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World Development Vol. 64, pp. S56–S66, 2014
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<http://dx.doi.org/10.1016/j.worlddev.2014.03.003>

Challenging Perceptions about Men, Women, and Forest Product Use: A Global Comparative Study

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Summary. — This study uses a multi-case dataset to question current assumptions about the gender differentiation of forest product use. We test some of the commonly held ideas on how men and women access, manage, and use different forest products. Overall, we found significant gender differentiation in the collection of forest products, which seems to support the claim that there are distinctive “male” and “female” roles associated with the collection of forest products. However, we also found that men play a much more important and diverse role in the contribution of forest products to rural livelihoods than previously reported, with strong differences across tropical Asia, Africa, and Latin America.

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Key words — gender, forest products, global comparison, income, livelihoods

1. INTRODUCTION

It has been repeatedly asserted that the roles, knowledge, and skills of rural men and women differ with respect to forest use and management (Agarwal, 2009; Bechtel, 2010; Hecht, 2007; Mai, Mwangi, & Wan, 2011; Peach Brown, 2011; Rocheleau & Edmunds, 1997). Gender-differentiated tasks and responsibilities in food production and provision, as well as in the generation of cash income, often result in different needs, opportunities, priorities, and concerns for men and women. Previous research has suggested that while the specific roles and responsibilities of men and women vary across regions and cultures, they often follow similar broad gender divisions of labor (Bechtel, 2010; Mai *et al.*, 2011). For example, men are typically reported to manage and use natural resources for cash-crop based agriculture, hunting, logging, construction, and the harvest of a smaller portfolio of high-value forest products for sale (Cavendish, 2000; Shackleton,

Shackleton, & Cousins, 2001; Shively, 1997). In contrast, women are said to focus more on subsistence agriculture and to be primarily responsible for collecting wild resources for household use, with a particular focus on those products that contribute to immediate household-level food security (Cavendish, 2000). Yet, although women seem to commercialize forest products less often than men, the sale of forest products is believed to be an essential source of cash income for women, who lack many of the opportunities for generating cash-income that are more commonly available to men.

*The authors are grateful to all of the PEN partners whose work has contributed to this global overview. Particular thanks to the following for additional contributions: Carol Colfer, Amy Duchelle, Pam Jagger, Esther Mwangi, Christine Padoch, Frances Seymour, Sheona Shackleton, and Patricia Shanley. Sven Wunder and Brian Belcher provided invaluable first comments on an earlier draft of this paper.

Women, and particularly those in female-headed households, are therefore often thought to be, overall, more directly reliant on consumption and sale of forest resources than men (Dovie, 2003; Khare *et al.*, 2000; Vodouhe, Coulibaby, Greene, & Sinsin, 2009). These divisions of responsibility and resource use have been attributed to factors such as the physical nature of certain tasks, historical patterns of natural resource use and ownership, and cultural barriers to accessing markets and harvesting infrastructure (Shackleton, Paumgarten, Kassa, Husselman, & Zida, 2011).

However, despite the oft-reported gender differentiation in the management and utilization of forest resources, research has also documented how in certain instances men and women work jointly or in complementary ways (Bechtel, 2010). For example, the harvest and sale of high-value products such as Brazil nuts (*Bertholletia excelsa*) in Latin America (Duchelle, Guariguata, Less, Alborno, Chavez, & Melo, 2011; Stoian, 2005) or bush mango (*Irvingia* spp.) in Central Africa (Sunderland, Asaha, Balinga, & Isoni, 2010) are often undertaken jointly by both men and women. Additionally, in forest-based swidden agriculture, men often clear forest for farmland and women subsequently plant and tend crops (Howard, 2006). Cavendish (2000) also noted this labor sharing, particularly in cases where the harvesting activities require more than one adult laborer. As these examples show, the gender patterns in the use of natural resources can be diverse and context specific.

Previous research has highlighted two additional points in the analysis of the relations between the different genders and natural resources. First, in most cultures use and access rights to natural resources, including land, trees, water, and animal protein are often differentiated along gender lines. In many societies, women have fewer ownership rights than men (Agarwal, 2010; Couilay-Lingani, Tigabu, Savadogo, Oden, & Ouadba, 2009; Ostrom, 1990; Rocheleau & Edmunds, 1997). Although women may frequently possess *de facto* or land use rights (compared to men's *de jure* rights), women's access rights are often mediated by their relationships with men, such as through marriage, divorce, or widowhood (Hecht, 2007; Mwangi, Meinzen-Dick, & Sun, 2011). Thus, in many cases, rural women lacking secure land tenure may depend on common property resources for their livelihoods (Agrawal, 2001). Secondly, women are frequently limited in decision making with regard to the management of natural resources. The literature suggests that although women's participation in forest management institutions, such as forest user groups (FUG), raises incomes and promotes resource sustainability (Agarwal, 2001, 2009; Upadhyay, 2005; Mwangi *et al.*, 2011), they overwhelmingly tend to be underrepresented in such groups (Agarwal, 2001; Das, 2011; Kelkar & Nathan, 2003; Sarker & Das, 2002). The reasons for women's lack of involvement in organizations dealing with natural resources management may be due to gender biases in technology access and dissemination, women's labor or skills constraints, or their lack of sanctioning authority (Bandiaky-Badji, 2011; Lewark, George, & Kermann, 2011; Nuggehalli & Prokopy, 2009; Reed, 2010).

Many of the facts appearing in the gender-focused literature are rooted in case studies, and it is unclear how widely generalizable such observations might be. Gender divisions of labor and contributions to household income are influenced by variables such as age, ethnicity, household composition, marital status class, and caste, all of which may have varying degrees of influence (Byron & Arnold, 1999; Cavendish, 2000; Cousins, 1999; Shackleton & Shackleton, 2006). Location and level of market integration are also important factors influencing the relative roles of men and women in the management,

collection, and sale of natural resources (Belcher, Ruiz-Pérez, & Achdiawan, 2005; Ruiz-Pérez *et al.*, 2004). Gendered relations and responsibilities with respect to natural resources are also dynamic and subject to change (Shackleton & Shackleton, 2000). For example, male out-migration (Giri & Dranhöfer, 2010), or the increase in the number of female-headed households, as is the case in Southern Africa due to HIV-AIDS, can lead to greater *de facto* access to land and resources by women, despite such rights remaining somewhat precarious (Agarwal, 2009). These complexities mean that individual case studies may not necessarily be indicative of general patterns, and may be misleading if transferred to other contexts and used for policy guidance.

Using household-level data from the Poverty Environment Network (PEN), we test the overall robustness of previous findings on gender and forest use and explore to what degree these findings are consistent across a large number of sites, countries, and regions. We examine whether this global dataset supports common assertions about gender differences with respect to forest product collection, access, and management. Specifically, we investigate gender differences in:

- *Forest product collection and sale:* We consider the forest products brought to the household by women and men respectively across several broad categories, including types and quantities of products, whether they are processed or not, and whether they are collected for consumption and/or sale.
- *Access to forest products:* We look at the value of forest products collected in lands under different land and resource tenure systems.
- *Community forest management:* We examine men and women's participation in formal FUGs.

2. DATA AND METHODS

(a) Data collection

The data were collected through the PEN project. The project itself and the data collection methods are described in more detail in Angelsen *et al.* (this issue) and on the PEN webpage.¹ In brief, the PEN project is a network of 33 collaborating researchers (primarily PhD students) who collected data under the framework of PEN, a project of the Center for International Forestry Research (CIFOR).² PEN sites, which includes 24 countries, cover the major tropical forested regions in Africa, Asia, and Latin America.

For each forest product collected by the household, the gender of the main person (or groups of people in the household) bringing the product to the household was recorded and grouped into three categories: products harvested or collected (a) mostly by women, (b) by men and women equally, and (c) mostly by men. For each product brought to the household, we also inquired as to the type of property rights regime under which the product was collected.

(b) Data analysis

We examine the relative roles of women and men in the collection of forest products and how these roles differ across different broad categories. Income from forest products is defined as the value of the product collected at market prices, irrespective of whether the household consumed or sold the output, less the costs of any non-labor inputs.

We use descriptive analysis to parse the data in several different ways. First, we examine the overall contributions of both

sexes to income from both unprocessed and processed forest products. Second, we generate product categories of use and examine the relative contributions of men and women to each category. Third, we investigate whether gender divisions arise in the collection of forest products for consumption *versus* sale. Fourth, we examine differences in activities across the three regions: Africa, Asia, and Latin America. Fifth, we look at the share value of forest products collected under different tenure regimes. Finally, we examine self-reported rates of participation in formal FUGs for men and women.

In addition to the descriptive analyses, we also report results from a series of regressions that measure the partial correlation between various factors that may be associated with the contribution of forest products to the household's overall forest use. The basic model that we use is:

$$y = \alpha + \beta X_1 + \gamma X_2 + \theta P + \varphi R + \varepsilon \quad (1)$$

where y represents the share of household income from forest products³ collected by women in a household; X_1 represents a vector of household characteristics (including demographic characteristics such as household wealth and household's land holdings); X_2 represents a vector of village level characteristics (including the distance of the village to the forest, the distance of the village to the nearest market, a measure of village market integration, and average village income); P is a dummy variable representing whether women in the household participate in forest user groups, and R is a vector of regional dummies. Because our dependent variable is bounded between zero and one, we employ fractional logit regressions (Papke & Wooldridge, 1996).⁴ All standard errors are clustered at the village level. While the PEN dataset has observations on approximately 8,000 households, our analysis uses the data from a subset of these for which there are no missing data for our variables of interest. Descriptive statistics for all variables used in the analysis can be found in Appendix A.

(i) Biases and limitations

Our data potentially suffer from a number of possible biases and limitations. First, the villages and sites in the PEN dataset were not chosen by random sampling across all developing countries, so we cannot claim the global dataset to be representative of rural households in developing countries.⁵ Overall, the sample appears to be more representative for Africa than for Latin America, the latter having fewer sites and including some special cases of markedly high-value forest products. Secondly, in some locations some forest products are collected illegally (e.g., through hunting or harvesting in protected areas), that may be underreported in household recall data. Enumerators were trained to reassure informants that their information would remain confidential, but some underreporting is still likely. If men are disproportionately engaged in these underreported activities, this could lead to an inflated estimate of women's share of forest product collection.

As for the limitations, the PEN standard questionnaire did not collect household consumption data, but focused on who collects forest products. An interesting complementary analysis would be the consumption of and spending on forest products within the household, i.e., intra-household spending decisions. One important finding in the literature on gender and development is that income controlled by mothers is more often spent on food, children's health, and education than income controlled by fathers (Blumberg, 1988; Duflo & Udry, 2004; Kennedy & Peters, 1992; Kishor, 2000; Thomas, Strauss, & Henriques, 1990). A second limitation is that we only have data on gender and forest products at the product collection and farm-gate sale level, not throughout the value chain.

Some recent gender analyses (e.g., Khan, 2008) have examined the role of children in income generation. One important pathway through which children's welfare might be impacted by forest use is via their contribution to income generation. Such activities would presumably generate benefits through contributions of income, but would come at some cost to the child in terms of greater work burden, health risks, and diversion from schooling. Child welfare impacts from forest activities also could result from the reallocation women's efforts toward forest activities and away from activities with positive health and nutrition impacts. The net effect of such a reallocation would depend on the overall magnitude of the increase in household income, the marginal propensities to spend cash income on food items or health-enhancing goods, and the deleterious impacts of withdrawn effort. These are potentially important issues in many of the sites covered by this analysis, but we have not been able to pursue this subject fully in the context of this paper.

3. RESULTS

The results presented below correspond to general findings in the literature presented in the introduction. For each, we state a research question and provide an assessment of the claim using the data from our overall global and regional samples of households. In the final section, we use multivariate analysis to examine the determinants of women's contribution of household income from forest products.

(a) Descriptive analyses

(i) Do women contribute more than men to household income from unprocessed forest products?

Figure 1 illustrates the share value of unprocessed forest products collected by women, men, and both, at a global and regionally disaggregated level. Globally, men and women contribute almost equally to the value of household income from unprocessed forest products, but this conceals some regional differences. In Latin America, men bring about seven times more income from unprocessed forest products to the household than women. In the Asian sites, the share value of unprocessed forest products is similar among the three categories of analysis, with men bringing slightly more. Lastly, in Africa the share value of unprocessed products collected by women is higher than that collected by men. In the African sites, the share value of products equally collected both by men and women is the lowest, representing only 13% of the total, indicating high levels of gender-specific specialization. Thus the gender division with respect to collection of unprocessed forest products in Africa is opposite to that in Latin America.

(ii) Do men contribute more than women to household income from processed forest products?

In Figure 2, we now turn to processed forest products. In contrast to the equilibrated global picture for unprocessed forest products, men bring a considerably higher share of processed forest product income (61%) than women (25%). Also, in contrast with the striking regional differences found for unprocessed forest products, the pattern of male income dominance is uniform across the three regions.

(iii) Do women tend to collect forest products for consumption while men collect them for sale?

Figures 1 and 2 also present the income shares collected for subsistence *versus* cash for each gender category of both unpro-

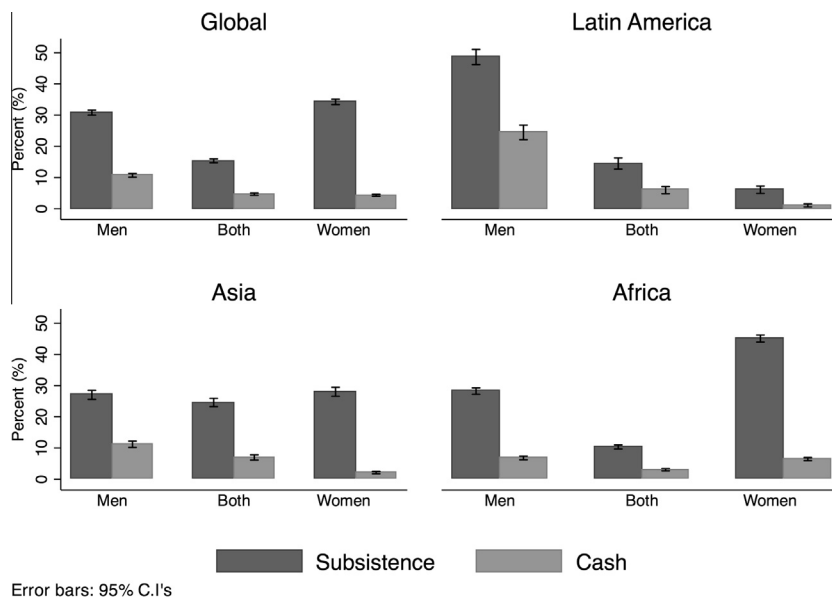


Figure 1. Share value of unprocessed forest products collected by women, men and both, at a globally and regionally disaggregated level.

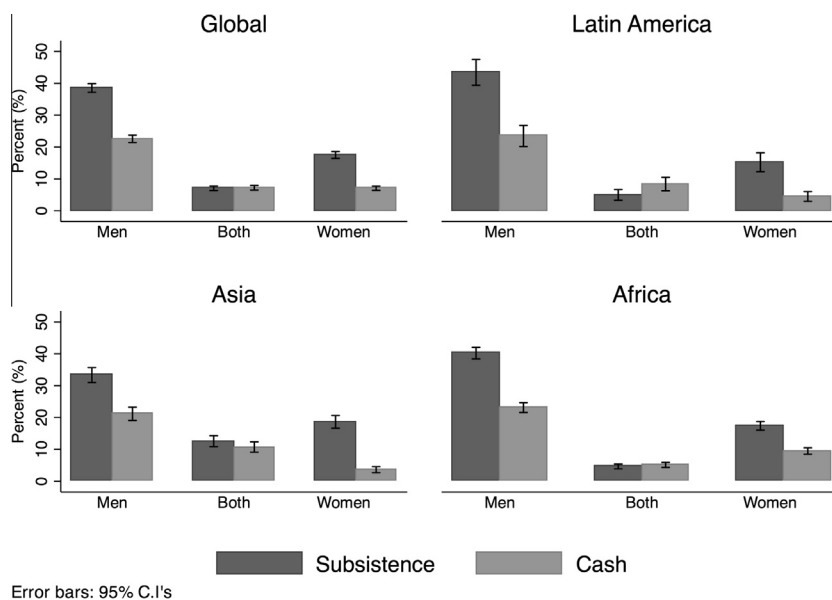


Figure 2. Share value of processed forest products collected by women, men and both, at a globally and regionally disaggregated level.

cessed and processed forest products. Overall, we find that most products (both unprocessed and processed) are used for household consumption, not for sale. Men’s primary contribution of forest income to the household is in the form of subsistence goods and not in the form of cash income. However, we observe a tendency for men to collect a larger share of the forest income from sales (both processed and unprocessed) than women, in common with the case study literature. Compared to women, globally men brought in more than twice the value share of sales of both unprocessed and processed forest products. However, we observe an important specialization of men in cash products in the Latin American and Asian sites, but in Africa the percentage of unprocessed forest products collected for cash and subsistence is similar between men and women. For processed forest products in all three regions men contribute substantially larger

shares of processed forest products to the household economy than women.

(iv) Who brings what forest products to the household?

Table 1 presents a breakdown of the global share of forest income for categories of unprocessed and processed forest products, disaggregated by gender. The rows sum to 100% for each sub-category.

Two noteworthy patterns can be observed in Table 1. First, we find clear evidence of a marked gender specialization in the collection and processing of most forest product categories, especially for processed products. Second, men contribute larger shares than women in four of the seven studied categories for both unprocessed and processed products. Thus at least with respect to our product category aggregations, men appear

Table 1. *Share of income from unprocessed and processed products (by gender categories and types of products)*

Product category	%Income from unprocessed forest products			%Income from processed products		
	Both	Women	Men	Both	Women	Men
Firewood	21.0	55.8	23.2	50.0	33.3	16.7
Charcoal	–	–	–	15.8	29.0	55.2
Food: plants and mushrooms	25.2	48.4	26.4	32.4	53.7	13.9
Structural and fiber	11.1	9.6	79.4	7.7	8.0	84.3
Medicine, resins, and dyes	15.0	29.2	55.8	14.1	69.8	16.2
Food: animal	12.9	9.4	77.8	0.0	0.0	100.0
Fodder and manure	31.8	28.6	39.6	–	–	–
Other	16.3	28.8	54.9	19.0	23.0	58.0

Table 2. *Shares of income from unprocessed and processed products, by gender types of products, and region*

Region	Product category	%Income from unprocessed forest products			%Income from processed products		
		Both	Women	Men	Both	Women	Men
Latin America	Firewood	21.0	55.8	23.3	–	–	–
	Charcoal	–	–	–	14.2	4.1	81.7
	Food: plants and mushrooms	25.2	48.4	26.4	21.2	34.8	44.0
	Structural and fiber	11.1	9.6	79.4	7.3	9.0	83.7
	Medicine, resins, and dyes	15.0	29.2	55.8	11.5	61.4	27.1
	Food: animal	12.9	9.4	77.8	–	–	–
	Fodder and manure	31.8	28.6	39.6	–	–	–
Asia	Other	16.3	28.8	54.9	15.5	31.0	53.5
	Firewood	30.9	39	30.1	50.0	33.3	16.7
	Charcoal	–	–	–	18.7	43.9	37.3
	Food: plants and mushrooms	26.2	53.2	20.6	72.7	20.6	6.7
	Structural and fiber	8.8	9.7	81.5	12.5	9.3	78.3
	Medicine, resins, and dyes	17.4	34.6	48.0	40.5	42.9	16.5
	Food: animal	8.5	17.9	73.6	–	–	–
Africa	Fodder and manure	48.0	32.0	19.9	–	–	–
	Other	26.4	30.0	43.5	23.6	21.3	55.2
	Firewood	13.4	77.0	9.6	–	–	–
	Charcoal	–	–	–	13.3	18.7	68.0
	Food: plants and mushrooms	24.6	56.2	19.1	21.0	68.3	10.7
	Structural & fiber	10.1	10.4	79.5	5.7	7.2	87.1
	Medicine, resins, and dyes	14.0	32.3	53.7	2.8	85.4	11.8
Food: animal	22.9	13.4	63.7	0.0	0.0	100.0	
Fodder and manure	9.0	23.6	67.3	–	–	–	
Other	9.6	30.7	59.7	15.7	23.1	61.1	

to collect a higher diversity of products than women. In Table 2 we examine these gender contributions by region.

The global analysis masks large regional variation in the gendered contributions to the different forest product categories. The degree of specialization is much higher in Latin America than in the other two regions. Also, men in Latin America dominate the collection of all unprocessed forest products, and four of the five processed categories. Even firewood collection, often considered a female activity, is dominated by men in Latin America. In Asia, men also contribute substantially to this activity. The gendered stereotypes of male domination in structural and fiber (e.g., timber harvesting) and animal product collection (i.e., hunting) appear to hold across the regions. In line with findings from the literature, women dominate wild plant food collection in Asia and Africa, but not in Latin America.

(v) *Do men participate more in forest user groups than women?*

Our findings confirm the commonly held view that women participate far less than men in formal forest user groups.

Figure 3 shows the percentage of women who participate in FUGs. Across the sample, the percentage of men participating in FUGs is higher than that of women. However, there are differences across regions. In general, few households participate in FUGs in Latin America (16%) and Africa (18%), and participation is somewhat higher in Asia (41%). Of the households where there is participation, women's involvement is lowest in Latin America and highest in Africa, with Asia falling in between. In about half of the sites, women in interviewed households do not participate in FUG meetings at all. With the exception of two sites in Africa, the reported male attendance in FUG meetings always exceeds that of women.

(vi) *Do women rely more than men on extraction from forestlands under common property?*

Figure 4 shows forest product values collected under different tenure regimes, globally and by region. Overall, we see much stronger reliance on state-owned property for forest product collection, as compared to private and communally held land (see Jagger, Luckert, Banana, & Bahati, 2012). The percentage

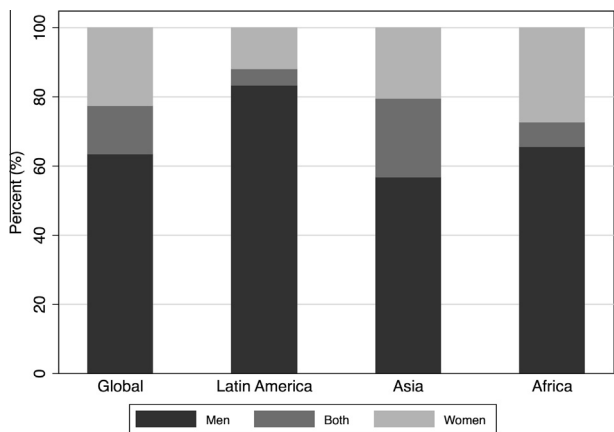


Figure 3. Percentage of women who participate in forest user groups (FUGs).

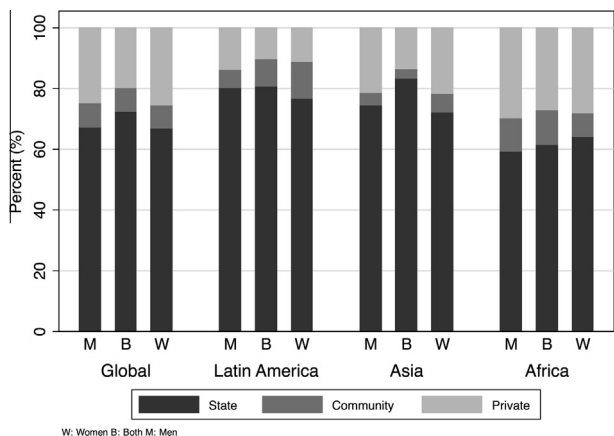


Figure 4. Forest product values collected under different tenure regimes, globally, and by region.

collected under the different regimes is quite similar for men and women in the global sample. This again hides substantial regional variation. In Latin America and Asia, women collect a larger share of forest products in the commons than men; about three times as much in both regions. In Africa, men collect a larger share of forest products in areas with common property regimes than women.

(b) *Multivariate analysis*

(i) *What factors are associated with women’s share of forest income?*

We next examine the multiple factors that may affect women’s contribution to household income from forest products. The results from four regressions (global sample plus the three regions) are presented in Table 3.⁶ In all reported models, standard errors are clustered at the village level to account for the fact that there may be unobservable features that are common within villages. Column I shows results for the model described by Eqn. (1) above. Columns II–IV show the regional results. Perhaps the most striking result is the large size and strong statistical significance of the regional dummies, even after including household- and village-level control variables. Note that we control for village average income and market integration at the village level,⁷ implying that these regional

differences in gender contribution from collection of forest products are not just due to differences in economic development.

Most of the household demographic characteristics do not have statistically significant impacts on women’s share of forest income. Only the variable for female-headed household was consistently statistically significant (and had the same sign) across regions. The fact that women in female-headed households contribute larger shares of income from forest products compared to women in male-headed households is unsurprising since female-headed households will tend to have one less active male to collect products.

The value of households’ assets does not have a statistically significant impact on women’s share of income from forest products in any of the regions. Larger landholdings are negatively associated with women’s share of forest income in all regions, but only had a statistically significant impact in Latin America.

Participation in FUGs did not have a statistically impact on women’s share of forest income in any region. Women collect a (statistically significant) smaller share of forest income in villages that are further from the forest in both Asia and Africa; but surprisingly, distance from forest is positively associated with women’s share in Latin America. This may be due to greater concerns about women’s security in Africa and Asia, than in Latin America. Although distance to market may be an important determinant of the level of income for a household (Angelsen *et al.*, this SI), it only has a statistically significant impact on women’s share of forest income in Africa.

Stronger market integration at the village level is associated with a smaller share of women’s forest income in Asia, but does not have a statistical impact in the other two regions. We included village average income as a proxy for economic development, but found that it only had a statistically significant impact in Africa where higher average incomes were associated with smaller female shares of forest income.

Therefore in Africa, women contribute more to forest income in villages that are closer to forests and where villages are relatively poor. In Asia, women contribute more to forest income in villages that are closer to forests as in Africa and where there is less market integration. Latin America seems quite different from the other two regions, there, women contribute more to forest income in villages that are further from forests and their share does not seem to be affected by market integration or village income.

Thus the regional heterogeneity that we saw in the descriptive analysis remains in a multivariate framework. Even after controlling for differences in economic development, the three regions seem to exhibit different gendered patterns.

4. DISCUSSION

Our global results suggest that certain stylized facts related to gender differentiation of forest product collection, sale, and management have, indeed, a general character; however, some generalizations are not supported by our analysis. We summarize the expectations from the literature and our results in Table 4.

Globally, forest income from unprocessed products collected by men makes a similar contribution to the total household income as that contributed by women. This alone is surprising, given that many authors suggest the majority of unprocessed forest products are collected by women. However, it is the regional differences that are particularly pertinent as highlighted in the results. The commonly held view that

Table 3. *Dependent variable—women's share of forest income (marginal effects from fractional logit regression with standard errors clustered by village)*

Variables	(1) Global Sample	(2) LA	(3) Asia	(4) Africa
Adult female share (>15 years)	0.0461 (1.070)	-0.0645 (-1.344)	0.0488 (0.884)	0.124** (2.033)
Baby < 2 years in hh (dummy)	-0.0173 (-1.544)	-0.00591 (-0.418)	-0.0352* (-1.843)	-0.0153 (-1.083)
Female-headed household (hh)	0.465*** (3.926)	0.151*** (3.301)	0.582*** (5.378)	0.430** (2.012)
Age of male head of household	-0.000588 (-0.845)	-0.00204*** (-3.098)	0.00202 (1.373)	-0.00119 (-1.247)
Age of female head of hh ^a	0.000904 (1.081)	0.00199*** (2.832)	-0.00220* (-1.708)	0.00130 (1.074)
Value of assets in PPP\$	-4.06e-06 (-1.369)	1.15e-07 (0.224)	2.90e-07 (0.0636)	-6.64e-06 (-1.482)
Land area of household	-0.000470*** (-3.513)	-5.87e-05*** (-2.833)	-0.000682 (-0.376)	-0.000806 (-1.059)
Woman attends FUG	0.0244 (0.793)	0.0721 (1.636)	0.0315 (1.253)	-0.0497 (-1.290)
Distance to forest in km	-0.00238*** (-3.263)	0.000850*** (2.855)	-0.00246* (-1.903)	-0.00349*** (-3.331)
Distance to market in km	-0.000671 (-0.324)	5.52e-05 (0.849)	-0.00861 (-0.644)	-0.00717* (-1.937)
Village market integration ^b	-0.446*** (-4.282)	-0.00162 (-0.0245)	-0.658*** (-4.303)	-0.134 (-1.183)
Village average income	8.37e-05 (1.062)	-1.25e-05 (-1.106)	0.000139 (1.387)	-0.000610*** (-5.249)
LA dummy	-0.163*** (-3.332)			
Africa dummy	0.186*** (6.005)			
Observations	5,685	757	1,796	3,132
Chi2	202.8	72.15	95.42	103.8

Robust z-statistics in parentheses.

^a For households with a male head of household who was married, the age of the spouse was used (or oldest spouse in the case of polygamous household).

^b Village average proportion of income earned in cash out of total income.

*** $p < 0.01$.

** $p < 0.05$.

* $p < 0.1$.

Table 4. *Commonly held perceptions of gender and forest use versus findings from the PEN data*

Issue	Perception	PEN findings
Overall contribution	Harvesting forest products mainly undertaken by women	For income from unprocessed forest products, the conventional wisdom only holds in Africa. For processed forest products, it does not hold anywhere; i.e., men are the main contributors in all three regions
Specialization in collection	Women collect mainly firewood, plants for food and medicine; men mainly collect construction materials and hunt	This holds in Asia and Africa, but not in Latin America. Also, men make substantial contributions to firewood collection in Asia, and to food collection in all regions
Diversification in products	Women collect a higher diversity of forest products	In terms of aggregated product categories, men collect a higher diversity than women
Subsistence <i>vs.</i> cash	Women collect mainly for subsistence use, men for sale	Both women and men collect predominantly for subsistence use, but men's sale share is generally higher than women's (except for unprocessed products in Africa)
Forest user groups (FUG)	Women are underrepresented in FUGs	Women's representation in FUGs is well below that of men, and below their input share of forest collections. But forest user groups actually only existed in 25% of our study villages
Common property	Women collect a greater share of products from land under common property tenure regimes than men	This claims holds for Latin America and Asia, but not for Africa. However, the vast majority of products for both genders is collected under state property tenure regime

women are the main collectors of forest products seems to hold only in Africa. Overall, men contribute greater income shares from unprocessed forest products than women; and

overwhelmingly so in Latin America. In Asia, the contribution is about equal. This regional variation resonates with previous work undertaken in a global analysis of market integration of

forest products (Belcher *et al.*, 2005; Ruiz-Pérez *et al.*, 2004). The marketing systems of forest products of Latin America have been described as “specialized,” those from Asia as “diversified,” and those from Africa as “subsistence-oriented.” Latin America, having the greatest level of market integration, is dominated by male activities, both for direct sale and subsistence. The diversified nature of the Asian forest product sector is reflected in a more even distribution of the contribution made by males and females, as well as shared forest product activity. Africa has a greater subsistence share of forest products and is dominated by women and with very little shared activity.

But while the regional dominating pattern of market integration seems to affect women’s involvement in forest use, the regression analysis indicates that the story is more complex. While village-level market integration had a statistically significant negative impact on women’s share of income from forest products in the global sample, the regional dummies remain strong and statistically significant. Thus it does not appear that differences in market integration and income across the regions fully explain the difference in gender shares.

There does appear to be gender-based differentiation in the type of products collected globally that support common perceptions about gender roles in the collection of forest products. For example, we find that men play a much larger role in the collection of animal products (i.e., hunting) and structural fibers and minerals than women (see Table 1). The finding that there is male-domination of physically constraining harvest of construction materials and animal products (primarily through hunting) supports current perceptions of gender differentiation (Fisher, 2004). But it is important to note that physical constraints are not the only explanation, as culture also seems to play an important role in explaining the gender-based differentiation in the collection of different products. For example, Veuthey and Gerber (2010) explain how throughout much of Central Africa, access to the steel-based “technology” required to clear farms and hunt (machetes, axes, and firearms) was, until recently, the sole preserve of men. Such cultural constraints might also affect gender specialization in the collection of forest products. Men overwhelmingly contribute the greatest share value of processed products ranging from “processed fuel” (i.e., charcoal) to all animal related food products, such as processed fish and meat. This might have to do with the actual location of the processing. Many products are processed in the place of collection, so transport becomes easier as processed products tend to be less bulky than unprocessed products. As in many cases, there are cultural restrictions about women spending large amounts of time in forested areas that might explain larger participation of men in the processing of these particular products. It is interesting to notice that this is not necessarily the case for those categories of products, such as plant foods or medicines that can be easily transported and processed at home.

But there are also some surprises in gender specialization. Whereas some previous literature has suggested that firewood collection is a solely female responsibility (e.g., Shackleton *et al.*, 2011), we find that men overwhelmingly dominate firewood collection in Latin America, and make a substantial contribution to firewood collection in Africa as well, particularly where transportation is required. We also find that the contribution of men to the household forest product portfolio is much broader than previously considered. Thus, both for processed and unprocessed forest products, the share value of the products men collected was larger than the female share in four of the seven product categories globally, with an even higher dominance in the Latin America sample. In sum, our analysis

supports the claim that there is some gender-based differentiation in the collection of forest products, but it also highlights that the male contribution to the household economy with respect to forest products is greater, in terms of quantity, value, and diversity (Engle, 1993; Terner, McNamee, Newlands, Belemsaga, Gbangou, & Cross, 2010) than commonly acknowledged (Blumberg, 1988; Kennedy & Peters, 1992).

Our analysis of the end use of forest products collected by people in the household again supports some previous claims, but not others. For example, we find that a larger share of men’s products contributes more to income generation than women’s, although the greater overall share of both unprocessed and processed forest products is used for household subsistence. Thus our study suggests some nuances to the generally accepted idea that men collect forest products for sale, whereas the collection of forest products for household subsistence is women’s responsibility, as it highlights that *both* men and women mostly collect forest products for household consumption.

Our data show that both men and women collect the greatest share of forest products on state-owned property, where there is *de facto* open access. The evidence presented in the literature that women collect a greater share of forest products in areas under common property regimes than men appears to hold in Latin America and Asia, but not in Africa. Also, Africa differs in that women collect a lower share from private property regimes than men whereas in the other regions it is the reverse. This may be because much of the private forest estate is often some distance from habitation in many places in Africa, thus requiring greater time spent away from home (Shackleton *et al.*, 2011). Women may prefer to be closer to home since they are often primarily concerned with the care of younger children and other household-based activities that do not allow them to have long incursions in the forest. In addition, associated security concerns for women roaming in relative wilderness some distance from home is also a major deterrent (Paumgarten, 2007). The results from the multivariate regression show that women’s share of income from forest products is inversely related with distance to forest, in all but the Latin American sample, thus confirming this preference (at least in Africa and Asia).

Our analysis supports the accepted wisdom that men participate more in forest user groups. Our data also support the previous finding that forest management organizations remain dominated by men (Sun, Mwangi, & Meinzen-Dick, 2011), as in all except two of the studied sites, we find a larger percentage of men participating in FUGs. The finding is, however, surprising given the amount of effort that has gone toward attempting to increase the level of women’s participation in forest management, and the strong social movements that are in place, such as the case of extractive reserves in Amazonia (Shanley, Da Silva, & MacDonald, 2011). It is interesting to notice that, at a regional level, women’s participation in FUG seems to correspond to the overall level of commercialization of forest products in the region: in Latin America, where commercialization is higher, women seem to have a lower level of participation, whereas in Africa, where commercialization is lowest, women have a greater level of participation in forest user groups. The low participation of women in formal systems of forest management might have important consequences for forests, as several studies have suggested that where women play a greater role in decision-making they focus less on sanctions and regulation and more on access, especially of products of household value (Das, 2011; Sun *et al.*, 2011; Thapa, Bilsborrow, & Murphy, 1996).

Finally, the regression results support the message of regional differentiation that is seen in the descriptive analysis. The

determinants of women's share of income from forest product collection vary quite a bit across the three regions. Only female household headship and tenure regimes are consistently associated with female income share across Latin America, Asia, and Africa. Since we control for almost all of the key variables discussed in the literature (household demographic characteristics, income, wealth, village characteristics, forest institutions, market integration, and inequality) and still find that "region" is statistically significant, it seems likely that there are unobserved cultural differences across the regions that affect gender roles in forest product collection.

5. CONCLUSIONS AND PERSPECTIVES

In this article, we test some of the commonly held ideas on how men and women access, manage, and use different forest products. Unlike most empirical research to date that relies on case study evidence, we use a large global dataset that allowed us to assess whether patterns commonly cited in the literature hold when considering a large, heterogeneous sample. Overall, we found considerable gender differentiation in the collection of forest products, which seems to support the claim that there

are "male" and "female" roles associated to the collection of forest products. However, we also found that men play a much more important and diverse role in the contribution of forest products to rural livelihoods than often reported. One of our key findings is that there are very strong differences across regions that cannot solely be explained by our control variables. An interesting question to be asked in relation to this regional differentiation is whether this is "evolving" or rather part of a continuum: will Africa's markets for forest products emerge from a more subsistence-based economy to one that is more like Latin America (i.e., that is "specialized"); and if so, will gender patterns of forest use change?

In summary, the gendered practices of forest use and management are much more nuanced than the literature currently presents. This global comparison highlights the similarities and differences that exist among regions. While we confirm some of the findings that derive from individual case studies, we have also shown that all but one are not universal. This heterogeneity complicates policy design, but is essential for policymakers to keep in mind when designing policies and management regimes that aim to support environmental management and both genders.

NOTES

1. <http://www.cifor.org/pen>.
2. <http://www.cifor.org/online-library/browse/view-publication/publication/3341.html>.
3. These include the value of unprocessed forest products and the value of the forest product inputs for processed products.
4. OLS estimates will be incorrect since the method presumes a linear dependent variable; in this case, the dependent variable can only take values between zero and one. One commonly used method to deal with this problem is to model the log odds ratio as a linear function. This method, however, is only correct when there is zero probability that the response variable will be at a boundary. Since there are a substantial number of observations that are zero and one in our case, this method is inappropriate. Thus we use the fractional logit regression technique first

proposed by Papke and Wooldridge (1996). We run a generalized linear model with a logit transformation of the dependent variable and assume it has a binomial distribution. We also run an OLS regression to check the robustness of our results and find that they remain qualitatively the same. These are available from the authors upon request.

5. For a comprehensive discussion of the way the village sites were chosen and the likely consequences, please see Angelsen, Larson, Lund, Smith-Hall, and Wunder (2011).
6. Results from OLS regressions were qualitatively similar and are available from the authors upon request.
7. This was defined as the village average of the proportion of income that households earned in cash out of their total income.

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APPENDIX A. DESCRIPTIVE STATISTICS (MEANS WITH STANDARD DEVIATIONS IN PARENTHESES)

Variables	(1) rev9 newwomsh		
Women's share of forest income	0.340 (0.359)	Land area	56.62 (265.7)
Adult female share	0.293 (0.147)	Woman attends FUG	0.0544 (0.227)
Baby in household	0.401 (0.490)	Distance to forest in km	14.94 (20.95)
Female-headed household	0.0254 (0.0940)	Distance to market in km	2.415 (13.72)
Age of male head	44.99 (13.97)	Village market integration	0.626 (0.161)
Age of female head	38.68 (13.09)	Village average income	285.8 (343.3)
Value of wealth in PPP\$	1,218 (3,920)	Latin America	0.133 (0.340)
		Africa	0.551 (0.497)
		Asia	0.312 (0.465)
		Observations	5,685

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