

# Smallholders and timber extraction in the Ecuadorian Amazon: amidst market opportunities and regulatory constraints

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## SUMMARY

Smallholders control an important portion of forestlands in the Ecuadorian Amazon. Timber is not the main source of income but contributes to complement relatively diversified livelihood strategies of smallholders. Timber extraction is stimulated by a vigorous network of intermediaries linked to the end-markets in the cities. Most small-scale operations are undertaken informally since smallholders require complying with still cumbersome procedures in spite of state efforts for simplifying the forestry regulations. Benefits for smallholders from timber extraction depend on how the harvesting operations are organized and whether they involve the participation of smallholders as well as on the species harvested, and whether these operations are conducted with a formal permit or not. This paper assesses the role of timber in smallholders' livelihoods, the influence of how timber operations are undertaken has on benefits distribution, and the role that urban markets have on shaping the dynamics of timber supply.

Keywords: Ecuadorian Amazon, illegal logging, timber extraction, smallholders, forest management

## Petits propriétaires et extraction de bois en Amazonie équatorienne: entre opportunités de commercialisation et contraintes réglementaires

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Les petits propriétaires contrôlent une part importante des zones forestières en Amazonie équatorienne. Bien que le bois ne soit pas leur source principale de revenus, il fait néanmoins partie intégrante de stratégies diversifiées des petits propriétaires en termes de moyens de subsistance. L'extraction de bois est stimulée par un réseau dynamique d'intermédiaires qui font la liaison avec les marchés dans les villes. La plupart des opérations menées à petite échelle sont entreprises de manière informelle, car les petits propriétaires doivent être en conformité avec des procédures lourdes et inadaptées en dépit d'efforts de simplification des réglementations forestières par l'Etat. Les bénéfices de la production ligneuse pour les petits propriétaires dépendent de l'organisation de la production, de leur degré d'implication dans les opérations de coupes et des espèces ligneuses concernées, ainsi que du fait que ces opérations sont mise en œuvre avec ou sans permis. Cet article évalue donc le rôle que joue le bois dans les moyens de subsistance des petits propriétaires, l'influence des divers modes d'extraction du bois sur la distribution des bénéfices, ainsi que l'impact des marchés urbains sur les caractéristiques de la chaîne d'approvisionnement du bois.

## Pequeños productores y extracción maderera en la Amazonía Ecuatoriana: entre oportunidades de mercado y restricciones de las regulaciones

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Los pequeños productores controlan importantes extensiones de tierras forestales en la Amazonía Ecuatoriana. Aunque la venta de madera no es la principal fuente de ingresos de los pequeños agricultores, ella contribuye a la diversificación de sus medios de vida. La extracción forestal es estimulada por una vigorosa red de intermediarios vinculados con los mercados finales en las ciudades. La mayoría de los aprovechamientos de pequeña escala son realizados de forma informal, esto porque los pequeños productores requieren seguir los que todavía constituyen procedimientos engorrosos, incluso a pesar de los esfuerzos estatales para simplificar las regulaciones forestales. Los beneficios para los pequeños productores de la extracción maderera están relacionados con la forma en la que se organizan estos aprovechamientos y si involucran la participación de los pequeños productores, así como de las especies que son cosechadas y de si el aprovechamiento se realiza a través de permisos formalmente aprobados o no. Este artículo analiza el rol de la madera en los medios de vida de los pequeños agricultores, la influencia que tiene en los beneficios la forma en la que se organizan los aprovechamientos y el rol que los mercados urbanos tienen en definir las características de las redes de aprovisionamiento de madera.

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## INTRODUCTION

The contribution of forest resources to the livelihoods of smallholders who live in or near forestlands, and the way in which it is affected by forestry regulations is a debate with significant policy implications. Recent studies indicate that forest-related income show significant regional variation, but they average 22% of total income in households across the tropics (Angelsen *et al.* 2014). One important source of smallholders' forest income is timber. The literature on timber extraction by smallholders has focused, among others, on smallholders' productive assets and livelihood strategies (Donovan *et al.* 2006), the political and institutional conditions that shape access and use of forest resources (Larson *et al.* 2008), and market conditions and smallholder capabilities to engage in those markets (Pacheco 2012). An important angle in the debate about the way in which smallholders and communities use and benefit from timber focuses on the barriers of stringent forestry regulations that smallholders have to overcome to obtain meaningful benefits (Kaimowitz 2013, Larson and Ribot 2007, Pokorny and Johnson 2008). Thus, legality compliance continues to be a significant challenge for the development of smallholder forestry.

Compliance with forestry regulations is expected to reduce unfair competition in the timber markets from timber originated on illegal sources due to their effects on price distortions (Vasquez 2004). Nonetheless, forest regulations also imply additional transactions costs that are especially burdensome for smallholders and small-scale chainsaw millers and other local forest users who produce relatively small amounts of timber (Tacconi 2007). In the context of existing forestry regulations, smallholders take decisions about how to undertake timber extraction, and whether or not to comply with these regulations based not only on their capabilities, but also on factors related to market access (Molnar *et al.* 2007). Market access tends to be mediated by middlemen who often have good knowledge on the end markets, available capital, and are able to organize timber extraction operations to respond to urban demand (Mejia and Pacheco 2013).

Small-scale timber extraction in the Ecuadorian Amazon constitutes an interesting case to understand better the interactions between smallholders' forest income, market access intermediated by middlemen and benefit sharing associated to the ways in which timber extraction is organized and undertaken. The Ecuadorian Amazon has an area of 115,613 km<sup>2</sup> in 6 provinces. A vigorous smallholder economy is present in this region, which is associated with both colonists and indigenous people who make an intensive use of land, and intervene their forests, while at the same time allowing for forests maintenance and regeneration. Overall, the timber from the Ecuadorian Amazon constitutes only 16% (or 458,000 m<sup>3</sup> in 2011) of total timber supply of the country, out of which 46% of this timber originates in native forests, 28% in agroforestry systems, and 19% in pioneer formations (Ministerio del Ambiente del Ecuador 2012). The proportion of timber locally consumed in the Amazon is only 8% since most of the timber produced is traded to the cities of Quito, Ambato, and Cuenca, and is demanded by the construction

and furniture industry (Mejia and Pacheco 2013). Most timber from small-scale operations is sawn into planks inside the forest using chainsaws, and transported to the market through networks organized by middlemen.

To overcome small-scale illegal logging, the government of Ecuador has made important steps to simplify forest regulations (see Ibarra *et al.* 2008, Thiel and Trelles 2008). For example, Ecuador is one of the few countries where chainsaw milling in the forests is legally allowed, and instruments like forest management plans have fairly simple requirements, compared to other countries in the region. Furthermore, it has been implemented an on-line based timber system to issue forestry permits associated with a legality verification system known as SAF (by its acronym in Spanish), which includes the use of geographical positioning, forest inventories, on road control and in situ verification. This system, however, while provides more accurate data on timber extracted using the legal requirements and the sources of that timber, it has also increased the need for smallholders to rely on professional foresters in order to comply with the administrative steps required by law, and on middlemen that burn the costs of legality.

Often small-scale logging is conducted informally or outside of the law by smallholders, since they are not in a position to pay for the forest inventories to be developed by a foresters in order to get a legal permit nor the stumpage fees of USD 3 per harvested m<sup>3</sup> (FAO 2012). Much of the timber is extracted in relatively small volumes to supply a vast network of middlemen (Palacios and Malessa 2010). These middlemen finance most of the timber operations and provide the links to the end-markets. As a result, they strongly influence how timber extraction is organized. Timber extraction operations range from those in which smallholders take care of harvesting, milling and sales to those that are fully managed by a middlemen with the help of a team of chainsaw millers. The roles that both smallholders and middlemen play in the operations have strong implications on how benefits are distributed and the way in which forests are managed.

This paper focuses on three complementary lines of enquiry. First, it assesses the importance that small-scale timber extractions has for the livelihoods of smallholders, both colonists and indigenous people, in the provinces of Napo and Orellana, in the Ecuadorian Amazon. Second, it looks at the way in which timber operations are undertaken, the influence of forestry regulations in such operations, and their effects on benefit sharing. Third, the paper also assesses how market conditions, mainly urban timber demand, shape the decisions of the middlemen, which has strong influence on how timber operations are undertaken. As such, the paper informs the debate on timber resources management among smallholders, and the way in which institutional support can be implemented in order to favor smallholder livelihood strategies while simultaneously contributing to improved distribution of benefits.

The paper is organized in six sections including this introduction. Section 2 provides the main conceptual underpinnings of our analysis, exploring the links between regulations, markets and livelihoods, and highlighting some analytical

gaps that this paper contributes to fill. Section 3 describes the methods used for data collection in two provinces. Section 4 discusses the main results focusing on three aspects: the role of timber extraction in smallholder's livelihoods; the ways in which timber operations are conducted and their implications for timber extraction and benefit sharing; and the role played by middlemen, which is linked to the formal and informal dimensions of the timber markets. Section 5 discusses some of the main issues that emerge from the Ecuadorian case of smallholder forestry, regulations and market networks. The final section presents the main conclusions and provides some policy recommendations.

### CONCEPTUAL UNDERPINNINGS: REGULATIONS, MARKETS AND LIVELIHOODS

A significant body of literature has been developed on how regulations and other institutional barriers constraint access to land and forests (see Agrawal and Benson 2011, Larson *et al.* 2010, Sikor and Lund 2009). Two less explored issues are related to the effect of regulations in how timber operations are organized and what is that this means for smallholders' benefits. With regards to the first issue, much of the debate has focused on the formal and informal dichotomy (Pacheco *et al.* 2008), and with regards to the second, on how market engagement and entrepreneurial skills tends to influence benefit sharing originated from timber use and processing (Molnar *et al.* 2007), which has broader implications for smallholders' livelihoods. This section provides some existing perspectives about the interactions between regulations, markets and livelihoods, and concludes signaling some analytical gaps that this paper is aimed to explore by using the case of smallholder forestry in the Ecuadorian Amazon.

There has been a strong trend to regulate access, management and use of forests (Guha-Khasnobis *et al.* 2006, Sears *et al.* 2007). The land and forestry regulations have often added institutional barriers to smallholders when trying to use their forests—mainly timber—thus ultimately have worked against local actors, making difficult for them to realize the benefits from using their forests (Larson *et al.* 2008). Yet, not all smallholders are on the same situation, since as it has been argued, individuals with significant endowments of land, strong social networks and financial resources, are better situated to gain access to the institutions of the state, markets, and derive economic benefits (see Bebbington 1999). When access and management are strongly regulated—as in the case of timber use—and the costs of regulations are restrictive, the main puzzle for smallholders is how to circumvent legal requirements, so as not to be excluded from the market (Pacheco 2012, Pokorny *et al.* 2012). Furthermore, smallholders are supposed to obtain more flexible and easier access to capital, technologies, and markets when engage in small-scale and informal operations, which help them to overcome the institutional barriers imposed by the legal frameworks (see Kartodihardjo *et al.* 2011, Kishor and Lescuyer 2012, Medina *et al.* 2009).

Thus, it is not surprising the persistence of smallholders in conducting informal operations, outside of the law since in situations where smallholders do not have means to gain access to markets through formal legal compliance, informal networks may constitute an effective way to engage in these markets. Informal markets, however, are characterized by more asymmetrical relationships and often smallholders selling their timber in such markets tend to obtain comparatively lower prices (Pacheco *et al.* 2008). Moreover, these markets do not lead to a fair distribution of benefits since an important part of them is retained by the middlemen depending on how the timber operations are organized (Mejia and Pacheco 2013). In the Amazon, there are different types of timber operations, while the most typical are, on the one side, the ones where the smallholder undertakes all the operations without the participation of third parties, and on the other side, the ones undertaken under the overseeing of middlemen. Obviously the total benefit and its distribution tends to vary since the first tend to be associated with low logging intensities, and the second tend to systematically extract higher volumes (Medina *et al.* 2009). Furthermore, the environmental implications of illegal logging are ambiguous, although it is likely that those smallholders with less access to markets and less capital are going to intervene and destroy much less forest than wealthier groups do, merely because they have less opportunity and capital to do so (Tacconi 2007).

When looking at livelihoods, several factors explain how much smallholders depend on timber in their livelihood strategies. Primarily these include access to land with sufficient commercially valuable forest resources, and access to capital (Angelsen *et al.* 2014). Other factors like the opportunities to sell labor and timber also tend to play an important role (Barrett 2008, Cardozo 2013). Often in smallholder economies, incomes from timber extraction are complemented with other sources of income like agriculture and off-farm income, as shown by other authors in diverse situations (Lescuyer *et al.* 2011, Lima *et al.* 2006, Porro *et al.* 2014). While timber does not necessarily constitute the main source of income it allows to generate cash when some immediate family needs arise. The decision to engage in legal transactions, however, is also related to decision-making at the household level since it is highly likely that smallholders will extract timber informally if is only to meet some short-term income gaps (Larson *et al.* 2010, Pacheco 2012, Vosti *et al.* 2003). Often smallholders engage in formal operations when the expected benefits outweigh the transactions costs (see Medina *et al.* 2009, Pulhin *et al.* 2010).

As shown above, while there is much discussion about the fact that standards and regulations for timber harvesting become economic and institutional barriers that tend to exclude smallholders and local forest users from access to forest resources and timber markets, a significant gap in the literature is the influence that the latter have on the functioning of the timber markets, and how that shapes decisions of smallholders and intermediaries about ways to undertake the timber extraction operations. As mentioned, in many situations informal networks constitute an effective way for

smallholders to engage in timber markets. Nonetheless, these networks do not warrant a fair distribution of benefits since an important part is retained by some actors, such as middlemen, depending on how the timber operations are organized. This paper makes explicit links between regulations, markets and livelihoods by providing empirical evidence from the Ecuadorian Amazon, thus contributing to more in-depth understanding of the conditions affecting forest actors' interactions, the factors shaping distribution of benefits, and the importance of the market networks.

## MATERIALS AND METHODS

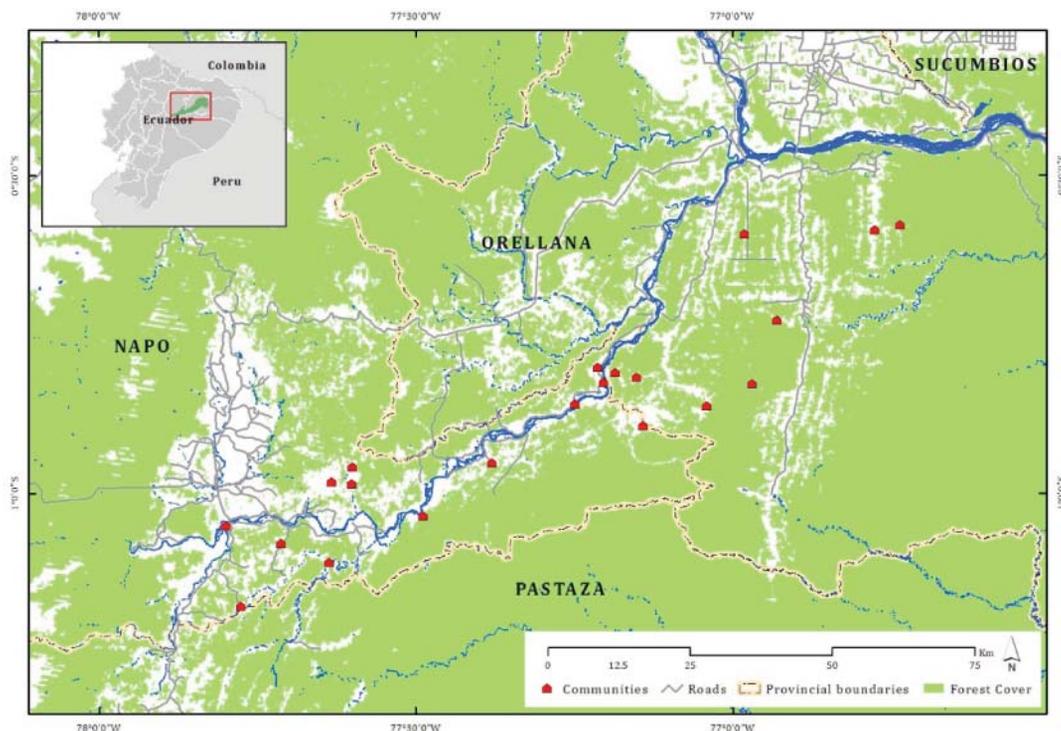
This study focuses in the Ecuadorian Amazon. Two provinces with marked differences in expansion of the agricultural frontier were selected for field work, namely Napo and Orellana (Figure 1). The Napo province is a relatively old frontier with older settlements, and thus experiences highest pressure while its forests hold fewer valuable timber species, compared to Orellana. In the latter province, smallholders have access to more land and their forests hold more valuable timber species. The two provinces share some common biophysical characteristics, the main difference being that Napo contains more highland tropical forest and Orellana mostly lowland tropical forest. The process of land occupation and settlement patterns in these provinces is explained elsewhere (see Bremner and Lu 2006, Finer *et al.* 2008, Gray *et al.* 2008, Irvine 2010). A look across two contrasting provinces provides a more nuanced perspective on the differentiated dynamics of timber

extraction along a gradient of situations in the Ecuadorian Amazon.

The information gathered for this study relies on a mix of quantitative and qualitative methods based on fieldwork carried out from February to September 2012. The overall analysis relies on information from household surveys, analysis of selected cases of timber extraction, and interviews with key informants. The paper addresses three issues, namely: 1) household survey data indicate the importance that small-scale timber extractions has for the livelihoods of smallholders, both colonists and indigenous people, in Napo and Orellana; 2) analysis of selected cases of timber operations, whether undertaken following the forestry regulations or not, enable to estimate costs and benefits of various operators in the value chain, and the distribution of benefits; and 3) the semi-structured interviews highlight market interactions and links between supply and end-market demand. Therefore, the three different sources of information, complement the analysis at the household level, timber operations, and market interactions.

A total of 243 household surveys were conducted in 21 communities. The selection of households was made in two stages. The communities were identified by using a purposive sampling based on the ethnic origin, size, and location of communities. The households to be interviewed were identified by simple random sampling. A questionnaire template from the Poverty and Environmental Network (PEN-CIFOR) was adapted in order to gather data at the household level. A total of 47 colonists and 76 indigenous (*Kichwas*) households were interviewed in 12 communities in the province of Napo,

FIGURE 1 Map of the study area and selected communities. Own elaboration based on information available at the technical office of the Ministry of Environment (MAE) in the province of Napo



and 48 colonists and 72 indigenous (*Kichwas* and *Shuars*) households were interviewed in nine communities in the province of Orellana, making a total of 95 interviews with colonists and 148 with indigenous households.

Additional information was collected from eight timber operations in order to quantify the dynamics, costs, and benefit sharing in these operations. The selection of case studies was based on a typology of four different forms of small-scale harvesting organization that takes into consideration two basic criteria: the first is the way in which intermediaries and smallholders participate in the harvesting process, and the second is whether the harvesting complies with legal requirements or not. The information was collected in previously validated template sheets. In practice, the selection of the timber extraction operations to study depended largely on the willingness of smallholders and intermediaries to provide relevant information. Timber operations were monitored on site for a sequential period of six months between March and August 2012. The monitoring of the cases was ended when the timber was placed on the side of the road, where smallholders' participation in the harvesting process ends. These eight cases provide useful information, yet they face limitations of representativeness and cannot be generalized.

Finally, 123 semi-structured interviews were conducted with key informants who hold different roles within the timber harvesting and marketing chain. These informants were selected according to opportunistic sampling using the information provided by other informants. These interviews were conducted in parallel with the household survey. The interviews with key actors were conducted in the same communities where the household survey was carried out. Its main purpose was to understand to what extent the timber legality verification system affect the way in which different actors (smallholders, indigenous peoples, and intermediary sawmill workers) interact with one another in the value chain.

## SMALL-SCALE TIMBER EXTRACTION: AMIDST MARKETS AND REGULATIONS

### Smallholders' livelihood strategies and timber extraction

Smallholder livelihoods are the result of differentiated strategies depending on the process of land occupation, access to resources and market opportunities. This analysis looks at land access, use and income portfolios as a way to depict the livelihood strategies adopted by the household in the provinces of Napo and Orellana. With regards to land access, colonists and indigenous households in Orellana have comparatively larger landholdings than their pairs in Napo. Indigenous landholdings in Orellana are larger (50 hectares) compared to those of colonists that equate 30 hectares and 35 hectares in Napo and Orellana. Indigenous households hold relatively smaller plots in Napo (19 hectares). Over time, greater land fragmentation has taken place in the Napo province due to an older process of land occupation.

The data from household surveys indicates that smallholder production systems are highly diversified, with agriculture being the most important economic activity. In the two provinces, colonist households obtained higher annual incomes (about USD 3,200) with respect to indigenous households (from USD 1,884 to USD 1,945). Colonists demonstrated a more diversified livelihood portfolios which included an important portion of off-farm income. Household incomes are relatively higher in Orellana province than in Napo province because off-farm salary incomes are as much as a high. (Table 1). The main source of income in both provinces is paid employment, which includes off-farm work, some of that non-agricultural work in the same province or other rural locations. Out of the 140 households that receive income for their paid jobs, 45 are related to chainsaw milling, which is 23% of the total income perceived as off-farm wage salaries. Forest income represents, on average, only 16% of total household income in both provinces, and it contributes to complement cash income used to meet basic family needs.

Between 64% in Napo and 74% in Orellana of the households interviewed have received income from the sale of timber between 2004 and 2012. During the year previous to the interviews, only 53% of the households sold timber, which suggest that timber-related income is relatively irregular over time. In Napo province, income from timber sales is higher among colonist than among indigenous households, while it is the opposite in Orellana province. This is likely due to pressure from intermediaries on indigenous who control landholdings with more valuable tree species. Indigenous households from Orellana province receive approximately twice the income from timber sales than their pairs in Napo, where landholdings are smaller. As a result, timber income contribution to total income is small in indigenous households in Napo (8%), it is higher among colonists in Orellana (10%), and much higher among indigenous in Orellana (22%) and colonists in Napo (23%) (Table 2). Timber extraction in Napo is mostly undertaken on lands under agroforestry, while in Orellana mainly from native forests. This also affects the species that are available, and consequently harvested in the different locations.

The strategies for harvesting differ by province. In Napo, 86% of the smallholders mentioned that they intervene in—or lead—harvesting operations, while this percentage is only 60% in Orellana. The rest of the interventions are made exclusively by middlemen without smallholder participation in the harvesting. This might be due to the presence of a stronger, more organized intermediary network in Orellana than in Napo. The characteristics of the negotiation with buyers are very similar in both provinces, since most smallholders sell their timber through a purchase order of the intermediary, and the rest find a buyer in local markets. In Orellana, about 65% of smallholders received an advance payment from middlemen for the last operation undertaken, while in Napo this proportion was much lower, in the order of 15%. When smallholders are in charge, they will cut the timber into planks in the forests and sell them at the farm gate, and the intermediary will transport these planks to the end market. The levels

TABLE 1 Total annual income from colonist and indigenous in Napo and Orellana<sup>a</sup>

Source of income	Average income						No. of households
	Colonists (n=95)		Indigenous (n=148)		Total (n=243)		
	USD	%	USD	%	USD	%	
<b>Napo Province</b>							
Wage labor <sup>b</sup>	1,064	33	813	43	909	38	76**
Sale of forest products <sup>c</sup>	1,019	31	210	11	519	22	84***
Human Development bond <sup>d</sup>	458	14	437	23	445	18	102
Sale of agricultural products <sup>e</sup>	435	13	322	17	366	15	111
Other income <sup>f</sup>	< 200	13	< 50	7	<110	11	67
Total	3,259	100	1,884	100	2,410	100	441***
<b>Orellana Province</b>							
Wage labor <sup>b</sup>	2,052	62	923	47	1,375	55	64***
Sale of forest products <sup>c</sup>	341	10	410	21	382	15	66
Human Development bond <sup>d</sup>	210	6	233	12	224	9	64
Sale of agricultural products <sup>e</sup>	217	7	155	8	180	7	84
Other income <sup>f</sup>	< 180	11	<150	10	<160	10	100
Total <sup>**g</sup>	3,298	100	1,945	100	2,486	100	383***

Note: a) annual income refers to the total income obtained in the year before the interviews were carried out, which ranges from August 2011 to September 2012 in Napo, and from February 2011 to July 2012 in Orellana; b) wage labor includes all labor that is carried out outside the smallholding and is paid, for example, agricultural labor, sawmilling, and labor under work contracts; c) forest income refers to income in cash for the sale of timber, non-timber forest products (NTFPs) and income from the Government's Socio Bosque Program (PSB); d) the Human Development bond is a cash transfer from the government; e) the sale of agricultural products refers to the cash income from the sale of these type of products, for example, cocoa, corn, coffee, guayusa, etc; f) other income refers to income that is not part of any of the above categories; g) independent samples t-test in the differences of income diversification between colonists and Kichwas at 1% (\*\*\*) and 5% (\*\*) level of significance. Own elaboration based on a household survey conducted from February to September 2012 in the provinces of Napo and Orellana.

TABLE 2 Income from timber products sale for Napo and Orellana<sup>a</sup>

Province	Timber income	Average income						No. of Households
		Colonists (n=95)		Indigenous (n=148)		Total (n=243)		
		USD	%	USD	%	USD	%	
<b>Napo</b>	Total household income	3,259	100	1,884	100	2,410	100	123
	Income from timber sales <sup>***b</sup>	764	23	159	8	381	16	63
<b>Orellana</b>	Total household income <sup>***b</sup>	3,298	100	1,945	100	2,486	100	120
	Income from timber sales	332	10	426	22	388	16	66

Note: a) annual income refers to the total income obtained in the year before the interviews were carried out, which ranges from August 2011 to September 2012 in Napo, and from February 2011 to July 2012 in Orellana; b) Independent samples t-test in the differences of income diversification between colonists and indigenous at 1% (\*\*\*) level of significance. Own elaboration based on a household survey conducted from February to September 2012 in the provinces of Napo and Orellana.

of informality declared by our respondents were relatively high. Timber harvesting carried out without an approved program amounts to 69% and 75% of total harvesting in Orellana and Napo, respectively. The following section explores the distribution of incomes depending on different characteristics of the timber operations.

### Distribution of benefits from timber extraction operations

The costs and incomes obtained from small-scale timber harvesting tends to vary significantly. We conducted a detailed

assessment of eight operations, three of which did comply with the forestry regulations—so were formal—and five were carried out outside of the law—so were informal. The decision made by smallholders to carry out timber harvesting, in the case of formal operations, is often made by a forester who works with the middlemen for preparing the forest inventories required to obtain the permits. In contrast, when timber harvesting is conducted with no legal authorization are the same smallholders who made the decision about how and when to carry out the timber operations, as well as how much to extract. Table 3 shows the main characteristics of eight timber operations analyzed.

TABLE 3 Characteristics of formal and informal timber operations

Cases analyzed	Type of timber extracted	Labor employed	Legalization and operative cost	Distance to road (Km)	Measured volume (m <sup>3</sup> )	Operation duration (days)
<b>Formal</b>						
Case 1	Hard and softwood	Hired	Intermediary	0.93	110.2	15
Case 2 <sup>a</sup>	Hard and softwood	Hired	Intermediary	0.62	16.8	4
Case 3 <sup>b</sup>	Hard and softwood	Hired	Smallholder	2.48	9.3	15
<b>Informal</b>						
Case 1	Softwood	Family	Smallholder	0.5	13.6	5
Case 2	Softwood	Family	Smallholder	0.31	9.04	5
Case 3	Softwood	Family	Smallholder	1.86	56.2	10
Case 4	Softwood	Family	Smallholder	0.43	31.1	10
Case 5	Hardwood	Family	Smallholder	1.55	36.2	8

Note: a) The intermediary just allowed the counting of part of the total operation volume (86 m<sup>3</sup>); b) Smallholder undertook the operations and lost most of the timber due to transport problems (75 m<sup>3</sup>).

From the data provided in Table 3, it is difficult to determine general costs and benefits generated by small-scale timber operations, since due to a combination of different factors (e.g. distance to markets, type of labor employed, available species, size of the operation), the fixed costs of timber harvesting show relatively large variation among cases. Thus, each of the eight selected cases has unique characteristics, thus making it difficult to establish clear patterns in terms of operational costs and resultant benefits. However, it can be observed that likely the most important fact determining final income was the species being harvested, with informal operations focusing more in the harvesting of soft species since they are easier to transport and more abundant, while hardwood timber needs extra hauling and is scarcer.

Table 4 indicates that legal harvesting provides more benefits when hard species are harvested, and that the operational costs tend to vary depending on the participation of smallholders in the harvesting. In one of the cases without participation of the smallholder, income was 30% lower than comparable to other cases. Thus, smallholder increase their income when participate with their labor in the operations, which also leads to lower the total costs of the operations. In addition, main costs of the operations are related with the cost of timber, use of labor and supplies (Figure 2). The costs associated with the legalization of harvesting are lower in comparison to the other costs, yet they constitute an important

constraint for smallholders to formalize their operations. The latter costs are associated with the hiring of a forester in charge to develop a forest inventory. Often these foresters prefer to undertake larger operations since they charge based on registered volumes; thereby the foresters prioritize operations of at least 100 m<sup>3</sup> (or 50 trees). Other cost are related to the stumpage fees that have to be paid to the national forestry authority. A few additional indirect costs are transport and time invested in processing the permits.

Timber prices per cubic meter paid to smallholders and middlemen show differences between 20% and 60%, depending on the species. The proportional distribution of income between smallholders and middlemen is relatively constant when it concerns hardwood species. The gap in incomes between these two groups is greater when softwood species are harvested. The fact that some timber harvesting operations are conducted informally does not seem to affect the final income obtained by smallholders. The differences in incomes are mostly related to the species that are harvested. The incomes derived by middlemen are higher than those obtained by smallholders, regardless of whether forest operations are authorized or not. The benefits obtained by smallholders and middlemen outweigh the total costs and thus both actors obtain profits across the eight operations analyzed. In the case of legal operations, the intermediary's generate between 50% and 110% of the total amount invested per m<sup>3</sup> (see Figure 3).

TABLE 4 Smallholders' net income from eight selected operations (USD/m<sup>3</sup>)

	Formal harvesting <sup>a</sup> (Mean = 61m <sup>3</sup> )			Informal harvesting <sup>b</sup> (Mean = 31 m <sup>3</sup> )		
	Costs m <sup>3</sup> <sup>c</sup>	Road-side prices	Net benefit	Costs m <sup>3</sup>	Road-side prices	Net benefit
<b>Hardwood</b>	86.0	161.7	75.7	45.6	90.0	44.3
<b>Softwood</b>	78.0	88.7	10.7	40.0	50.3	10.3

Note: a) average based on three harvesting operations; b) average based on five harvesting operations; c) the cost of the operation is covered by the intermediaries. Own elaboration based on data gathered from March to August 2012.

FIGURE 2 Distribution of costs for eight select small-scale timber extraction operations with and without formal permits and according to different types of smallholder and middlemen participation (in USD/m<sup>3</sup>). Own elaboration based on interviews carried out from March to August 2012

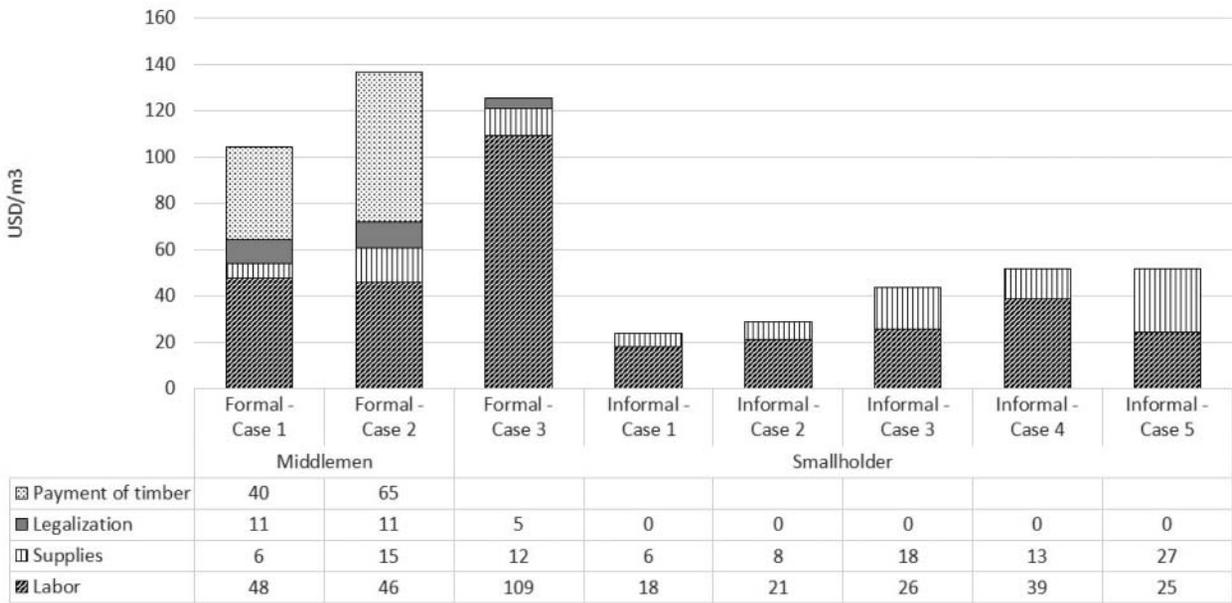
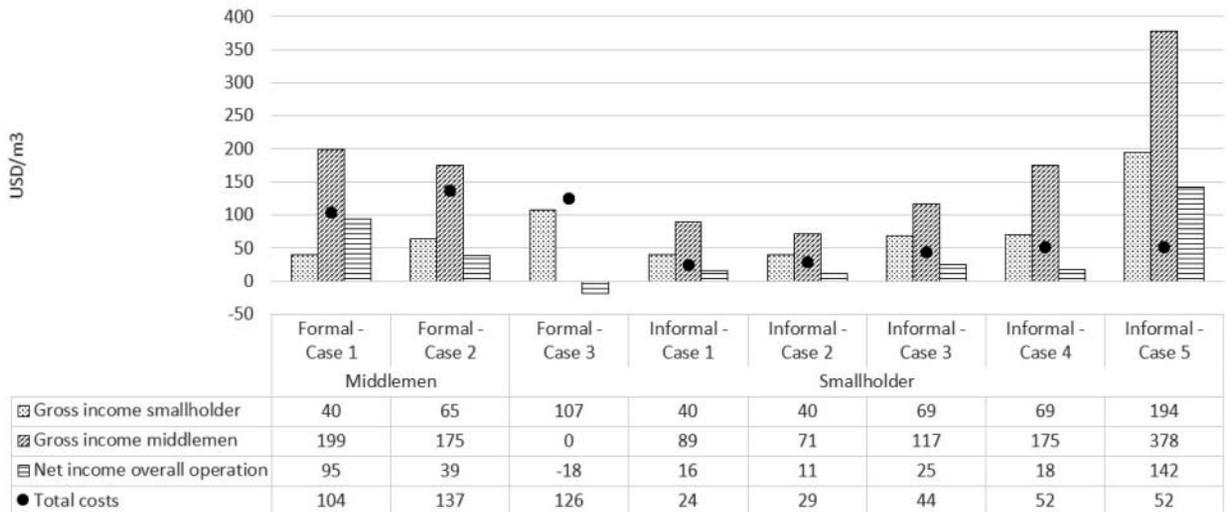


FIGURE 3 Income and costs for eight select timber extraction operations undertaken with and without formal permits and according to different types of smallholder and middlemen participation (in USD/m<sup>3</sup>). Own elaboration based on interviews carried out from March to August 2012



Smallholders obtain higher income when undertake formal timber operations, except when hardwood species are harvested outside of the law, as in the case of informal case 5 and when the operation was undertaken by the smallholders as in the formal case 3. In the former, where only hardwood was harvested, the profit obtained by the smallholder was 53% higher than any other operation. In formal case 3, the smallholder held a legal operation with losses, principally due to the lack of experience and access to the proper market networks; this despite the fact that he benefited from the support of the government in order to legalize his operation.

In general, legal timber operations held by intermediaries focus on hardwoods, or a combination of both hardwood and softwood. According to intermediaries, a harvesting operation that only focuses on softwood is not profitable, although it can be so for smallholders as shown by informal cases 1 to 4 (see Figure 3). Furthermore, volumes greater than 50 m<sup>3</sup> of soft-hard sawn timber are harvested only by intermediaries since they need extra logistic. This allows them to reduce permits costs per unit of logged timber. Overall, smallholder get higher incomes when they conduct small harvestings of hardwood species in an informal scenario; for this to be truth, they

depend on forest quality and the links with intermediaries that as seen is not the case of every informal operation.

### Demand-driven (formal and informal) market networks

Timber harvesting and marketing are strongly influenced by market demand in urban centers in terms of volumes, quality, species, and the way in which smallholders and middlemen interact in these markets. The analysis of timber circuits is beyond the scope of this paper and has been analyzed elsewhere (see Mejia and Pacheco 2013). Total demand in the cities, estimated at 400,000 m<sup>3</sup>/year/round wood seems to exceed legal supply. This difference is provided by intermediation networks that rely on a mix of legal and illegal timber in order to meet urban demand. Timber markets are under the control of intermediaries who play different roles, usually related to their financial and logistical capacities. Intermediaries operations respond mainly to purchase orders from timber buyers located in the large urban centers (i.e. Quito, Ambato, Cuenca), usually the owners of a depot or sawmill. The purchase order is normally an agreement between both parties that guarantees the delivery and payment of the product within a certain timeframe. The agreement includes specific species, established sizes, and quality of sawmilling. A small portion of middlemen are owners themselves of depots and sawmills in the small cities (Table 5).

Transactions between smallholders and middlemen follow the law or not depending on timber volumes, species, and the end-market. The main negotiation between these two actors is related to setting up the price for the timber to be harvested as well as forms of payment, as indicated in Table 6. According to the middlemen interviewed, they approach smallholders as potential suppliers on the basis of family

relationships, often through co-workers, and forest technicians. In some cases, smallholders tend to find the middlemen by themselves. In most of the cases, smallholders wait for an agreement with middlemen before undertaking the harvesting. In some cases, smallholders seek a buyer both before and after harvesting, and some wait for the buyers on the road or in local markets by the rivers. Concerning the negotiation, often the buyer in the cities imposes the timber price, which serves as the base for the negotiation between middlemen and smallholders. Only in a few cases smallholders have the chance to influence the final price, especially in operations involving higher value and scarcer species.

According to our interviews, middlemen's decisions to undertake timber extractions outside of the law depend on the time that final buyers are willing to wait for the timber that was requested. The purchase orders placed by buyers through telephone calls put in motion to the middlemen who start looking for sources of timber in order to meet the volumes of specific species included in the order. In some cases, middlemen have access to areas with legal harvesting permits approved by the Ministry of Environment. Yet, in many cases, intermediaries do not have at their disposal the volumes of timber or species requested by the buyers. In those cases, they have the option to initiate new operations with approved plans, undertake operations with no plans, or buy timber from smallholders who log on their own, often outside the law as mentioned earlier. Thus, in most of the cases, intermediaries rely on a combination of formal and informal sources of timber to meet demand. Most of the timber is legalized before to reach the cities. A description of the strategies followed by intermediaries to launder illegally sourced timber has been addressed elsewhere (see Añazco *et al.* 2010, Palacios and Malessa 2010, Vasquez 2011).

TABLE 5 *Type of buyer for Amazon timber during 2011*

	Buyers in urban centers (in thousand m <sup>3</sup> )							Total
	Depot	Industry	Sawmills	Furniture stores	Carpentry	Not identified	Other <sup>a</sup>	
<b>Total</b>	81.9	41.5	34.7	21.3	39.6	15.2	12.0	246
<b>%</b>	33.3	16.9	14.1	8.7	8.1	6.2	4.9	

Note: a) this group is comprised with all not associated with timber, building, food, agriculture, carpentry, industries, hardware, mining and fishing. Source: Own elaboration based on SAF, Ministry of Environment of Ecuador (2011).

TABLE 6 *Type of intermediary strategies with respect to smallholders*

Intermediary strategies	Payments
Intermediary saws and transports	<ul style="list-style-type: none"> <li>• Price of standing timber is USD 20–30 per tree</li> <li>• Partial payment in advance (30%)</li> <li>• Final payment at the end of operation (70%)</li> </ul>
Smallholder saws the timber and transports to the road side	<ul style="list-style-type: none"> <li>• Payment in advance to buy inputs (50%)</li> <li>• Payment of 50%, 15 days later</li> </ul>
Intermediary looks for a timber dealer, transporter or sawmill worker	<ul style="list-style-type: none"> <li>• He does not pay the smallholder</li> </ul>

Source: Own elaboration based on interviews conducted from May to August 2012.

The income obtained from formal operations (including income from laundered timber) is often used by middlemen to invest in new operations, this in order to keep their business running. On average, intermediaries work with two to four legal operations per year. Often, middlemen working with several operations simultaneously gives them the chance to offer better prices for timber to smallholders and have the necessary economic capacity to continuously conduct legal logging operations. Middlemen who engage in multiple operations simultaneously achieve greater flexibility to meet the demands of final buyers more rapidly, and obtain greater access to authorities in charge of approving management plans, which increases their returns of investment over time. It also increases the possibilities to pay bribes.

## DISCUSSION

We have argued above that a significant gap in the literature is the influence that regulations have on the functioning of the timber markets, and how is that the interactions established between smallholders and middlemen, shaped by the way in which timber operations are organized, tend to effect on the resultant income distribution. The analysis that we undertake shed some light to this discussion based on the Ecuadorian Amazon case where still timber supply originates in smallholder lands, and there is an active network on middlemen that supply timber to the construction and furniture industry in the cities.

The findings suggest that timber is not the main economic activity of smallholders, yet it contributes with important cash income to the household economy in the area under study in the Ecuadorian Amazon, with differences across the two sites. There is important income diversification in both provinces, both in colonist and indigenous households. Although work outside the smallholding is the main source of income, the income generated by the agricultural sector is considered the main strategy used in many households. Forest income represents, on average, 16% of total household income in both provinces, and it contributes mainly to meet short-term cash needs, thus creating liquidity for the family economy. The factors that positively affect the dependence on forest income are likely associated with the possession of a chain-saws, and distance to the markets, among others. However, the possibility for a household to obtain an income outside of the farm is negatively associated with forest incomes. This entails that to the extent that the households have opportunities to draw incomes from the agriculture or off-farm employments, they will have less interest to harvest their timber. Other authors have documented similar trends (see Angelsen *et al.* 2014, Barham *et al.* 1999, Mamo *et al.* 2007, Medjibe and Putz 2012).

In Ecuador, the main factor that prevents the formalization of timber harvesting operations is the inability of farmers to cover not only the costs for requesting the legal permits but also to get access to the capital necessary for undertaking the extraction, this issue was already highlighted by Brown *et al.*

(2009). In this sense, not having to follow a forest management plan gives smallholders enough flexibility to decide about what species to log as well as the harvesting volumes, which remain at relatively low levels in comparison to formal operations. This allows smallholders to better manage their forest resources in the long term and even allow for the growth of trees inside their property, chiefly fast growing species (see Erazo *et al.* 2014, Sears *et al.* 2014). Nonetheless, when smallholders decide to undertake legal operations, they have to depend on middlemen who tend to cut higher volumes given the fact that they can afford to undertake larger operations. In the latter cases, smallholders benefit less in relative terms per unit of timber harvested, but obtain higher absolute profits since operations are bigger and the more valuable species tend to be selected. This findings were also documented in the analysis of selected species by Kautz (2003) and Gatter and Romero (2005) in the southern Amazon and Schlotzhauer (2012) in the northern Amazon.

In this context, smallholders choose to extract, outside of the law, small volumes of hard timber or larger ones of soft timber when facing short-term needs for cash, in most of the cases using their own family labor. Therefore, low prices for timber or raw materials, in particular softwood species of low economic value, are compensated by family labor. This explains why middlemen conducting formal harvesting operations are not interested in harvesting softwood species and prefer, instead, to purchase softwood in the market from operations undertaken by smallholders. A similar conclusions was reached by others (see Sierra 2001, Southgate *et al.* 2000). While middlemen prefer to undertake larger operations, their size also depends on middlemen's capacity to access financial resources and the volume of the purchase orders placed by final buyers. In several cases, relatively rigid orders—in terms of species, volumes and delivery times—make it difficult for intermediaries to fulfill these orders in time, and thus they resort to illegal timber harvesting from areas with no plans and smallholders' supplies. Intermediaries use different means to legalize the timber they sell in the cities taking advantage of legal loopholes, weak enforcement, and bribing corrupt officials. This type of procedure seems to be normal rule in many countries dealing with high value timber (see Pacheco *et al.* 2008, Putzel *et al.* 2012, Sears and Pinedo-Vasquez 2011).

The timber supply meets a growing demand in the cities from the construction sector, furniture industry, as well as small-scale carpentries and flooring craft sales. In practice, it is the demand for timber in the cities that to a large extent defines the rhythm and intensity of the supply, which is put in motion by a robust intermediation network. These networks in many cases are fully informal since the buyers are not part of the control system or they do not have the means to participate in chains of custody, especially when sourcing from small-scale operations through middlemen. Overall, buyers in the end markets do not have any link with timber extraction, placing all the responsibility about species sustainability on the suppliers and middlemen. The role played by demand-side actors has been analyzed by previous

studies in Ecuador (see Middleton 2007, Sierra 2001, Wunder 2005). Evidently, final buyers may have a role to play for supporting legal supply chains, with implications for more sustainable timber extraction.

## CONCLUSIONS

This paper explores, first, the importance that small-scale timber extractions have for the livelihoods of colonists and indigenous smallholders. Second, it looks at how different types of timber operations, whether formal and informal, tend to influence on benefit sharing from timber extraction. Finally, it assesses the role that urban demand has on putting in motion an intermediation network that makes use of both legal and illegal means to supply the timber requested by final buyers. Our findings suggest that timber contribution to rural households' income is relatively small and makes part of more diversified livelihood portfolios, yet it contributes with cash required to meet urgent family needs. Most smallholders tend to carry out operations outside of the law. In those cases, in absolute terms smallholders tend to obtain relatively lower benefits when compared to formal operations, which is mainly explained by the scale of the operation and the type of timber that is harvested. Nonetheless, smallholders obtain a higher benefit in relative terms when they conduct their own operations due to a large use of family labor.

In a broader sense, smallholder benefits from timber extraction depend on the way in which the timber operations are organized, on the species harvested and connections to the intermediation networks rather than on whether the operations comply or not with the existing forestry regulations. The evidence suggests that larger timber extraction operations, which are often conducted by middlemen, are undertaken with approved plans, while smaller scale ones, which are undertaken by smallholders, remain outside of the law and focus on soft species. In turn, middlemen adopt flexible strategies by sourcing hard and semi-hard timber species from legal operations, often financed by themselves, while also buying timber, mainly softwood from informal small-scale operations, in order to meet the demand from buyers in the cities. This due to the fact that middlemen have to respond quickly to purchase orders from final buyers that specify volumes and species under relatively rigid time frames. Nothing suggest that informal timber supply will decrease in a context of increasing urban demand with vigorous market networks.

For smallholders, there is an important gap between what they can produce on their own outside of the law, and what they can produce formally with the help of a middlemen. This suggests that, in order to achieve legality, it is also important to meet the needs of capital, technological know-how and market access with final buyers. The role of middlemen as capital providers for timber harvesting shows that smallholders lack access to finance that hinders them to undertake large-volume harvesting operations under legally approved plans. Our data suggests that smallholders tend to earn more money through engaging in legal operations as long as they

participate in the sawing and harvest hardwood species, but that also may likely lead to exhausting their forests more rapidly. The ecological impacts of small-scale logging is not addressed in this paper, and deserves more research; however, evidence suggest that hardwood species are logged more intensively which may lead to forest degradation. We argue that species and participation in the harvesting are far more important than legality to smallholders' income.

In order to overcome the difficulties faced by smallholders, both colonists and indigenous, additional efforts are needed to adjust regulations to better adapt them to the needs and interests of these actors. In addition, it is necessary to rethink the legal system for small-scale harvesting operations, possibly giving privilege to long-term extractions of lower volumes in native forests and agroforestry systems; since this seems to be the option that better suits smallholders' preferences. The regulatory frameworks should have the flexibility to support different smallholder's strategies for using their forests, so to gradually adapt their practices and strategies in ways that allow them to make an income from timber extraction while at the same time preserving and restoring their forests. However, policies have to look beyond the supply side, and placing greater attention to make more transparent the market networks that shape smallholders' decision making, and propose more collaborative solutions with end-market buyers.

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