The world's largest private sector?

Recognising the cumulative economic value of small-scale forest and farm producers

Michael Verdone

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Foreword

While the global community moves beyond setting targets and commitments to actions in support of the Sustainable Development Goals, climate change mitigation and adaptation strategies for Nationally Determined Contributions, Aichi Biodiversity Targets, and national poverty reduction and development strategies, there is a growing need to further understand the role of key stakeholders in delivering those actions on the ground. With growing pressure on land availability, we must build more integrated and inclusive social, environmental and economic production models that will help meet the demands of the forest and food sectors.

As international policy forums, governments and development aid agencies promote the engagement of the private sector in increasing forest and farm production, there is tremendous opportunity to strengthen the potential of an enormous group of small-scale land managers, literally millions of forest and farm producers. Fortunately, these less visible actors are getting better organised and the momentum is growing from major companies, governments and other institutions to build systems based on the productive role of smallholders, local communities and Indigenous Peoples, and small and medium scale entrepreneurs. This shift stems from a growing understanding of the collective global value that these groups add in enhanced land management and forest and food production, income generation in rural economies – key contributions for delivering national and global targets and commitments.

Because of their small scale as individual producers or entrepreneurs and the fact that much of their economic activity takes place in the informal sector, there is insufficient information or awareness about their aggregate numbers. This publication brings renewed attention to the collective value and roles of Indigenous Peoples, local communities, family farmers and smallholders who should not be excluded as we develop policies and strategies for growth. The sheer number of people that comprise this group, their collective footprint and the economic value of their production should be harnessed as one of the main contributions to development – perhaps even as the world's largest private sector.

Both public and private investment should respond to the type of analysis highlighted in this publication. This work is an important start that makes some informed estimates. More data is needed to refine the analysis to highlight the value of such groups. To unlock this potential, we must put in place enabling conditions that strengthen capacity to deliver more inclusive models of growth, secure tenure and rights, and generate incentives for such land management systems. Programmes such as the Forest and Farm Facility, who spearheaded this analysis, will be critical in increasing support for the recognition of this powerful engine of growth and landscape viability.

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Executive summary

More than 1.5 billion smallholders throughout the world depend on forest landscapes to produce food, fuel, timber and non-wood forest products to meet their subsistence needs and generate cash income. Despite the large number of smallholders and the large collective scale of their production, policy makers have overlooked smallholders' role as a powerful economic engine.

The analysis conducted as part of this report was done as part of a scoping exercise for an expert meeting on the collective scale of smallholder forest and farm producers. The meeting was held at the FAO's headquarters in Rome, Italy in June 2017. The objective of the analysis was to estimate the economic value produced by smallholders globally and identify gaps in data that prevent a more complete accounting of smallholder production value. The output from the analysis helped assist experts from AgriCord, the Forest and Farm Facility (FFF), FAO, IFRI/FLARE, IIED, IUCN, RRI, US Forest Service and The World Bank to explore collaboration on this topic, and discusses approaches to more effectively compile evidence and ultimately empower small producers.

New evidence presented in this report suggests that the value of smallholder production exceeds that of the world's largest companies, making smallholder production collectively the world's largest private sector. The gross annual value of smallholder crop, fuelwood and charcoal, timber and non-wood forest products production is between US$ 869 billion and US$ 1.29 trillion in 2017 dollars. Additional economic multiplier effects and non-market values associated with smallholder production could increase these figures ten-fold or more. Smallholder-led crop production alone rivals the agricultural output of countries such as China. Smallholder produced wood energy generates more value than several of the world's largest oil and gas companies.

The findings of this report aim to:

- Alert land-use decision-makers to the existing value of smallholder production;
- Encourage greater efforts to secure, invest in, and add value to that production;
- Promote devolution of control downwards to local levels where context-specific issues are most efficiently solved, and;
- Protect smallholder landscapes from incursions by agro-industrial models whose large unit value can exceed the collective value of multiple smallholder producers.

Acknowledgements

List of abbreviations

CIFOR	Center for International Forestry Research
FAO	Food and Agriculture Organization of the United Nations
FAOSTAT	Food and Agriculture Organization Corporate Statistical Database
FFF	Forest and Farm Facility
FLARE	Forests & Livelihoods: Assessment, Research, Engagement (An IFRI Community of Practice)
GNI	gross national income
IFRI	International Forestry Resources and Institutions
IIED	International Institute for Environment and Development
ITTO	International Tropical Timber Organization
IUCN	International Union for Conservation of Nature
NWFPs	non-wood forest products
RRI	Rights and Resources Initiative
PEN	Poverty Environment Network
PPP	purchasing power parity
SDGs	Sustainable Development Goals

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Introduction

More than 1.5 billion smallholders throughout the world depend on forest and farm landscapes to produce food, fuel, timber and non-wood forest products (NWFPs) to meet their subsistence needs and generate cash income (Angelsen, et al., 2014; Mayers, et al., 2016). Despite representing nearly a quarter of the world's population, most of the economic value produced by these smallholders is unaccounted for and unacknowledged by decision-makers, donors and other interested parties because of its small unit scale and unrecorded nature. As a result, the collective scale and economic importance of the smallholder farm and forest sectors are largely unknown. This is problematic because it is from the smallholder farm and forest sectors that the poor derive most of their food security and income (CIFOR, 2014).

Without valuing what smallholders produce, policy makers cannot gain insight into or appreciate the magnitude of smallholder farm and forest production, its role in the national economy and its potential contribution to the Sustainable Development Goals (SDGs), climate adaptation and mitigation, and local development outcomes. This information is also important for helping policy makers assess the impacts of large-scale, agro-industrial investments, landscape degradation and climate change on smallholder production systems (Boussard, 1992).

A greater understanding of the value of smallholder production could help policy makers design policies that conserve the ability of forest and farm landscapes to continue supporting the livelihoods of smallholder households (Vedeld, et al., 2004). Increasing investment in smallholder production systems also has the potential to increase the growth rate in the broader economy and promote pro-poor growth (Deininger & Byerlee, 2011). When the value that smallholders create is unaccounted for, the benefits of investing in smallholder-controlled forest and farm landscapes are undervalued (Mayers, et al., 2016).

In this paper we use available data to estimate the value created by smallholders through farm and forest production to highlight the size of their direct economic impact on the global economy. Our analysis estimates the value of crop, timber, fuelwood/charcoal and NWFPs produced by the global population of smallholders. We use the estimates to accomplish three objectives. First, we show that smallholder farm and forest production creates significant economic value across the world. Second, we highlight the important role natural resources play in the smallholder economy. Third, we demonstrate the economic importance of the smallholder farm and forest economy by comparing the value of its output to the value produced by corporate enterprises in the farm and forest sectors.

1. Definitions and methods

Smallholders

In a global sense, smallholders represent a diverse group of men, women and children. A precise definition is elusive because smallholders come from unique environmental, social and economic situations and represent a range of socio-economic backgrounds. Still, if there is one defining trait of smallholders, it is their connection to scarcity. Smallholders are primarily dependent on domestic production using scarce local resources to meet their livelihood needs. Smallholders also rely on relatively small (i.e. scarce) landholdings, family labour and limited technology. They are sometimes defined by the amount of land they control (e.g. see Hoare, 2015), although the size of landholdings they control can vary widely across countries and regions. Ultimately, it is the scarcity of resources available to smallholders that defines them as a group.

Methods

Amidst the limitations explained below, our approach makes the best use of available information on smallholders to estimate the annual value of their forest and farm production. We use simple 'back-of-the-envelope' calculations to derive estimates of the gross product of production for:

- crops;
- fuelwood and charcoal;
- timber production; and
- NWFPs.

We reviewed previous work on smallholders and gathered data from various sources to estimate the gross product of each good above. The gross product of smallholder-led production can be estimated with population and valuation information and/or production and valuation information. We reviewed previous work and gathered data that allowed us to make our calculations. We focused on finding information on the number of smallholders involved in forest and farm production systems, the total output they produce and the financial values associated with

that production. We used a range of parameters in the available data to estimate high and low values to reflect the high degree of uncertainty in the calculations. This also allowed us to observe how the estimates responded to changes in assumptions regarding key parameter values, which in turn provided insight on where researchers should focus their efforts to improve the accuracy of future estimates.

The gross product metric refers to a monetary measure of the direct economic impact that producers and consumers have on the economy. Gross product measures the amount of market activity created through the production and trade associated with a particular good or service. It has been argued (Macqueen, 2013) that gross product underestimates the value of smallholder production because smallholders also receive various categories of non-market values from forest and farm landscapes (measured on scales that are non-commensurate with market values) including:

- The appreciation, stewardship and/or refinement of natural and cultural beauty;
- The formation and maintenance of relationships with humans and/or other living species;
- The sense of security intrinsic to the natural and social ordering of events;
- The personal fulfilment that comes from using one's natural abilities in one's environment; and
- A sense of purpose and meaning derived from the world around us.

Smallholder forest and farm producers perceive many such non-market values, which are often partially or entirely lost in industrialised, corporate landscapes. Gross product does not reflect non-market values (for which marker prices do not exist) and as a result, it does not reflect the total economic value of forest landscapes, which is likely to be substantially larger. While outside the scope of this report, Angelsen, et al. (2011) give a broader discussion of values that may be of interest to readers.

2. Observations from the literature review

We began the study with a survey of the literature to see if any gross product estimates existed in the smallholder literature. We also examined previous studies to see how they had constructed their estimates so we could determine which estimation approaches would be best for this study. Previous work on smallholder production has typically focused on estimating:

- Populations: the number of people who rely on a specific type of land use or good (e.g. food, charcoal/fuelwood, timber, NWFPs);
- Production: the quantity of production of different goods and services produced by smallholders (e.g. crops, fuelwood, and timber); and
- Values: the value associated with the production and consumption of goods and services by smallholders.

The literature review also showed that valuing smallholder production is difficult because smallholders produce a rich assortment of goods from forest and farm landscapes, but the informal nature of their production keeps the value of this production hidden from most observers (Cavendish, 1999). Smallholders work in home gardens and large agricultural plots to grow food and non-food crops for subsistence consumption and they sell the excess products at local markets to generate modest cash incomes. Smallholders also rely on forest and tree resources to produce a variety of goods, which studies have shown can provide an average of 57% of a smallholder household's average annual income of US$ 1,852 (Angelsen, et al., 2014).[1]

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1. This estimate comes from the Poverty Environment Network (PEN) field study research project that estimated the environmental income of 8,000 households in 24 developing countries. Many of the field sites used in the study are from areas of high forest cover and not automatically representative of every smallholder in the world due to significant inter-site variability.

We also looked at side-by-side comparisons of previous gross product estimates discovered during our literature review. They showed a wide range of values (Table 1).

- Crop production: global estimates suggest smallholders produce anywhere from 53% to 80% of the world's crop revenue each year;
- Fuelwood and charcoal: FAO (2014) estimates that the gross product of fuelwood and charcoal production is US$ 33 billion per year;
- Timber: estimates of the value of informal wood production range from a high of US$ 17 billion per year to a low of US$ 159 million; and
- NWFPs: estimates suggest that smallholders produce between US$ 21 billion and US$ 88 billion of NWFPs annually.

The wide range in values demonstrates the significant amount of uncertainty that pervades global estimates of smallholders' gross product. There are several explanations for the wide ranges. Many of the estimates rely on different data sources, make different assumptions and use different subsets of goods for their calculations. Determining which estimates are the most reliable is difficult because researchers know so little about the scale, value and diversity of smallholder production systems that there is no agreed point of reference. Still, it is feasible to develop reasonable estimates of the likely range and magnitude of gross product created by smallholders. If estimates of smallholders' gross product created with different methods, data sources and assumptions are of similar magnitude, it suggests that the approximate size of smallholder's gross product is known within an order of magnitude.

The remainder of this report develops new estimates of the annual gross product produced by smallholders. For each good we begin by reviewing the data sources that are available for constructing an estimate of gross product. Next, we discuss the data contained in each source and its relative strengths and weaknesses for our application. We describe the assumptions that are required to make our analysis tractable given the limitations of the data, and then we present our estimates of gross product for each good. The final section of the report brings all of the estimates together to estimate the total gross product of smallholder production.

Table 1. Value estimates of smallholder produced goods from forest and farm landscapes (values in US$)

Good	Annual gross value	Source	Notes
Crop production	80% of gross annual production	FAO 2014	No explicit value is given
	53% of gross annual production	Graeub et al. 2015	No explicit value is given
Charcoal and fuelwood production	$33 billion	FAO SOFO 2012	
Informal timber production	$159 million	FAO SOFO 2012	Estimate reflects the value of wood produced for construction materials
	$5 billion	Seneca Creek Associates and Wood Resources International	Estimate reflects value of illegal timber production
	$17 billion	Hoare 2015	Estimate reflects value of illegal timber production
Non-timber forest products production	$21 billion	FAO 2010	Estimate is for India only
	$27 billion	ITTO 2007	
	$88 billion	FAO SOFO 2012	Based on a. medicinal, b. animal-based, and c. plant based NWFPs

Source: The table was created by BBC Research and Consulting. Specific sources of information are given in the table.

3. Smallholder agricultural production

Available data sources

Previous studies of smallholder agricultural production have focused on estimating the number of smallholder farming households and the size of the land area farmed by those households. FAO (2014) and Graeub, et al. (2015) both estimated the number of smallholder-farming households worldwide. FAO (2014) estimated that there are 500 million smallholder-farming households worldwide and that they account for 80% of the world's annual food supply. Graeub, et al. (2015) estimated that agriculture employs more than 475 million family and smallholder households across the world (Table 2). Using data from the 2010 Census of Agriculture, Graeub, et al. (2015) found that family farms,[2] including smallholder-owned farms, constitute 98% of all farms worldwide, control 53% of agricultural land (approximately 1 billion ha), and produce 53% of the world's annual food supply.

The relative consistency in the findings from the two studies (i.e. that there are approximately 475 to 500 million smallholder-farming households across the world), despite our reliance on different data sources and sample sizes, adds credibility to the estimates.

Data on the gross value of farmland from different world regions shows that the average value of a hectare of farmland varies from a low of US\$ 619 in Africa to a high of US\$ 1,271 in Asia (Table 3). The estimates come from the FAOSTAT database and do not include the value of livestock. We used the database to derive the estimates in Table 3 by calculating the average gross product per hectare for each world region and each crop type from 2006 to 2013. We believe this approach is appropriate as Graeub, et al. (2015) assumed that the productivity of family farms, including smallholder-managed farms, is equal to the country-wide average. We believe this

Table 2. Family farms, including smallholder farms, and farm area across the world

World region	Number of family farms (including smallholder farms)	Total area of arable land (Ha)	Area of arable land managed by family farms (including smallholder farms) (Ha)	Area of arable land managed by family farms (including smallholder farms) as % of total	Average farm size (Ha)
Africa	25,907,157	78,546,149	52,423,668	67%	2
North and Central America	9,529,825	502,453,727	339,515,929	68%	36
South America	9,188,288	704,987,755	128,574,890	18%	14
Asia	416,558,949	426,329,943	363,234,685	85%	1
Europe	13,683,053	182,756,398	125,515,339	69%	9
Oceania	200,152	11,847,966	242,541	2%	1
World	475,067,424	1,906,921,938	1,009,507,052	53%	10

Source: Graeub, et al. (2015)

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2. There is no universal definition of what constitutes a family farm. Still, most definitions are based on farms that use family labour and are generally managed by a single family. In some cases, definitions limit the size of the family farm to a specific number of hectares and farms over this limit, even if a single family owns them, are not considered to be family farms. Other definitions set income limits for what can be considered a family farm. For a more detailed discussion, see Lowder, et al. (2016).

Table 3. Average gross product of agricultural land in four world regions (values in US$)

World region	Average annual gross product (Ha)
Africa	$619
Asia	$1,271
Central America	$1,269
South America	$1,105

Note: The figures in the table were constructed by calculating the average total gross product of agricultural production for each world region and dividing it by the average total number of hectares harvested in each world region using data from 2006 to 2013. Estimates are in 2017 US dollars. Source: FAOSTAT (2017).

assumption is appropriate as the literature has shown that smaller farms can be as productive as, or even more productive than, on a per hectare basis, larger farms (Barrett, et al., 2010).

Limitation of data sources

Graeub, et al. (2015) estimated the global number of family farms by combining data for 98 countries and 7 territories. Using family farm data as a proxy for smallholder farm data is a limitation of this study because family farms can be quite large depending on how they are defined and in which part of the world they are located. In Australia, the average farm size is 3,000 ha, while in China and parts of sub-Saharan Africa farms may be less than 1 ha in size (Lowder, et al., 2016). Graeub, et al. (2015) relied on a tiered estimation system that first collated data from countries that directly report the number of family farms. The subsequent approaches relied on decreasingly precise methods to estimate family farm numbers. The first approach used quantitative proxies to measure family farm ownership. The second approach used a definition of smallholders as a substitute for family farms, and the last approach relied on farm size as a single measure of family farm ownership. As a result, the estimates provided in Graeub, et al. (2015), like other studies that estimate subsets of global populations, are order of magnitude estimates of the smallholder population. FAO's (2014) estimate is also imprecise because it relied on a sample of only 30 countries and used land-size proxies to estimate the number of family farms. Uncertainty over the number of smallholder-controlled hectares creates uncertainty in the gross product estimates due to the multiplicative relationship between the two parameters.

The data from FAOSTAT database represent the gross prices received by producers for crops sold at the farm gate (FAOSTAT, 2017). According to FAO, there are differences in the way this data is collected by

each country due to differences in data collection infrastructure and capacity. As a result, the accuracy and quality of the data varies across regions and may even be incomplete for some areas. Moreover, the price concept used by each country may be inconsistently applied and the point of transaction used to capture the price of each good may also vary. If prices are measured on international markets, they are likely to be higher than farm-gate prices and therefore bias the gross value estimates upwards. Bias may also be introduced by aggregating different crop varieties under the same commodity definition.

Approach used to estimate gross product

To estimate the gross product of annual smallholder crop production, we multiply the average gross product per hectare from Table 3 by the number of hectares managed by family farms, including smallholder-managed farms, in each region as reported by Graueb, et al. (2015) in Table 2. As an alternative method, we simply multiplied the average total gross product of agricultural production in each world region between 2006 and 2013 by the fraction of food production attributed to smallholder farmers (53%) as reported by Graueb, et al. (2015).

Estimates of smallholder gross product

Our calculations suggest that smallholder farmers produce between US$ 768 and US$ 947 billion worth of crops each year. The crop value produced by smallholder farmers is sizeable and economically significant even at a global scale. If smallholder farmers formed their own country, they would produce as much value as the world's largest food producer: China. In 2016, China produced approximately US$ 964 billion of agricultural output, which is approximately equal to the upper bound estimate of the crop value produced by smallholder farmers (CIA, 2016). If smallholder farmers formed their own corporation, they would produce more value per year than the 10 largest food companies combined. The largest food companies in the world are multinational corporations that control large pieces of the global food supply chain, including production, processing and distribution (Oxfam, 2013). The two largest food companies in the world, Nestle and Unilever, generated a gross output of approximately US$ 150 billion in 2016. The 10 largest food companies in the world produced a combined gross output of approximately US$ 378 billion in 2016, which is 50% to 60% less than our estimates of the gross value produced by smallholder farmers.

4. Fuelwood and charcoal

Available data sources

Previous estimates of smallholder-based fuelwood and charcoal production, value and use have focused on the number of people who rely on fuelwood and charcoal, and the amount they spend on the energy source each month as measured by market prices. FAO (2014) estimated that more than 2.4 billion people throughout the world are dependent on fuelwood and charcoal to meet some or all of their energy needs for cooking. The same study used country-level fuelwood and charcoal production data to estimate the income generated from the production and sale of charcoal and fuelwood (Table 4). The study calculated that the annual value of charcoal and fuelwood production and sales equalled US$ 36.76 billion in 2017. The estimate implies that each of the 2.4 billion people who rely on charcoal and fuelwood spend US$ 1.28 per month on these fuel sources. The implied monthly expenditure is extremely low when it is interpreted in the context of fuelwood being the sole energy source for most smallholders.

In contrast to FAO's estimates, a 2010 study from The World Bank examined monthly rural household expenditure on biomass energy and found that the average household spent US$ 10.61 per month on fuelwood and charcoal (Table 5). The study used nationally administered household surveys in nine countries to investigate the share of household expenditures devoted to energy consumption at different income levels. If we assume that an average household contains four people, the World Bank study suggests the average monthly fuelwood and charcoal expenditure for an individual was US$ 2.65, which is substantially larger than the US$ 1.28 produced by FAO estimate. In the World Bank study, average per capita monthly expenditures ranged from a low of US$ 2.23 for high-income households to a high of US$ 3.19 for households in the second lowest income quintile.

An alternative way to value fuelwood and charcoal production is to consider the amount of time people spend in collecting it. FAO (2014) estimated that each year 115 million people produce charcoal and fuelwood on a full-time basis. The estimate is based on a review of the literature, which showed that the average amount of time required to collect one cubic meter of fuelwood varies from 106 hours in Latin America and the Caribbean to 110 hours and 139 hours in Africa and Asia/Oceania, respectively. The estimates were multiplied by the annual volume of fuelwood and charcoal production reported in the FAOSTAT database to calculate the total years of labour required to meet the observed level of production.

Since time has an opportunity cost, the time people spend collecting fuelwood/making charcoal can be multiplied by the opportunity cost of time as one way of estimating gross product. The opportunity cost of the time used to collect fuelwood/produce charcoal could be approximated with a measure of gross national income (GNI) per capita. GNI per capita measures the total annual income of a country divided by the country's population. By definition, it is a measure of the average annual income of a country's citizens and is therefore one way to represent the opportunity cost of time. The World Bank reported GNI per capita for low, lower-middle, upper-middle, and high-income countries (Table 6). In low-income countries, the GNI per capita is US$ 1,682 per year.

Table 4. Gross product of global fuelwood and charcoal production (values in billions US$)

Region	Woodfuel	Charcoal	Total
Africa	$4.11	$11.75	$15.86
Asia and Oceania	$4.94	$6.00	$10.93
Latin America and Caribbean	$4.34	$5.62	$9.96
World	**$13.39**	**$23.37**	**$36.76**

Note: Estimates are in 2017 US dollars.
Source: FAO (2014).

Table 5. Average monthly total household expenditures on fuelwood and charcoal by income quintile (values in US$)

Country	Income quintile					Average
	1	2	3	4	5	
Bangladesh	$7.91	$9.89	$11.30	$12.71	$14.41	
Cambodia	$10.17	$12.43	$13.56	$14.69	$15.82	
India	$11.30	$12.71	$13.28	$12.71	$10.17	
Indonesia	$4.52	$4.52	$4.24	$3.39	$4.24	
Kenya	$1.98	$3.39	$4.52	$6.78	$8.76	
Pakistan	$13.56	$15.82	$16.95	$16.39	$19.21	
Thailand	$4.52	$3.39	$2.26	$1.13	$0.00	
Uganda	$7.91	$9.04	$11.02	$11.30	$12.15	
Vietnam	$9.89	$11.30	$9.89	$9.32	$7.91	
Average HH Expenditure	**$9.01**	**$10.36**	**$10.92**	**$11.10**	**$11.63**	
Average PP Expenditure	**$2.25**	**$2.59**	**$2.73**	**$2.78**	**$2.91**	**$2.65**

Source: The World Bank (2010).

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The GNI per capita of lower middle-income countries is US$ 6,729 per person. In upper middle and high-income countries, GNI per capita is US$ 16,408 and US$ 48,442, respectively. These figures represent the average cost of employing one person in a country of a given income level for a single year.

FAO's (2014) estimate of the time used to collect fuelwood and produce charcoal applies to the entire world. It is not disaggregated to any sub-regions. In order to use it, we estimated the average opportunity cost of a globally representative smallholder. We constructed a weighted average of per capita GNI for low and lower middle-income countries by giving the GNI per capita for low-income countries a weight of 0.8 and giving lower middle-income countries a weight of 0.2. The average per capita GNI estimated with this method was US$ 2,691 per year in 2017 (Table 6).

Limitation of data sources

Using data on household expenditures on fuelwood and charcoal to estimate gross product could create a positive bias in the calculation because prices paid by end users may be higher than the prices smallholders place on production and consumption. Using the data from the World Bank (2010) and FAO (2014) to estimate gross product also requires two strong assumptions.

Table 6. Per capita gross national income at purchasing power parity by country income level (values in US$)

World Region	Per Capita GNI PPP
Low income	$1,682
Lower middle income	$6,729
Upper middle income	$16,408
High income	$48,442
Weighted average of low and lower-middle income	**$2,691**

Note: The weighted average per capita GNI income of low and lower-middle income countries was calculated by assigning a weight of 0.8 to low income GNI and 0.2 to lower-middle income GNI.
Source: The World Bank (2015).

First, we must assume that the 2.4 billion people throughout the world who are dependent on fuelwood and charcoal to meet some or all of their energy needs for cooking are all smallholders. Second, we assume that the value smallholders place on the effort they exert to produce fuelwood and charcoal is adequately reflected in market prices. As rural smallholders

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collect fuelwood from their surroundings, they avoid monetary expenditure which leads to reduced valuations in the literature. In fact, the estimates from both studies may underestimate the true household expenditures on fuelwood and charcoal because they reflect monetary expenditures. They do not reflect the significant investments of time and energy that smallholders exert to collect fuelwood in lieu of paying market prices.

FAO data accounting for the time required to collect fuelwood and produce charcoal is adequate in reflecting the investments of time and energy that smallholders exert to collect fuelwood. However, the data provide point estimates without confidence intervals so they should be treated as if they contain significant uncertainty. The GNI data representing the opportunity cost of time may also be overestimating opportunity cost as smallholders may not be as connected to developed markets and therefore would not be expected to have high opportunity costs.

Approach used to estimate gross product

To estimate the gross product of smallholder-based fuelwood and charcoal production, we multiply the number of people who use fuelwood and charcoal to meet all or part of their energy demands (2.4 billion people) by the average per-capita monthly expenditure as reported by the World Bank (2010)

(Table 5). In order to estimate a range of values we also use an alternative method. We multiply the total person-years required to produce the world's annual supply of charcoal and fuelwood as estimated by FAO (2014) by an estimate of the opportunity cost of time as shown in Table 6.

Estimates of smallholder gross product

The results suggest that smallholders produce between US$ 76 and US$ 309 billion worth of charcoal and fuelwood each year. The world's largest corporate energy producers are oil and gas companies such as Exxon Mobil and Royal Dutch Shell. In 2016, Exxon Mobil and Royal Dutch Shell both created gross revenues of US$ 219 and US$ 240 billion, respectively. This means the upper bound gross value of fuelwood and charcoal produced by smallholders is more than US$ 69 billion larger than the gross revenue of either company. Even the lower-bound estimate of the gross value of fuelwood and charcoal produced by smallholders is larger than the gross revenue of energy companies such as Petronas, the oil and gas company owned by the government of Malaysia and the most profitable company in Asia. In 2016, Petronas generated gross revenues of US$ 63 billion, which is US$ 13 billion less than the lower-bound estimate of US$ 76 billion in gross value produced by smallholders involved in charcoal and fuelwood production.

5. Timber production

Available data sources

Estimating the gross product of smallholder's timber production is difficult. The informal nature of transactions for the production, sale, and consumption of smallholder-produced timber reveals little information. The small and casual nature of transactions in the informal economy prevents the transactions' price and quantity data from being reported in official accounts of economic activity. As a result, the geographic coverage of official measurements of smallholder timber production and value is patchy and limited to countries with well-developed forest management institutions. It is possible to piece together data from each country that tracks smallholder production, but it would be time consuming and would contain very limited information from less developed countries.

To overcome this barrier with global data, the size of the informal timber market has to be estimated as a percentage of the formal timber market's size. Data on the size of the formal timber market suggests that the sector produces US$ 13.39 billion in output each year.[3] Previous studies have shown that the size of the informal timber market ranges from 10% to 90% of the formal market's size across different countries (Table 7). A global study estimated that informal timber production accounts for 15% to 30% of the formal timber market size (Nellemann and Interpol Environmental Crime Programme, 2012).

The studies in Table 7 show that the ranges of the informal timber markets size as a percentage of the formal markets size are moderately consistent within countries. As an example, the estimates from Cameroon suggest that the informal market is

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3. The estimates were derived by building a database of the gross product of timber export values from FAOSTAT from 2006 to 2015. The average values were calculated with the sample from 2006 to 2015 for the timber products that were most likely to give smallholders opportunities to sell their informally harvested timber.

Table 7. Estimated share of informal timber production as a percentage of the total value of the formal market

Country	Seneca Creek Associates and Wood Resources Internaitonal (2004)	World Bank (2006)	Hoare (2015)	Nellemann & INTERPOL (2012)
Bolivia	80%	80%		
Brazil	20 to 47%	20 to 47%	50%	
Cambodia	90%	90%		
Cameroon	50%	50%	65%	
Colombia		42%		
Democratic Republic of the Congo	70%		90%	
Ecuador	50 to 70%	70%		
Gabon	34 to 60%	70%		
Ghana	70 to 80%		70%	
Indonesia	45%	70 to 80%	60%	
Lao PDR	80%	45%	80%	
Liberia	35%			
Malaysia	50%	35%	35%	
Myanmar	70%	50%		
Papua New Guinea	80 to 90%	70%	70%	
Peru		80%		
Republic of Congo	20 to 50%		70%	
Russia	40%	10 to 50%		
Thailand	20 to 40%	40%		
Viet Nam		20 to 40%		
World				**15 to 30%**

Source: Hoare (2015).

50% to 60% of the formal markets size. Estimates from Malaysia vary between 35% and 50%. The estimates from large countries such as Brazil, where illegal deforestation is a serious problem, show less agreement and hint at greater uncertainty about the true size of the informal timber market. However, the estimates presented in this paper only consider the value of smallholder production, not its legality.

Limitation of data sources

The major limitation of the data used to estimate the value of smallholders' timber production is that it measures the economic size of the formal timber sector and not the size of the informal timber sector. To overcome this limitation, the size of the informal timber sector has to be estimated as a proportion of

the formal timber sector's size. This approximation may not accurately capture the nature of informal timber production when the production systems and markets used by informal and formal timber produces diverge. As the information in Table 8 shows, the informal timber sector's size as a proportion of the formal timber market's size can range widely between countries. This makes it difficult to know which number to use to represent the informal timber sector's share of global timber output. The data also reveals almost no information about the nature of smallholder timber production and transactions. It is impossible to know from the data how much timber smallholders produce, how much they consume and how much they sell. The data provide little insight about the nature of the informal timber market beyond helping to estimate its size.

Approach used to estimate gross product

We estimate the size of the smallholder timber sector by assuming that its size is proportional to the size of the formal timber sector. We use the proportions shown in Table 7 to provide a range of possible values. To provide a high and a low scenario, we use the lowest and highest global estimates from Hoare (2015).

Estimates of smallholder gross product

Smallholders engaged in timber production are producing US$ 2 to US$ 4 billion of worth of gross product each year, although this is substantially less than many large timber companies. Smallholders, especially in North America and Europe, are also engaged in formal timber production through cooperatives such as Metsallito cooperative and Södra, which generated US$ 598 and US$ 741 million, respectively, from the sale of wood products in 2016 (Metsä Group, 2016; Södra, 2016). The five largest forest, paper and packaging companies produced combined gross revenue of US$ 91 billion in 2012 (PwC, 2012). The largest, International Paper, had gross revenues of approximately US$ 28 billion, which is larger than the combined gross output produced by smallholders, but the nature of this estimate is highly uncertain and may not reflect the true value of smallholder-led timber production.

6. Non-wood forest products

Available data sources

Worldwide, more than 1.5 billion people are involved in the collection, consumption and trade of NWFPs (Shanley, et al., 2015). Like the other goods discussed in this report, NWFPs are also produced informally by smallholders and as a result, production and value information is scarce, incomplete or unknown. FAO estimated that the global harvest of NWFPs was equal to US$ 18.5 billion in 2005, with the caveat that this estimate failed to account for the value of subsistence production and likely represented "only a fraction of the true total value of harvested non-wood products" (FAO, 2010). In 2011, FAO undertook a new study on the value of the forestry sector. The report determined that NWFPs comprised 5% or US$ 21 billion of the US$ 421 billion annual production value of forest products, although the report acknowledged this is likely to be an underestimate (FAO, 2012). FAO (2014) reported that the estimated income from the informal production of NWFPs is $88 billion per year, including medicinal, animal-based and plant-based NWFPs.

A separate set of studies has focused on estimating the importance of forests to household incomes. While this work has not led to estimates of the global value of NWFP production, the information may be useful for constructing such an estimate. Case studies from the tropics have shown that NWFPs in many countries make significant contributions to household incomes (Table 8). A study from central Viet Nam showed that NWFPs contributed between 4% to 22% of a household's annual income and estimates as high as 50% were reported by a study in northern Lao PDR.

If the size of smallholder income derived from forests were known, the information in Table 8 could be used to calculate the share of forest income that comes from NWFPs.

In a study conducted by Anglesen, et al. (2014), a survey of 8,000 households in tropical or sub-tropical regions of 24 developing countries found that an average of approximately 23% of forest-dependent rural household income came from forests (Table 9). Latin America had the highest household incomes observed in the survey (US$ 5,030) and African households had the lowest incomes (US$ 1,033). Households who participated in the survey received between 18% and 29% of their total annual income from forests. Unsurprisingly, the study also found that the income of poorer, forest-dependent, rural households relied more heavily on forests than the incomes of their relatively wealthier peers.

Limitation of data sources

While the Poverty Environment Network (PEN) data set is a rich source of information on the percentage of income forest-dependent households get from forests, it doesn't provide an explicit estimate of the value of NWFPs. Moreover, the value of NWFPs is arguably spread across several income categories defined in the study. The study defined the income received from forests as the value of products whose supply depends on the existence of forests. This includes fish caught in rivers and lakes within a forest, timber, environmental payments and other benefits

Table 8. Estimated contribution of NWFPs to annual household income reported in case studies from the tropics

World Region	Country	Percent of Household Income	Reference
Africa	Benin	30%	Heubach et al. (2011)
Asia	Northern Lao PDR	40 - 50%	Foppes and Ketphanh (2004)
Latin America	Eastern Brazil	20%	Shanley and Gaia (2004); Shackleton et al. (2007)
Asia	Orissa State, India	19%	Mahapatra et al. (2005)
Asia	Central Viet Nam	4-22%	Polesny et al. (2014)
Asia	Northern Thailand	30%	Sribandit et al. (2008)

Source: Shanley, et al. (2015).

tied to forests. Income from mineral extraction, for example, was counted as non-forest environmental income. The study defined environmental income as goods produced through the extraction of non-cultivated resources including natural forests and other non-forest wild lands. Environmental income was also defined to include the value of plants and animals harvested from croplands. As an additional concern, the PEN data set may have captured income from NWFPs that inflated their contribution to household incomes. Two of the highest cases were from Bolivia and Peru where Brazil nuts gave the households some of the highest average incomes (and Brazil nuts provided the largest share of household income).

Approach used to estimate gross product

We estimated the gross product of smallholder NWFP production using data from Angelsen, et al. (2014) and Shanley, et al. (2015). We multiplied total household forest income for forest dependent people (Table 9) by the share of total household forest income that comes from NWFPs (Table 8). We estimated the range of potential values using a 4% lower boundary and a 35% upper boundary for the household income received from NWFPs.

Estimates of smallholder gross product

The results show that the gross product of smallholder NWFP production is between US$ 35 billion to US$ 245 billion per year. It is more difficult to develop similar comparisons of the value of smallholder-led NWFP and informal production. NWFPs are diverse and include plants, fungi and other biological material harvested from forests for sale and consumption purposes. They also include medicinal plants and herbs. The results show that the production of NWFPs creates significant value for smallholders. However, the range of the NWFP estimate is the widest of any of the goods considered in this study and reflects how little is known about NWFP production and values.

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Table 9. Absolute and relative incomes of forest-dependent households (values in US$)

Income Category	Absolute income ($US PPP)				Relative income (percent of total)			
	Global	Latin America	Asia	Africa	Global	Latin America	Asia	Africa
Forest (natural)	$422	$1,353	$263	$201	23%	29%	16%	21%
Forest (plantation)	$18	$1	$29	$16	1%	0%	2%	2%
Forest (natural and plantation)	**$440**	**$1,354**	**$292**	**$217**	**24%**	**29%**	**18%**	**22%**
Non-forest environmental	$86	$119	$47	$103	5%	3%	3%	11%
Environmental (natural forest and non-forest environmental)	**$508**	**$1,473**	**$310**	**$304**	**27%**	**31%**	**19%**	**31%**
Crop	$432	$787	$426	$305	23%	17%	27%	31%
Livestock	$235	$578	$250	$98	13%	12%	16%	10%
Wage	$326	$1,155	$238	$87	18%	24%	15%	9%
Business	$180	$328	$181	$124	10%	7%	11%	13%
Other	$154	$424	$169	$41	8%	9%	11%	4%

Note: Estimates are reported in 2017 US dollars. Relative incomes may not add up to 100% because of rounding errors.
Source: Angelsen, et al. (2014).

7. Total size of smallholder gross product

The results from our analysis show that the gross product of smallholder crop, fuelwood and charcoal, timber, and NWFP production is between US$ 881 billion and US$ 1.5 trillion per year (Table 10). The multiplier effect, where the total impact of smallholder production may be amplified several times over, is also a factor. These multipliers can be increased by equitably distributing investment across urban and rural landscapes (Deininger & Byerlee, 2011).

When the value of multiplier effects are accounted for, the total economic value created by smallholder production may be as large as US$ 8.7 to US$ 25.9 trillion per year, which is approximately 12% to 35% of global economic output.[4] These estimates further reinforce the importance of smallholder production in the overall economy and suggest that economic growth can be increased with strategic investments in smallholder production systems.

Table 10. Global gross product of crop, charcoal and fuelwood, timber, and NWFPs produced by smallholders (values in US$)

Good	Annual gross value (2017 dollars)	Data sources	Assumptions
Crop production	$768 to $947 billion	FAOSTAT; Graeub et al. (2015)	Smallholder land is equally productive to other land. Smallholders produce a diversified crop mix that resembles the crop mix found at the regional level.
Charcoal and fuelwood production	$76 to $309 billion	FAO SOFO 2012; World Bank (2010)	Global charcoal consumption varies between a low of $2.22 per person per month to a high of $3.19, on average.
Informal timber production	$2 to $4 billion	FAO FRA; Hoare (2015, 2016)	The range of estimates depends on the fraction of formal timber production that occurs informally and/or illegally. The low end of the estimate assumes the fraction is 15% and the high end of the estimate assumes the fraction is 60%.
Non-wood forest products production	$35 to $245 billion	Angelsen et al. (2015); Shanely et al. (2015)	The range of estimates depends on what fraction of household forest income we asssume is made up of NWFPs. The lower bound of the estimate assumes NWFPs make up only 5% of household forest income and the high end of the estimate assumes that NWFPs make up 35% of household forest income.
Total annual gross product			**$881 to $1,505 billion**

Source: Author's calculations.

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4. The small estimate is based on multiplying the lower-bound total gross value estimate by a factor of 10 and the large estimate is derived by multiplying the upper-bound gross value estimate by a factor of 20.

8. Conclusions

Smallholders are a sizeable economic force in the world but the value of their production is intimately tied to the landscape they live on. The value of smallholder production also relies on each smallholder's ability to use their labour to turn the landscape's resources into marketable output. Despite using basic technologies and relatively small areas of land, this study has shown that the combined value of smallholder production in agriculture and forestry exceeds many of the world's largest companies for food, energy and construction materials. Smallholder-led crop production alone rivals the agricultural output of countries such as China. Smallholder-produced wood energy generates more value than some of the world's largest oil and gas companies.

This study has also shown that data measuring the direct productivity of smallholders is sparse. This poses a major challenge for policy making. Better methods are needed to collect information on the linkages between smallholders, landscapes and markets to develop effective policies that empower smallholders to secure their means of production. Relying on national databases of formal economic activity to estimate the value of the informal smallholder economy is not enough because it does not provide any information about the nature of smallholder production. We cannot use the data to evaluate policies or projects. Instead, information is needed on the nature of smallholder production and how it is linked to household dynamics, environmental conditions and market linkages.

Future data collection could be improved if more countries began conducting censuses of smallholder household economics and production systems. Smallholders have diverse economic lives and consistent information is needed in order to understand how their environment, social lives and market linkages shape their choices over time. This would include surveying smallholders to gather information on key assumptions used in this study, such as the amount of time smallholders spend collecting a standardised volume of fuelwood and charcoal each month and the value they place on its consumption and sale. Information on the types of NWFPs collected by smallholders and the share of household income they account for would also be helpful. Additionally, targeted studies are needed to characterise smallholder households and their production systems – particularly making progress on understanding the diversity of crop and tree-based products – and what each is worth.

Several recent studies (see for example Angelsen, et al., 2014; Graeub, et al., 2015) have contributed to this effort, but they leave key questions about the degree to which smallholder farming households depend on forests (and vice versa) unanswered.

In the short-term, national governments could improve the collection and reporting of information on smallholder production using similar methods to the ones used in this report. Many governments throughout the world already report information on forest and farm production to FAO each year. If countries could estimate the size of the smallholder economy as a proportion of the formal economy, the statistics that countries are already collecting could provide an approximate indication of the relative size of the smallholder economy. FAO could assist this process by providing guidance on simple methods that are compatible with data already being collected that would allow countries to approximate the size of the smallholder economy without intensive data collection efforts.

As decision-makers become more aware of the important role smallholders play in rural, national and global economies, they should begin to ask themselves what can be done to enhance the output of smallholder production systems and increase their resiliency to environmental, economic and social shocks. Further research will be needed to identify policy levers, such as land tenure reform, that can offer the most promising avenues to achieving these goals. Researchers will also need to identify the key barriers that constrain the economic activity of smallholders and ask how those barriers can be overcome. These policies will be context specific and pursue unique goals. For example, Graeub et al. (2015) found that in Brazil, the government created policies to help farmer families produce crops for domestic consumption as analyses determined that this was where their comparative advantage in relation to large, export-oriented farms. The same study found that the Malawi Government focused on creating policies targeted toward improving food security with investments in crop fertilizer subsidies. We believe that estimates like the ones presented in this report are an important first step in this process because they highlight the size of the smallholder economy and the importance of protecting and enhancing the value produced by smallholders.

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