 27% and 11% had not noticed a change and were not sure, respectively. Declines were noticed in the following NTFPs: thatch grass (12 respondents), bamboo/rattans (8), frogs (8), mushrooms (5), fish (4), wild fruits (2) and medicinal plants (1). The reasons most frequently stated for the declines were economic land concessions (33%) and unsustainable harvesting (24%).

Discussion

The present study suggests that NTFP sales contribute substantially to household incomes in Oddar Meanchey, with a mean contribution of 24%. While NTFPs represent as much as 60% of household incomes in India (Narendran *et al.,* 2001), their share falls to 6% in southwestern Cameroon (Amrose-Oji, 2003). In the latter country, their

contribution differs according to the livelihood strategy adopted by households (Timko *et al., 2010)*. For instance, hunter and gatherer communities in Cameroon can generate 90% of their income from forest products, whereas sedentary people in the same region retrieve 20% of their incomes from NTFPs. In areas such as the present study site where rice farming is the main economic activity, NTFPs can act as a major supplementary source of income. As forest-based incomes account for a fifth of household incomes worldwide on average (CIFOR, 2011), the contribution of NTFPs to rural livelihoods in Oddar Meanchey Province can be considered typical.

Household dependence on NTFPs

This study tested the hypothesis that poorer households are more dependent on NTFPs than richer households. Although differences between these were not statistically significant, households below the poverty line nonetheless derived somewhat more income from NTFPs (29%) than those above it (20%). This mirrors the findings of other studies (Cavendish, 2002; McElwee, 2008) and may be because the former earn income from less profitable activities, which results in lower total income, thereby amplifying the importance of NTFP income. The significant differences between labour-based incomes and government incomes suggests that households below the poverty line obtain more of their income from poorly-paid activities such as the former, while those above the poverty line are involved in more lucrative occupations, such as military or teaching employment. This is supported by the negative association between the contribution of NTFP income (%) and total income. Households
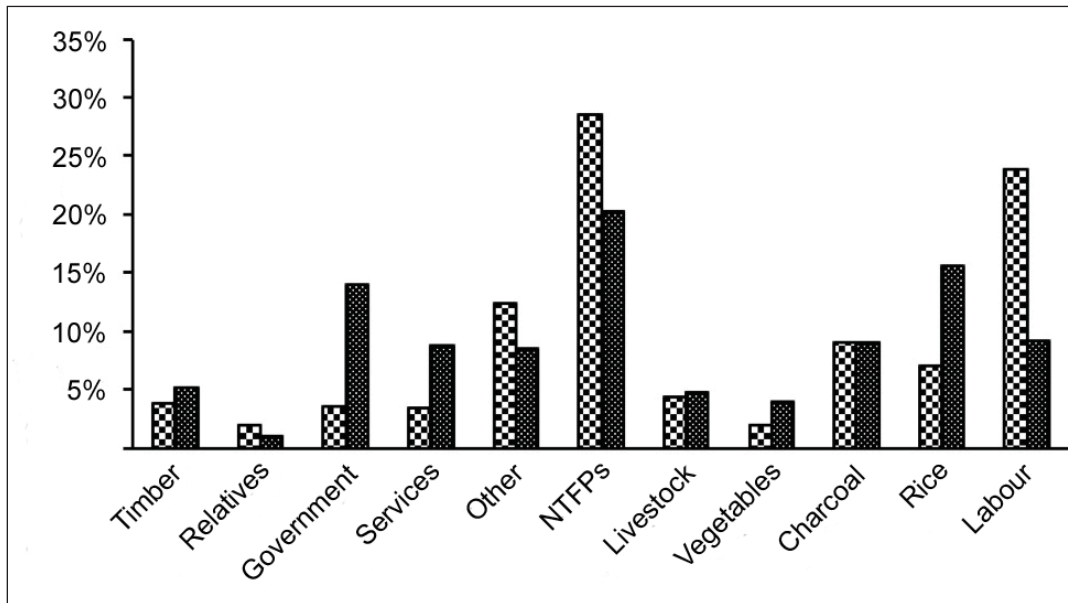
Fig. 2 Distribution of income for households below (hatched bars) and above (dark bars) the poverty line.

Table 4 Comparison of incomes for households (HHs) below and above the poverty line. BPL = below poverty line, APL = above poverty line.

Income source	% of total income		Z	p
	BPL HHs (*n*=29)	APL HHs (*n*=26)		
Agricultural labour	24	9	-2.834	0.005
Rice sales	7	16	-1.828	0.068
Charcoal sales	9	9	-0.870	0.384
Vegetable sales	2	4	-1.845	0.065
Livestock sales	4	5	-0.588	0.556
NTFP sales	29	20	-0.0936	0.349
Services	3	9	-1.775	0.076
Government employment	4	14	-1.976	0.048
Support from relatives	2	1	-1.048	0.295
Timber sales	4	5	-0.187	0.852
Other occupations	12	9	-0.690	0.490

with higher incomes engage in profitable activities, yet still appear to sell NTFPs as a means of livelihood diversification. The relative importance of NTFPs declines nonetheless, with the result that NTFP dependency decreases as total household income increases. This confirms the findings of Vedeld *et al.* (2004), although its causality remains uncertain (e.g., whether higher income results in

lower NTFP dependency or if higher NTFP dependency results in lower household income).

Influence of socio-economic status

This study assesed whether a variety of household characteristics are associated with different levels of NTFP dependency. Significant differences were found in the

Table 5 Socio-economic characteristics of households (HHs) with high, medium and low dependence on NTFPs.

Indicators	High dependency (*n*=16)	Medium dependency (*n*=18)	Low dependency (*n*=16)	χ^2	*p*
Number of females	2.75	2.50	2.31	1.485	0.476
Number of children	2.38	2.44	2.38	0.812	0.666
HH size	5.25	4.89	4.94	0.661	0.719
Land holdings (ha)	1.97	2.17	2.38	0.544	0.762
Sex of household head (1=female, 2=male)	81	78	63	1.637	0.441
School attendance, household head (1=yes, 0=no)	75	78	71	0.205	0.903
Number of years locally resident	9.25	11.18	8.93	0.327	0.195
Number of months of rice shortage per year	3.00	3.06	1.81	4.862	0.088
Number of income sources	2.75	3.61	3.81	8.190	0.017
Number of HH earners	2.31	2.78	2.56	1.188	0.390
HH income (KHR per year)	2,963,000	4,245,055	4,521,520	3.416	0.181

number of income sources possessed by households with high, medium and low NTFP dependency, highly reliant households having the least number of income sources. This supports the notion that livelihood diversification inflences the degree of reliance (Paumgarten & Shackleton, 2009; Illukpitiya & Yanagida, 2010). Forest-based activities are among the least lucrative income sources, which is why households depending heavily on NTFPs in Oddar Meanchey have much lower total incomes.

Although no other significant differences were found between households with high, medium and low NTFP dependency, several trends were apparent. Firstly, households with high NTFP dependency had the greatest number of female members, similar to other studies (Quang & Anh, 2006; Timko *et al.,* 2010). Women usually have fewer income generation alternatives, possibly due to lower education or cultural norms (Momsen, 2004), and in Cambodia, their main responsibilities are usually in the domestic domain (Phat P. pers. comm.). This limits the potential for generation of alternative incomes and field obervations also revealed that women are the main producers of thatch roofs at the study sites.

Secondly, households less dependent on NTFPs appear to have larger land holdings. This likely translates into greater crop production and food security and would explain the smaller shortages of rice these reported each year. As rice is the main component of every meal in Cambodia, its supply is of the utmost importance and households facing greater shortages must generate additional income for its purchase. NTFP sales are an important means of generating such income and this may

explain the higher reliance upon NTFPs among these households, similar to Vietnam (Quang & Anh, 2006).

Although communities located far from markets are often more dependent on forest products (Kamanga *et al.,* 2009), the lack of significant differences between households with differing NTFP dependency in the present study is likely due to the fact that they were all relatively close to the main road and because a visiting trader collected local produce, obviating the need for travel to sell products in the town market. The absence of a clear link between NTFP dependency and education is somewhat more surprising, since other studies (Babulo *et al.,* 2008; Kamanga *et al.,* 2009) have found these to be negatively related (higher education being expected to translate into better employment). However, as this study only determined if household heads had ever attended school (education usually being limited to primary school years), such a trend might emerge if a finer scale of analysis was employed, such as the number of years of school attendance (e.g., McElwee, 2008).

Sustainability of NTFP harvesting

The present study highlights the importance of NTFPs to rural livelihoods in Cambodia, particularly for poorer households. Though sustainable resource use is consequently central to income stability and livelihood security, environmental degradation appears to be the reality, with 67% of respondents claiming declines in the abundance of NTFPs in the previous five years. Although forest clearance due to economic land concessions was the most common reason stated for these declines, over-

harvesting also featured prominently. The latter may be excarbated by low ecological knowledge, social heterogeneity and weak local institutions (Shaanker *et al.,* 2004; Mutenje *et al.,* 2011). The fomer was suggested by the reported felling of trees for fruit and occurrence of electro-fishing. The latter were suggested by the reported lack of rules or restrictions for NTFP harvesting and that 95% of respondents were migrants from 10 different provinces. Migrants elsewhere have been found to take greater advantages of forest resources (Ambrose-Oji, 2003) and low sustainable harvesting skills can result in greater environmental degradation (Lacuna-Richman, 2002). Nonetheless, forest loss and degradation due to economic land concessions (and illegal logging; Pfoffenberg, 2009) evidently constitute most serious threats to rural livelihoods involving NTFPs in Oddar Meanchey Province.

Conclusions

This study indicates poorer households are more dependent on NTFPs than richer households in Oddar Meanchey Province and suggests that several household factors may influence this dependence. Declines in NTFP resources in the province will impact poorer households the most. As a consequence, greater attention should be given to the importance of forests to rural livelihoods in the region. Cultivation of NTFPs could help support livelihood needs, whereas development of alternative income sources would help reduce forest dependence. Efforts to reduce forest loss and degradation could also be made through carbon credit schemes under the Reducing Emissions from Deforestation and Forest Degradation (REDD+) initiative.

Additional studies are recommended to evaluate the role played by NTFPs in household subsistence (as opposed to cash incomes) and determine their importance as a cost-saving strategy. These would likely amplify the value of NTFPs and emphasize the costs of environmental degradation. Further research into the household characteristics that influence NTFP reliance would also assist identification of highly dependent households, for whom tailored interventions could then be developed. Finally, additional assessments to determine the ecosystem service values and cultural significance of NTFPs (Vedeld *et al.,* 2007; Rist *et al.,* 2011) would serve to further highlight their importance for rural livelihoods and societal costs of continued deforestation (Delang, 2006).

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