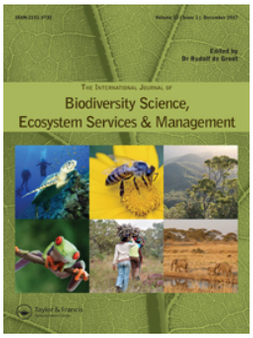

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SPECIAL ISSUE: CERTIFYING ENVIRONMENTAL SOCIAL RESPONSIBILITY

Energizing agroforestry: *Ilex guayusa* as an additional commodity to diversify Amazonian agroforestry systems

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ABSTRACT
Guayusa (*Ilex guayusa*) is a native tree of the western Amazon region grown by indigenous farmers in traditional agroforestry systems. Its leaves are used as a drink similar to tea, which is now commercialized and marketed outside of the Amazon. To assess the impacts from the early stages of commercial guayusa production, we conducted interviews in four commercial guayusa-producing communities with indigenous guayusa farmers in the Ecuadorian Amazon. We focus on their experiences and critically discuss and speculate about the socio-ecological implications of the expanding commercialization of guayusa, particularly in relation to propositions of this special issue. Results reveal that revenues from guayusa have not overtaken those from other cash crops. Commercializing guayusa can have benefits for farmers and the environment, provided that rigorous criteria that measure social and environmental impacts are adhered to. Furthermore, guaysa production is characterized by vertical integration where many individual farmers supply one processing and wholesale company in a short value chain fostering a locally tailored certification approach that is able to exert the continuation of the traditional agroforestry practices. Yet, sustainability initiatives, standards and certification only provide partial solutions for protecting ecosystem services in the Ecuadorian Amazon.

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Introduction

Every year, large swaths of tropical forests are cleared to make way for agriculture, furthering an ecological crisis (Mannion 1997; Geist Lambin 2002; Hansen et al. 2013; Putz & Romero 2014). In addition to the loss of biodiversity habitat (Brooks et al. 2002; Butchart et al. 2010) and carbon storage (Malhi et al. 2014; Lawrence & Vandecar 2015), the conversion of tropical forests for intensive agricultural production has the additional negative impacts of displacing small-scale farmers and local communities in many regions (Pretty et al. 2010).

Promoting alternative and more sustainable agricultural land uses in the tropics is imperative. Certification of tropical agricultural commodities for instance, is a strategy to show more socially and ecologically beneficial production standards in order to distinguish these products in their global value chains (Bishop et al. 2009; Rueda & Lambin 2013). An alternative approach is the promotion of an ecologically and socially more beneficial form of tropical agriculture, that is agroforestry (McNeely & Schroth 2006; Mosquera-Losada et al. 2008; Anderson & Zerriffi 2012; Nair & Garrity 2012), combined with certification (Tscharntke et al. 2015).

Agroforestry is a dynamic, ecologically based, natural resources management system that, through the integration of trees on farms and in the agricultural landscape, diversifies and sustains production for increased social, economic and environmental benefits for land users at all levels (Mead 2004). Scientists and practitioners alike claim that agroforestry practices rather than the promotion of mono-cropping can reduce some of the local effects of climate change and increase food security and nutrition, particularly for small farmers in developing countries (Nair et al. 2009; Nair & Garrity 2012; Kull et al. 2013; Kiptot et al. 2014; Luedeling et al. 2014). Agroforestry stores more carbon in aboveground biomass than plantations (e.g. coffee or cacao), monocultures (e.g. cassava, maize, plantain), or open pasture (Pandey 2002; Montagnini & Nair 2004; Roshetko et al. 2007; Nair et al. 2009; Anderson & Zerriffi 2012). Furthermore, it provides increased habitat for biodiversity (McNeely & Schroth 2006; Bhagwat et al. 2008; Perfecto & Vandermeer 2008; Kull et al. 2013), helps to reduce pesticide use, and can contribute to household food security (Nair 2012; Nair & Garrity 2012; Galhena et al. 2013). For farmers, agroforestry means the potential for accessing new markets (e.g. for carbon sequestration), income diversification from a variety of cash crops, and decreased vulnerability to climate change and pests (Leakey 2007; Anderson & Zerriffi 2012; Nair & Garrity 2012; Porro et al. 2012).

Agroforestry is practiced widely (Leakey et al. 2012). Depending on the precise definition, the global areal

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extent of agroforestry is estimated to range between 307 and 1215 million ha, and significantly located in the tropics (Zomer et al. 2014). Recently, however, there has been an increase in the amount of both tree domestication (Weber et al. 2001; Leakey et al. 2012) and non-timber forest products (NTFPs) collected as well as agroforestry tree products (AFTPs) grown for commercial purposes where they are often exported to consumer markets in North America and Europe (Leakey et al. 2005; Morsello et al. 2012). One recently commercialized AFTP is *Ilex guayusa* [hereafter referred to as guayusa], a tree leave that is traditionally consumed in the form of tea by indigenous groups in the Amazon region of Ecuador (Dueñas et al. 2016). Guayusa is an example of an emerging agroforestry tree product that links indigenous farmers in the Ecuadorian Amazon to the global market. It is a production chain arranged around a single company who claims to promote both ecological and social-economic benefits for growers. However, there is a lack of evidence if the commercial production of guayusa provides both ecological and social benefits. Does, for example, the expanded market for this commodity increase diversity in agroforestry systems? Are farmers' incomes augmented with the addition of guayusa growing for commercial purposes? Furthermore, are there added socioeconomic benefits of partaking in this commercialized agricultural production system?

This article contributes to this special issue by examining an alternative commodity and management system from the perspective of a sustainability initiative and the proposition that such an initiatives can only provide a partial solution for protecting ecosystem services and addressing social problems (Mithöfer et al. 2017, this issue). We assess the ecological and socioeconomic impacts of the early stages of commercial guayusa production in the Ecuadorian Amazon. The commercialization of guayusa is claimed to augment farmers' incomes and to further increase the diversity of local chakra agroforestry systems. The focus is placed on the experiences of four commercial guayusa-producing communities and we present qualitative results from interviews with 14 farmers. First, we assess the impact of commercial guayusa growing on crop diversity in agroforestry plots, specifically analyzing the impacts on the local chakra agroforestry systems. Subsequently, we focus on the social and economic benefits for farmers who engage in commercial guayusa production, assessing and comparing the economic importance of guayusa growing with other integrated cash (crop) systems of timber, coffee, naranjilla and cocoa. The two main research areas addressed are linked to uncertainties associated with the longer-term socioeconomic and environmental effects of growing guayusa for international markets. Despite the standards and certification systems currently in place for guayusa growing and processing, we query if the inclusion of commercial guayusa maintains, furthers or decreases crop diversity in the local chakra agroforestry and if it has the potential to provide additional socioeconomic benefits for growers.

The Amazonian agroforestry system and its commodities

Amazonian chakras

The chakra is a particular, indigenous agroforestry system of the western Amazon that satisfies nutritional, medicinal and spiritual requirements for local indigenous populations (Whitten & Whitten 2008; Torres et al. 2015). Chakras are passively managed and provide food security for local populations while minimizing labor requirements related to maintenance and soil amendments. Chakras have traditionally functioned more as modified forests and to the outsider's eye almost resemble a primary tropical forest or a secondary forest. They are characterized by a diversity of plants where often more than 50 different species that are grown together. The most common perennials among these are cocoa, guava, guaba (Inga spp.), citrus, coffee, and plantains, a variety of palms such as peach palm (*Bactris guisapeas*), a range of medicinal plants and timber trees (*Ceiba pentandra*). The main annual crops grown include pineapple, cassava, sweet potato, corn, peanuts and various beans and tubers.

Most indigenous communities in the Ecuadorian Amazon have recognized collective land titles and each community member is assigned a certain plot that can be farmed. Depending on the size of the community land, its location and the number of people in each community, farm plot sizes vary; however, individual farms can be up to 50 ha (Krause et al. 2013). On these plots each farmer decides what crops or agroforestry tree products to grow and how much land to dedicate to each. Despite having collective land titles, indigenous farmers are generally poor and farmer's incomes are usually based on the selling of unprocessed cocoa and coffee, whose prices are determined by local traders.

Guayusa – a new agroforestry crop

Guayusa is a native tree from the western Amazon region that grows 6–30 m tall (Figure 1). Until recently, guayusa was almost unknown beyond its native range in the Amazon region of Ecuador, parts of southern Colombia and Northern Peru and only few publications about guayusa exist (cf. Patino 1968; Dueñas et al. 2016). Local indigenous people have planted guayusa trees for subsistence consumption in their chakras for centuries (Dueñas et al.

Figure 1. Photograph of a young guayusa plant (approximately 2 m tall) in a chakra.

2016). Traditionally, indigenous groups of the western Amazon have used the leaves as a drink; the plant is claimed to have many spiritual and medicinal properties. For instance, the Kichwa in the Ecuadorian Amazon believe that drinking guayusa in the early morning offers protection against venomous snakes, and provides one with the energy to work throughout the day (Patino 1968; Lewis et al. 1991; Innerhofer & Bernhardt 2011).

Guayusa is often grown together with subsistence crops such as plantain, cassava and maize and cash crops, mostly coffee, cocoa, and in some higher altitude locations also naranjilla (*Solanum quitoense*). In the past, the numbers of guayusa plants on family plots were low because a small number of mature plants produced enough leaves to meet subsistence consumption. Apart from its assumed medicinal and spiritual properties, guayusa has become popular because of its high caffeine content and levels of antioxidants similar to green tea (Weissmann 2014). Guayusa tea has been promoted on the basis of its health and stimulating effects and has become desirable for consumers. Since 2010 guayusa is commercialized and marketed in North America. An U.S.-based start-up company is the main organization commercializing guayusa, fostering the growing of guayusa among indigenous farmers. The growing of commercialized guayusa is promoted as bringing a number of benefits to farmers including a stable and contractually pre-determined price per pound of leaves and reducing the price volatility that exists with the other main cash crops: cocoa, coffee and naranjilla. This advantage, although not as of yet measured, might decrease farmers desires to clear additional forest land to expand coffee and cocoa production in order to stabilize or increase incomes. Guayusa is a perennial, native tree that can further support the environmental benefits of Amazonian chakra agroforestry, such as providing shade and habitat for local biodiversity. In addition, it supports farmers to diversify away from cocoa and coffee, which are facing increasing disease pressures.

Due to the stable tropical climate and sufficient rainfall throughout the year, guayusa plants grow fast and leaf harvesting can start roughly a year after planting. The yield per plant increases substantially with age, leveling off upon plant maturity after approximately 5 years (Logan-Hines, 2016, personal communication). In addition, guayusa can be harvested throughout the year, which is an important advantage compared to coffee and cocoa that have specific harvest seasons. Many farmers prune trees to invigorate regrowth and to avoid the tree from growing too tall, making it possible to reach the branches for harvesting without tools (Logan-Hines, 2016, personal communication). Guayusa branches are not cut in the harvesting process; instead, leaves are pulled off the branch and regenerate again after harvest. Once harvested, the green leaves can be stored for a day or two. In order to prevent further withering and a loss of quality, the leaves should be transported to the processing plant, where they are dried and further processed in a sanitary environment.

Commercializing guayusa

Runa is the company that in 2009 started to commercialize guayusa in Ecuador. Runa [hereafter referred to as 'the company'] is the first and only company to export guayusa. The guayusa products are both *USDA organic* and *Fair Trade USA* certified, thus addressing social and environmental concerns consumers might have. Currently, 477 ha of guayusa growing are USDA organic certified, which includes processing and related activities as well as commerce and export (Kiwa 2016). In addition, the company complies with Fair Trade USA Independent Smallholders Standards. Furthermore, the company has also developed internal criteria for farmer agroforestry practices. For instance, the company recommends a minimum spacing of 4 x 4 m for the guayusa plants in order to maintain sufficient space between plants and to counteract the potential decrease of diversity. The spacing of 4 x 4 m equals 625 plants per hectare, which is the recommendation given to growers.

The main developmental phases of the company are shown in Figure 2. The activities require a steady supply of leaves from growers in Ecuador and the establishment and maintenance of a market (presently limited to the United States). Ensuring a stable supply is performed through direct contact with

Figure 2. Main developmental phases of Runa since the beginning of commercial guayusa production in 2010.

growers via the companies own extension workers. In the first years, the company provided guayusa seedlings from its nurseries to growers for free in order to initiate a quick increase in plants in order to increase supply. The contracts between the company and the growers specify the minimum price per pound of fresh guayusa, which is currently 0.35 USD (0.77 USD/kg), and has to date generated 700.000 USD in income for farmers (personal communication Logan-Hines, 2016). Growers are paid directly when leaves are collected. The collection of leaves is arranged up to two times per year for each community, and growers are usually informed several days in advance so they have time to harvest the leaves. The company does not work with intermediaries; rather, they directly collect the leaves and transport them to the processing plant close to the town of Archidona in the Napo province. Most of the communities and growers that supply guayusa to the company are located along roads accessible by motor vehicle and at a distance of up to 3 h from the processing plant.

A unique and important characteristic augmenting commercial interests is the sister organization: *Runa Foundation*. Members of this organization work directly with guayusa growers to conduct research and produce knowledge on guayusa growing. Specific projects that have been carried out by the Foundation include research on medicinal plants in the chakras, planting of timber trees on community lands, supporting communities in land management planning and the support of the farmer associations.

Methods

Study site

Four communities were selected where indigenous farmers grow and sell guayusa commercially. The company works in three provinces in the Ecuadorian Amazon, with the majority of communities being within 2 h drive from the processing plant. The selected communities are located in two provinces, Napo and Orellana (Figure 3), to which we hereafter refer to as Napo-1, 3, 4 and Orellana-2. Napo-1, Napo-4 and Orellana-2 were selected because they are part of active guayusa growing associations that were formed in response to Fair Trade certification requirements and indicate a certain level or organization and knowledge about the wider guayusa value chain among the growers. In addition, these three communities were relatively easy to access by car, which is a criterion for the company when promoting guayusa growing in communities. Napo-3, however, was located 30 min away from the main road and accessible only via a small gravel road. Growers in this community are not actively organized in a guayusa association and earn less income from agroforestry, but instead focus on timber extraction. We decided to select Napo-3, as we were also interested in comparing the socioeconomic potential of guayusa growing to other forms of land use, in this case the extraction of timber. In addition, we visited the company's processing plant and obtained information regarding the history and development of guayusa commercialization as well as current challenges the company has through personal communication with employees of the company and the foundation.

Table 1 is a description of the four selected communities. The main cash crops in communities two and three are coffee and cocoa. Due to its higher altitude, farmers in Napo-1 grow naranjilla instead of coffee and cocoa. In Napo-3, timber extraction of the communal forest area is the main source of income. Farmers in all four

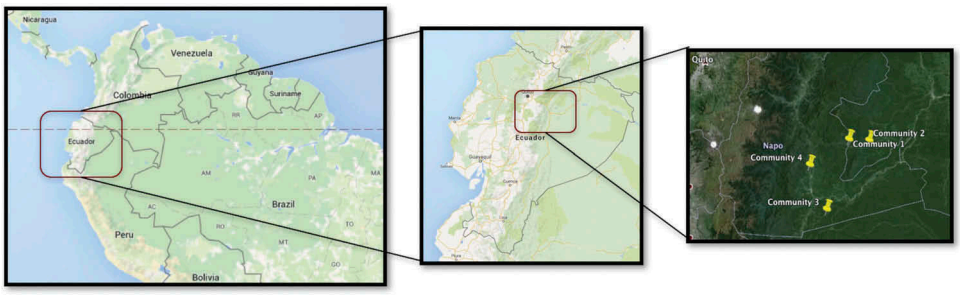

Figure 3. Location of the four case study communities (Source: googlemaps.com).

Table 1. Description of the four grower communities selected in the study.

	Community Napo-1 (n = 4)	Community Orellana-2 (n = 4)	Community Napo-3 (n = 3)	Community Napo-4 (n = 3)
Province	Napo	Orellana	Napo	Napo
Size area (ha)	9000	6700	2000	1800
Number of families	105	103	80	120
Main cash crops/forestry	Naranjilla, timber extraction (including planted)	Coffee, cocoa, guayusa, timber extraction (including planted)	Timber extraction (non-planted)	Cocoa, timber extraction (planted)
Other important crops/ agroforestry products	Cassava, plantain	Cassava, plantain	Corn, rice, cassava, plantain	Timber trees (planted), cassava, plantain

communities are to large extent subsistence farmers, dedicating a substantial share of their chakra to growing cassava, plantains, corn and a variety of other fruit and vegetable crops.

Farmer interviews

We used a mixed methods approach for data collection and conducted semi-structured interviews with 14 indigenous *Kichwa* farmers that grow guayusa commercially and sell, or intend to sell, guayusa to the company. For Napo-1 and Orellana-2, the interviews were with individuals active in the growers' groups . In Napo-3 and Napo-4, we sought a random selection of farmers that grow guayusa for commercial purposes and who sell, or intend to sell, guayusa to the company.

The interviews consisted of 20 open- and closed-ended questions. All interviews took place in February 2015 and were conducted in Spanish. The average time for the interviews was 30–45 min. The questionnaire used covered the total number of hectares under production, description of plants grown, plant density, the year commercial guayusa growing began, number of plants for commercial production guayusa harvest quantities per year (estimated), to whom guayusa is sold, amount of money received for last harvest, and whether fertilizer and/or pesticides are used in the chakra. We asked interviewees about the number of guayusa plants and on how many hectares they have planted them.

Furthermore, we queried farmers whether they sell less coffee, cocoa or naranjilla since they started growing commercial guayusa, and if they have planted more guayusa instead of coffee, cocoa or naranjilla. We also enquired if and how the economic situation has changed for interviewees since they started selling guayusa. Finally, grower were asked about their relations with the company and what they think can be improved as well as their future expectations regarding the growing and selling of guayusa.

Farm visits

In most cases, we combined the interviews with 'narrative walks' around the chakras. The walks allowed for active conversation with farmers in the specific setting we were interested in. In turn, farmers showed us the different crops in their chakras as well as their growing strategies for guayusa. These walks provided additional details and observations about the growing techniques employed by the individual farmers beyond the information received in the interviews. It also created an additional opportunity for targeted questions to better understand the respective chakra agroforestry system, its overall complexity and plant diversity. The walks often took 30–60 min each, depending on the size of the chakra.

Results and discussion

Ecological aspects and management strategies

The Kichwa chakra systems are characterized by a diversity of plants and trees, both for income and subsistence food and medicinal purposes. The interviews and observations reveal that farmers have not yet begun to plant guayusa on large areas of their chakras. Instead, they plant guayusa mainly on smaller plots, usually under larger trees and together with existing coffee and cocoa plants. The main goal for the farmers is to maximize leaf yields (the number of leaves per plant). This requires pruning so as to make the plants dumose and wide, instead of thin and tall.

Table 2 shows the number of guayusa plants and the approximate area the plants cover in the chakra for each interviewee. The density of plants per hectare is important for two reasons. First, it is an indicator to determine how much space is available for other plants to be grown in the same area. The more and denser guayusa is planted, the less space there is for other plants. Especially when the plants mature and increase substantially in height and aboveground volume. Furthermore, plant density can also have an impacton the probability of the spread of pests in the future.

The number of plants varies markedly, being quite substantial for a few farmers. However, most of the plants have been planted recently, attributing to limited tree sizes and production levels. The area planted with guayusa is often well below 1 ha; only one interviewee (#11) stated to have 2 ha of guayusa altogether. However, some of the interviewed farmers stated that they have planted in excess of 625 plants per ha, which means they have removed other plants, therefore, decreasing crop diversity. Thus, while some interviewed farmers have

Table 2. Number of guayusa plants, plants per hectare, stated by the interviewees.

Community	#	Number of plants (stated)	Number of ha planted with guayusa (stated)	Plants/ ha
Community 1	1	900	0.50	1.800
	2	50	0.25	200
	3	1.500	0.25	6.000
	4	700	NI[a]	NI
Community 2	5	800	0.25	3.200
	6	155	NI	NI
	7	500	1	500
	8	500	0.25	2.000
Community 3	9	500	1	500
	10	320	0.50	640
	11	700	2	350
Community 4	12	500	0.50	1.000
	13	37	N/I	N/I
	14	100	0.25	400

[a]No information – respondents were not sure about the correct numbers and did not respond.

planted guayusa more densely than the recommended 4 m x 4 m, a few others stated that the plants should not be so close together and that the branches should not touch. This is interesting because these farmers also claimed that the extension workers from the company told them to plant guayusa at denser spacing than what the company itself recommended, pointing to a certain degree of miscommunication or misunderstanding of the recommended planting density of guayusa. This might be a result of a lack of sufficient extension worker presence. It might also be that the recommendations are insufficiently communicated and that those farmers who decide to plant more densely have profit-maximizing interests, while the others who plant less densely than the recommendations have an interest in maintaining the long-term viability and nutrient availability in the chakra.

The ecological risks in the form of plant diseases have been an ongoing challenge. For example, in recent years a number of pests have hit coffee and cocoa plants in Central and South America. Coffee rust (*Hemileia vastatrix)* and Eye of the rooster (*Mycena citricolor*) are two coffee plant diseases that have decreased coffee yields substantially. Both diseases are expected to worsen with global climate change (Porter et al. 1991; Avelino et al. 2004; Ghini et al. 2011; Jaramillo et al. 2011). Several of the interviewees mentioned that these pests are a major problem, significantly impacting coffee and cocoa yields and incomes. So far, guayusa is pest free and farmers see this as an advantage of increasingly growing it in their chakras. However, due to the low genetic diversity of guayusa, where most plants are clones, the risk of future pests is high, and another reason why the company promotes a maximum of 625 plants of guayusa per ha.

During the interviews and narrative walks, interviewees mentioned, or we witnessed, the removal of trees in order to provide more light and space to the guayusa plants. In Napo-1, an interviewee had just cut a mature chirimoya tree (*Annona cherimola*) in order to create additional light for his guayusa plants. He mentioned that he plans to clear out more secondary forest on his land in order to expand the number of guayusa plants. Another interviewee noted that she is experimenting with guayusa growing in different plots where she planted guayusa in a small rice field together with balsa trees (*Ochroma pyramidale*) for timber production. However, she also mentioned that she wants to clear out additional trees to make space and provide more light for the guayusa seedlings, once they are strong enough to withstand direct sunlight.

Guayusa plants, particularly the seedlings, are sensitive to direct sunlight. All interviewees were aware of this sensitivity to direct sunlight. Young seedlings and plants that have not yet developed deep roots are susceptible to drying out, which decreases plant survival rates. Therefore, farmers mentioned that they plant seedlings under the protective cover or larger trees and bushes. However, some of the interviewees also stated that they intend to clear more of their fallow land and secondary forests and plant guayusa if there was the opportunity to sell it. Once the guayusa plants have reached approximately 2–3 years and about 1 m in height, then they can withstand more direct sun exposure, increasing growth rates and leaf yield.

Guayusa means less use of chemicals compared to naranjilla. It is easy to grow and a less heavy work. (Interviewee, Napo-1)

The guayusa purchased from the company is certified organic. Farmers that want to sell to the company must not apply synthetic fertilizers, herbicide and pesticides that are prohibited according to the USDA organic standard (USDA 2016). Commercial naranjilla production for instance requires fertilizer and pesticide inputs, which farmers increasingly connect with negative health impacts. Guayusa represents a significant cost reduction and alternative income source, especially in Napo-1 where naranjilla is the main cash crop. However, income from naranjilla is still substantially higher compared to guayusa, which takes several years to reach maturity and provide a return on investment. This constrains farmers economically in their ability to shift to guayusa.

Socioeconomic benefits

Farmers

Cocoa and coffee have too many pests and fluctuating prices; guayusa is more stable. (Interviewee, Orellana-2)

Interviewee responses regarding the socioeconomic aspects reveal that income generation from guayusa does not yet play a substantial role in

Table 3. Stated income for 2014 by agricultural commodity.

		Income from crops in USD/year per household			
Community	#	Coffee	Cocoa	Naranjilla	Guayusa
Community 1	1	–	20.00	900.00	140.00
	2	–	–	960.00	12.00
	3	–	–	1.760.00	19.00
	4	40.00	200.00	1.710.00	123.00
Community 2	5	–	–	–	35.00
	6	180.00	560.00	–	6.00
	7	14.00	270.00	–	105.00
	8	–	35.00	–	18.00
Community 3	9	–	–	–	21.00
	10	–	20.00	–	18.00
	11	–	16.00	–	25.00
Community 4	12	24.50	100.00	–	35.00
	13	3.00	2.50	–	6.00
	14		80.00	–	–

farmer's overall household income (Table 3). The majority of the interviewees earn more from the sale of coffee, cocoa and naranjilla than from commercial guayusa. This is expected since most of the guayusa plants have only been planted in the past 3–4 years, and have not yet reached maturity with resulting low yields; furthermore, the consumer market for guayusa is still limited to the United States. Naranjilla is a major crop and source of income in only one of the communities (Napo-1). Respondents in Napo-3, on the other hand, focus their economic activities largely on the extraction of timber and, therefore, have a small amount of income derived from cocoa or coffee. For growers in Napo-3, agroforestry in general and guayusa in particular will probably not be a major source of income until at least the stock of available timber trees has been exhausted

Risk reduction is important to farmers. Commercial guayusa production represents one additional commodity for farmers to hedge against market price fluctuations and guarantee more steady incomes. However, due to the recent commercial interest and planting of guayusa, farmers are not yet receiving a sufficient income from guayusa, compared to coffee, cocoa, naranjilla or even timber. One of the main reasons for guayusa not yet replacing the traditional cash crops is farmer's hesitation to give up their investments of both time and space for the traditional cash crops, unless they can be more certain that guayusa will be a good and reliable replacement. One of the interviewees (#6) stated that she is considering guayusa and has a few plants intercropped with timber, cocoa and coffee, but wants to wait until the coffee plants die before she plants more guayusa. This demonstrates that only when the economic benefits from guayusa can out-compete incomes from other cash crops, will it become a viable alternative. One of the reasons for the lack of incentive is due to farmer's inability to sell their increasing guayusa harvests. Interviewees have expressed the desire to continue with coffee and cocoa until the harvest from guayusa can be sold more frequently and the plants can produce higher yields. However, interviewees stated that they would grow more guayusa, provided a steady and sufficient market for it.

Guayusa is more economical than coffee or cocoa; it can provide more income. (Interviewee, Orellana-2)

Despite that incomes are still relatively modest for commercial guayusa growing, it is important to mention that the economic aspects should not be measured merely by strict income generation for each farmer. Incomes must be viewed in the context of transaction and input costs such as labor. Interviewees stated that growing and harvesting guayusa is less labor-intense compared to naranjilla, coffee or cocoa, making it an attractive commodity. In addition, there are price stability aspects that increase the interest in guayusa. For example, many farmers have mentioned that the price they receive for coffee, cocoa and naranjilla, fluctuates frequently, and is dependent on the intermediary who buys the commodities from growers. The current commercial guayusa system operates on a pre-determined price, which is contractually set between the growers and the company.

Guayusa provides better additional income. Prices for coffee and cocoa are low and they are a lot of work to clean and harvest. (Interviewee, Orellana-2)

Additional benefits that interviewees mentioned relate to the time and effort spent to harvest leaves. They referred to guayusa as being an easier crop requiring less labor. Compared to harvesting coffee and cocoa, they emphasized that harvesting guayusa is comparatively easy because the leaves are just pulled of the branches. Another benefit, particularly for those who have their chakras further away from roads or the community center, is the relation between price and weight. While one pound of guayusa yields 0.35 USD, one pound of coffee beans sells for anything from 0.10 to 0.30 USD and one pound of cocoa seeds for around 1.00 USD. Cocoa is harvested in pods and the seeds are separated from the cocoa pod back at the farmer's house. Coffee and cocoa that equals the income from guayusa is heavier to carry, which is important if a farmer's chakra is a great distance from the road. However, the main determinant for harvesting of guayusa is the demand for guayusa, which currently is based solely on the export market in the United States. Although farmers can harvest whenever there are sufficient mature leaves on the plants, the decision to harvest is determined by the company. This has been an increasingly delicate issue and criticized by the farmers, since the company is purchasing less frequently.

Grower communities

It's good to be part of an association; it creates knowledge exchange. (Interviewee, Orellana-2)

Most of the commercial guayusa production is USDA certified organic and producers must adhere to a specific set of production standards. Furthermore, guayusa products are also certified by Fair Trade USA, which requires that grower associations be established in each community where social premiums are distributed back to the groups based on the quantity of guayusa sold. The company supports the process. Once the growers are organized, they are eligible to receive the Fair Trade social premium with the aim of benefitting the grower associations. The social premium is not disbursed to individual growers; rather, it is used for community projects by the means of participatory budgeting. Participatory budgeting is a tool by which decisions about the use of a common pot of money are made in an open and transparent meeting by a group of people to whom the money belongs. Apart from being an additional source of income to grower associations, the process of operationalizing an association is an important benefit in itself, for example, creating a forum for growers to meet and exchange information on farming practices, a setting to collectively negotiate better prices for their products, as well as a general place to strengthen institutional capacities, a foundation for long-term farmer empowerment. In 2014, the company disbursed 30,000 USD to the eight grower associations (personal communication, Logan-Hines 2016).

Critique from farmers

I want a product with more value and that the company continues to work well and grows so that farmers and the company can keep working together and it doesn't end as many other bad projects which started and then stopped! (Interviewee, Napo-1)

Notwithstanding the multiple benefits iof growing guayusa, growers had a number of concerns about the commercial guayusa system. The limited and uncertain level of demand from the company was the criticism stated most often by interviewees. The power asymmetry is largely the result of the company being the first to export guayusa in conjunction with its push for rapid expansion of guayusa production and by handing out free seedlings. Farmers responded by planting more guayusa than demanded, as they saw it as a beneficial investment with higher returns compared to coffee and cocoa. Since the company is the sole purchaser, farmers are now facing a situation where they are unable to sell their increasing harvest.

Moreover, despite the advantage of a simple transaction process between a single buyer and the contracted sellers, there is also a risk for growers when the one buyer is unable to purchase the supply they themselves promoted. For example, the last guayusa collection in Napo-3 was 1 year prior to the time of the interviews. Despite the strong promotion of growing and production at the onset of their operations, the company has decreased the amount they are purchasing from the producers. This is due to the sharp rise in supply that has outgrown the demand in the export market, which is still rising but not keeping up with the supply. This uncertainty has important implications on growers' decisions on what to plant in their chakras.

Another concern that interviewees repeatedly mentioned is the price of guayusa. Almost all interviewees perceived that the 0.35 USD/lb. price paid by the company was too low and that prices needed to increase to 0.50–1.00 USD/lb. to be considered a fair price for them. However, one can question these sentiments considering prices for coffee and cocoa were 0.10 and 1.00 USD/lb. respectively, at the time of the interviews, and require more labor inputs compared with guayusa.

In addition, several growers mentioned communication deficiencies between the company's extension workers and themselves. A few interviewees stated that specific harvest and purchase times are poorly communicated to growers; in addition, a number of growers mentioned the need for more efficient growing methods and knowledge about organic fertilizer use. A frequent suggestion by farmers was to have additional workshops for each of the producer associations in order to provide more and better information and capacity building regarding techniques and guidelines for growing guayusa.

Market expansion and certification

We have presented and discussed results from the interview with Indigenous Kichwa farmers in four communities in the Ecuadorian Amazon. For most of the interviewees, guayusa is a viable and welcomed alternative crop in the chakra systems, particularly compared to coffee and cocoa. Research on agroforestry in other parts of the Amazon has shown that this is an important and beneficial strategy to cope with external pressures and changing prices, while also buffering against unexpected risks, increasing the resilience of the agroforestry systems (Porro et al. 2012; Dawson et al. 2014; Torres et al. 2015). However, from an ecological and food security perspective, a diversity of plants in the chakras must be maintained. This means that guayusa should not come to dominate the chakra or lead to the decreased production of other subsistence crops.

In their work with farmers, the company actively promotes chakra diversity, for instance through their

planting density recommendation. Nevertheless, it is the individual farmers that make decisions about their land use, which can be made with greater emphasis on income maximization instead of landscape diversity. Although the Fair Trade USA and the USDA organic certification of guayusa comes with certain criteria that must be met, plant diversity in agroforestry plots is currently not one of them and farmers cannot be excluded from selling their guayusa based on such a criterion.

Important lessons can be drawn from other forest products that have been only recently commercialized on a larger scale, for instance açaí berries (*Euterpe oleracea*) from the Brazilian Amazon. In the 1980s açaí was seen as a solution to deforestation and rural poverty in the lower Amazon (Weinstein & Moegenburg 2004). In the years that followed the demand for açaí continued to increase leading to an açaízation in many parts of the Amazon estuary (Hiraoka 1995) that intensified and expanded. The resulting açaí enriched flood-plain forests increasingly resemble açaí plantations (Weinstein & Moegenburg 2004). This expansion of açaí-managed forest areas has led to deforestation in the flood-plain forest comparable to upland forest areas (Zarin et al. 2001). On the other hand, Brazil nut (*Bertholletia excelsa*) harvesting is considered a good example of the commercialization of a non-timber forest product from the Amazon, contributing to rural livelihoods and forest conservation (Ribeiro et al. 2014). However, the sustainability of harvesting Brazil nut depends on the intensity of nut collection and sound management of Brazil nut stands in Amazonian forest ecosystems (Peres et al. 2003).

I would like to have other markets to sell more to, not just one price-setting company. (Interviewee, Napo-1)

The question that remains concerns the long-term benefits of the partnerships between the company, which is currently the dominant purchaser of guayusa, and the guayusa growing communities. Morsello et al. (2012) conducted a study among communities from different ethnic groups in Brazil and Bolivia that collect and sell a range of non-timber forest products. They suggest that these trade partnerships with companies where processing does not take place at the community level, particularly when they are remote, but instead is carried out by the companies, is more beneficial in terms of income and financial returns. This is due to the fact that investment into processing technology does not need to be borne by communities themselves, premium prices from the companies are paid and purchase of the product is guaranteed (Morsello et al. 2012).

Guayusa is a niche market, but the company is implicitly building on the superiority of guayusa in terms of greater consumer's health benefits compared to coffee and a more environmentally friendly production that benefits small-scale indigenous farmers. The major comparative advantage is that the company's is the only one that offers guayusa products in the United States. Nevertheless, they decided to have their product certified from the early stages. Contrary to proposition three by Mithöfer et al. (2017, this issue) that public pressure evokes sustainability initiatives and shifts standard systems, certification and the development of the guayusa growing standards emerged as a result of the company's own vision and ambition to maintain the traditional chakra agroforestry systems and to complement, rather than replace, income generation from these. Therefore, it was not consumer pressure that led to certification, but a desire to further differentiate guayusa among the breadth of other tea brands and to market it based on its quality as a product that supports indigenous farmers and Amazonian Kichwa chakra agroforestry systems.

Being the main purchaser, processor and wholesaler of guayusa, the company has obtained a sizeable market power for guayusa. Consumers in the United States who wish to buy guayusa do not currently have a choice of which product to buy. Moreover, they cannot compare the Runa brand to other production standards, as is the case with coffee or cocoa where a diversity of certification schemes and production standards exist. With commercial guayusa, it is the company that sets the agroforestry standards which consumers must trust. Nevertheless, guayusa is a niche product and supplied in relative low quantities, as compared to e.g. tea or coffee.

The current certification and production standards in place for guayusa production can be explained by proposition 2 suggested by Mithöfer et al. (2017, this issue), stating sustainability standards, initiatives, and certification depend upon the dynamics of global value chain governance. It is characterized as a vertically integrated system where a multitude of farmers supply the leaves to the single company. The supply of guayusa is organized through individual contracts between the company and farmers, augmented by extension workers encouraging farmers to plant guayusa and teach best practices. With no intermediaries between the farmers and the retailers in the United States, the value chain is relatively short and allows the company to implement locally tailored standards and, in addition, demand from farmers to comply with standards devised by Fair Trade USA and USDA organic.

Up to now, the demand for guayusa has continued to increase. This is due to the company's intense marketing efforts in the United States and the introduction of new products based on guayusa, such as bottled teas. To what extent this demand will continue to match the supply from maturing guayusa

plants that has currently outgrown the demand is uncertain. The success of guayusa as a new product, portrayed as beneficial for the farmers and the environment, is very likely to lead to the establishment of new economic actors that will compete with the company. This might have positive benefits for the farmers associations that can ask for higher prices. Yet, it might also lead to an outsourcing of production to company owned plantations in order to increase economic efficiency and a stable supply of quality guayusa leaves, with detrimental implications for the farmers who have invested time and space in planting guayusa in their chakras. As suggested by the proposition that public discourse on sustainability concerns and associated actions is part of an issue–attention cycle with progression between stages (Mithöfer et al. 2017, this issue), lessons can be drawn for the emerging guayusa market. As of now, it is unlikely that guayusa consumers, particularly in the United States, are aware of the local Ecuadorian context and conditions in which guayusa is grown. It is a relatively new product internationally and media coverage on social and environmental aspects related to its production has been limited as compared to coffee or cocoa production (*see articles in this issue*). However, with rising demand in the United States and eventually other markets, interest in the local production standards and social-ecological conditions of guayusa growing will likely increase. Yet, experiences from other agroforestry commodities suggest that while some production systems might see a further development of social and environmental standards demanded by consumers aware of the shortcomings of existing standards, other production systems might not (Kennedy et al. 2017, this issue).

Guayusa developmental pathways

I want a better price [for guayusa] so I can make more money and pay for the education of my children. (Interviewee, Napo-4)

The traditional chakra agroforestry systems of the western Amazon are diverse, with dozens of plants grown together by small-scale farmers (Coomes & Ban 2004). Kichwa chakras are no exception, providing farmers with subsistence food, medicinal plants and cash crops. Moreover, compared to monoculture plantations of coffee, cocoa or oil palm, chakras are more diverse, with different layers of vegetation and ecological niches. They play an important role as a more sustainable land use for small-scale farmers and entire communities, particularly in tropical environments (Perfecto & Vandermeer 2008).

The extent and scale to which guayusa can play a part in this is uncertain. Much depends on how the demand develops in overseas markets and to what extent the growers adhere to the company's internal agroforestry standards. Moreover, with the market for guayusa expanding in the United States and in other countries, it is likely that new actors will appear, creating additional value chains, which have the potential to undermine any certification efforts and growing standards.

The results also demonstrate that sustainability initiatives, as the example presented here using two common certification schemes, must be combined with other strategies to promote agroforesty and to be an effective tool to alleviate the socioeconomic challenges that exist in smallholder commodity production systems. Despite the current Fair Trade USA and USDA organic certification, both labels do not include the range of ecological benefits that are provided by the local chakra agroforestry, such as biodiversity habitat and higher carbon storage. For example, if farmers choose to take out large shade trees because they believe that it increases guayusa production, they can do so under the current standards. This is a limitation of current guayusa certification in terms of its ecological benefits supporting plant diversity and biodiversity habitat in agroforestry systems.

Since commercialization guayusa has achieved to avoid negative effects found with other commodities. Nevertheless, an increasingly global value chain for agricultural commodities, such as guayusa, is likely to affect local environmental values and social relations among the indigenous farmers and the guayusa growing communities (cf. Meyfroidt et al. 2010; Rueda & Lambin 2013). The example of certification of small-scale coffee production in Colombia shows that this can lead to more sustainable land uses and farmers livelihood benefits (Rueda & Lambin 2013). However, examples from other commodities have shown the risk that is inherent in the trade-induced growth of tropical agricultural or non-timber forest products (Weinstein & Moegenburg 2004; Sheil et al. 2009). This is a call for caution and highlights the necessity to assess the management swing potential that might arise in the future when guayusa production expands to other regions and includes a larger number of individual farmers and company-owned plantations, trade-partners and purchasing companies (Mithöfer et al. 2017, this issue). If the expansion of guayusa production is not managed properly, trade-induced growth may contribute to the degradation of forestlands and the conversion of secondary or even primary forests through the expansion of chakras.

In addition, if the guayusa market expands and leads to increased demand farmers might be triggered to reduce the plant diversity of their chakras in order to increase guayusa production. This has ecological impacts as the shift of management to maximize the production of one ecosystem service, that is guayusa leaves, negatively affects a range of other ecosystem services, such as biodiversity habitat or pest resistance of the agroforestry systems (Braat & de Groot 2012).

Conclusion

Indigenous people in the western Amazon have used guayusa for centuries and it has only recently been commercialized and marketed beyond its native range. This has led to a market-oriented production of guayusa on indigenous chakras, primarily in the Ecuadorian Amazon. As of now there is very limited research on guayusa production and the socioeconomic and ecological impacts it generates. We have presented a pilot study that examines the ecological and socioeconomic impacts of commercial guayusa production in local smallholder chakra agroforestry systems.

We conducted in-depth interviews with 14 indigenous Kichwa farmers in four Amazonian communities, which is a fairly small sample size. Nevertheless, this study provides a first picture of how guayusa as a new commercial crop has the potential to changes local land use and augment farmers' incomes. However, in order to continuously assess and study the impact of an increadsing guayusa production on the local chakra agroforestry systems and farmers socioeconomic situations requires a broader long-term study, with a larger sample size that covers all grower associations and that measures land-use impacts over time.

Currently, guayusa production is a niche agroforestry experiment and our results provide insights into some of the challenges these farmers currently face with regards to the commercial growing of guayusa and their working relation the company that currently purchases and exports guayusa. Being a niche agroforestry experiment with a relatively small, but increasing market, it is unlikely that guayusa consumers, particularly in the United States, are aware of the local Ecuadorian context and conditions that guayusa is grown. However, with increased demand this might change and consumers will start to demand more information on local production standards and social-ecological conditions. Furthermore, the analysis supports the proposition of this special issue that sustainability initiatives, standards and certification are only a partial solution for protecting ecosystem service and addressing social issues in producer countries.

Although guayusa is emerging as an alternative cash crop for small-scale farmers it will likely not replace the traditional cash crops in the near future, nor should it. Based on the data we have shown that guayusa contributes to increasing and diversifying incomes and it can reduce growers' risks as a buffer against plant diseases that are threatening coffee and cocoa. Due to stable and pre-determined prices guayusa also reduces risks regarding price fluctuations for coffee and cocoa.

Concerning the ecological benefits of commercial guayusa growing, more analysis is needed. With the growth in demand and an increase in the number of actors that enter the market, the value chain of guayusa production will likely become increasingly complex and competitive. This has the potential to both undermine or further support current certification efforts, which so far have been led by the company's internal vision and efforts to integrate guayusa production into the diverse agroforestry systems of the Ecuadorian Amazon. A potential risks that arises with market expansion is the increase in area planted with guayusa. More stringent certification is needed that focuses on the ecological benefits of agroforestry systems, which is currently a void not filled by neither of the two certification schemes for guayusa. Hence, the example of guayusa as an emerging agroforestry crop shows that caution is required in order to not create a new tropical cash crop that displaces diverse agroforestry systems and leads to a monoculture system with long-term detrimental effects for the local ecosystem and farmers.

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