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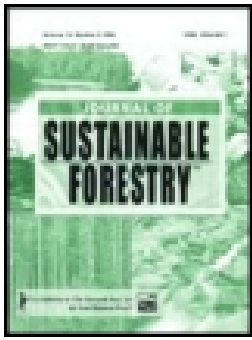
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Analysis of the potential of small-scale enterprises of artisans and sawyers as instruments for sustainable forest management in Puerto Rico

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ABSTRACT

Small-scale forest enterprises have been recognized as a potential instrument for sustainable development. In particular, the production of handicrafts is a major form of cultural expression and a significant source of income in several developing countries. In this study, we characterize the local handicraft sector in Puerto Rico to identify essential elements for fostering small-scale forest enterprises. Artisans and sawyers were home-based microenterprises that harvested, processed, and traded a wide variety of local forest products, including 125 types of wood and several non-wood forest products. Nonetheless, severe competition from cheaper imported crafts, low demand, and high product variability hamper the development of the local handicraft sector. Despite globalization, sawyers and artisans in Puerto Rico, as part of the U.S., have access to the largest markets of tropical woods and home accessories in the world. But, to participate in these markets, they must increase competitiveness. Lack of institutional effectiveness is a major constraint for the success of the artisan development program in Puerto Rico. Therefore, cooperation and linkages between all support organizations, including government agencies, non-governmental organizations, and associations of artisans, need to be enhanced to provide effective technical assistance, marketing, and financial services to artisans.


KEYWORDS

artisan livelihoods; forest products; handicrafts; small-scale forestry; sustainable forestry

Introduction

In recent years, the concept of small-scale forestry has been gathering impetus as a potential instrument for poverty reduction and natural resources conservation through long-term sustainable forest management (Donovan, Stoian, Macqueen, & Grouwels, 2006). The livelihoods of many poor rural people living in or near forested landscapes rely on small-scale forest enterprises (SFEs) (Kozac, 2007; Macqueen, 2008; Scherr, White, & Kaimowitz, 2004). Millions of carpenters, wood artisans, furniture makers, round wood suppliers, and traders exist as small enterprises of less than 20 employees in the informal sector worldwide (Mayers, 2006; Molnar et al., 2007). SFEs can make positive contributions to local employment and generate wealth that stays within local communities because they tend to be labor-intensive industries that are intrinsically tied to the

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communities in which they operate (Donovan et al., 2006; Kozac, 2007; Scherr et al., 2004). Growing markets for highly valued grade wood products, fair trade products, and payments for ecosystem services currently represent key prospects for SFEs (Donovan et al., 2006; Hajjar, Sánchez Badini, & Kozac, 2016; Scherr, White, & Kaimowitz, 2002; Tomaselli & Hajjar, 2011). In particular, the growth of international markets for home accessories and ecotourism has opened up new opportunities for artisans (United States Agency for International Development (USAID), 2006; Richard, 2007). The production of handicrafts is an important source of employment and income in several developing countries, as well as an essential means for maintaining and promoting cultural and artistic traditions (United States Agency for International Development (USAID), 2006; Richard, 2007; Grobar, 2017).

The development of SFEs into viable economic businesses requires favorable political and economic conditions to guarantee legal accesses to forest resources, provide incentives for sound forest management, support increased value adding, and promote the formation of sustainable capital (i.e., natural, human, social, financial, and manufactured capital) for the production of forest products (Donovan et al., 2006). Few developing countries, however, have implemented a consistent framework to empower the potential of SFEs for sustainable development (Hajjar et al., 2016; Macqueen, 2008; Scherr et al., 2004). In general, SFEs struggle to advance beyond the start-up of business development, exhibit low levels of production, value addition, and profitability (Donovan et al., 2006). The success of SFEs depends upon a unique combination of elements that help to overcome scale disadvantages, economic instability, market imperfections, and policy failures (Kozac, 2007). Rather than directly subsidizing or protecting SFEs, policies and programs to create a positive and legal market environment for SFEs must support mechanisms to encourage entrepreneurship, legitimize business, and allow fair competition (Donovan et al., 2006; Kozac, 2007). The enabling environment for SFEs is context specific and the level of importance of each essential element is unique for each case (Westholm et al., 2011 as cited in Hajjar et al., 2016). In this study, we characterize the local handicraft sector in the Caribbean island of Puerto Rico to identify essential elements for fostering SFEs of artisans and sawyers and shed light on strategic actions to support economic alternatives for the utilization of local forest resources that in turn could promote sustainable forest management in a forest transition scenario (i.e., forest recovery at a national scale).

Puerto Rico, along with Cuba, was one of the last two colonies of Spain in the New World. Nonetheless, at the end of the Spanish-American War in 1898, it became an unincorporated territory of the U.S. (Duany, 2003). During the early part of the twentieth century, the economy was based on agriculture, mainly sugar, coffee, and tobacco, for exportation; but since 1947 government policies promoted industrialization, leading to widespread agricultural abandonment that resulted in extensive forest recovery (Rudel, Pérez-Lugo, & Zichal, 2000). Forest cover increased from less than 10% of total land area in the late 1940s to more than 53% in 2009 (Brandeis & Turner, 2013).

The socio-ecological circumstances of Puerto Rico's forest transition have been extensively studied (e.g., Grau et al., 2003; Rudel et al., 2000, 2005), but we know little about how forest recovery has impacted people's livelihoods. At the time of agriculture, a timber industry based on artisanal practices supplied materials for construction, fuel, and a great variety of utilitarian crafts, which were made using fibers, woods, and clay extracted from

the island's forests (López, 2003, 2004; Wadsworth, 2012). But during the process of industrialization most of the traditional crafts were replaced by cheaper industrial products and the handicraft production was relegated to a few household objects and souvenirs for tourists (López, 2003, 2004). Today most of the solid wood products that are consumed on the island are imported, while locally grown woods are harvested by small private sawmills and mainly used by local artisans for the manufacturing of traditional furniture, musical instruments, and handicrafts (Kicliter, 1997).

Since 1977 the government of Puerto Rico has operated the Arts and Crafts Development Program, locally known as artisans-FOMENTO, to help certified artisans to develop microenterprises by providing technical support and economic incentives to purchase working materials, machinery, and tools. The program also sponsors opportunities for training, offers marketing assistance, and in cooperation with the Institute of Puerto Rican Culture supports the commemoration of festivals where certified artisans can exhibit their work and sell their products directly to the public with tax exemption (Law 64 of 20th June 2016). Even though forestry is not currently a significant economic activity, the utilization of local wood could contribute to the local economy and in turn encourage sustainable forest management (Longwood, 1961; Wadsworth, 2009). The aim of this study is to describe the current situation of the handicraft market and wood exploitation in Puerto Rico to analyze the potential of SFEs for sustainable forest management in a forest transition scenario. In doing so, firstly we describe the current use of forest products in the local handicraft market, secondly we characterize local wood exploitation, and finally, we identify major challenges for the development of small enterprises of artisans and sawyers in Puerto Rico to provide potential solutions.

Methods

Information on the use of local forest products and commercialization of handicrafts was gathered through semistructured interviews with artisans and sawyers from April 2012 to May 2013. The questionnaires were developed over a two-step revision process. In the first step, a semistructured questionnaire was designed to identify the strategic practices of sawyers and artisans. Second, a content validity test was carried out in which the questionnaire was applied to 3 sawyers and 20 artisans in order to obtain feedback about the clarity of the questions, the use of appropriate terminology for the target population, and the possible omission of important issues in the market of locally grown woods and handicrafts in Puerto Rico.

Different instruments were employed for each social sector. The questionnaire for artisans was designed to reveal the types of forests products [i.e., wood and non-wood forest products (NWFPs)] from which handicrafts are produced and provide a profile of the range of manufactured handicrafts (see online supplementary information (SI), Annex 1). The questionnaire for sawyers gathered general information on harvesting, milling, and marketing of locally grown woods (see online SI, Annex 2). The questionnaires also requested basic socioeconomic data and gathered information on perceptions and attitudes on work-related challenges for artisans and sawyers. Within the time frame of the survey, it was not possible to quantify how much of any raw material is harvested or determine the precise mechanisms of pricing given that in general a wide range of products are made by each artisan (see Table 3). Nonetheless, to characterize the structure

of the market the handicraft products were categorized as luxury (i.e., high end-term), middle-end term, and low-end term, according to their price, quality, and design using a framework proposed by the United States Agency for International Development (United States Agency for International Development (USAID), 2006).

An intercept survey technique was used to sample the local artisan community. The surveys were conducted in-person in public places or in workshops using paper-based guides with open and close questions. After receiving approval from the Institutional Review Board, we visited 2 permanent exhibitions in San Juan, 7 artisan workshops, and 14 festivals, which were celebrated in public places such as squares, parks, and malls, in seven municipalities to contact the artisans. The survey was focused on certified artisans since the law of the Artisan Development Program (Law 64 of 20th June 2016) requires artisans to be certified in order to participate in the program, with the result that this is a requisite to work as a professional artisan in Puerto Rico. Thus the festivals were exclusively attended by certified artisans, and mainly visited by locals. In each event, we interviewed from 8 to 40 artisans, including adult men and women working with wood and NWFPs (Table 1). Before conducting the interviews, we requested verbal consent and finished contacting artisans when most of the participants in the festivals were familiar to us. The participants were generally pleased to share information about their work. The response rate to the questionnaires was high for both artisans (90%) and sawyers (84%). Altogether, we interviewed 271 certified artisans (199 men and 72 women) including joiners, carvers, cabinetmakers, weavers, jewelers, and luthiers (Table 1). Eleven private sawmills of about 14 currently active on the island were visited to gather information on local wood production.

In addition to the semistructured interviews, during 2012–2014, the authors participated in 12 meetings on sustainable forestry, sponsored by the Department of Natural Environmental Resources (DNER) of Puerto Rico and the International Institute of Tropical Forestry, to discuss the potential for local wood industries in Puerto Rico. These meetings were attended by a variety of people including staff of the two environmental agencies, the artisans-FOMENTO program, local non-governmental organizations (NGOs), scientists, students, environmentalists, artisans, farmers, arborists, and sawyers, which gave the opportunity to supplement the data with informal interviews among key

Table 1. List of the festivals that were visited to interview artisans.

Festival	Municipality	No. of participants	No. interviewed
Encuentro de Talladoras de Santos	San Juan	28	6
Encuentro de Talladores de Santos	San Juan	90	20
La Campechada	San Juan	200	20
Feria del Descubrimiento de Aguada	Aguada	100	30
Feria Indígena de Jayuya	Jayuya	50	10
Feria de Cataño	Cataño	50	16
Grito de Lares	Lares	40	8
Festival del Petate	Sabana Grande	50	10
Feria Nacional de Artesanías Barranquitas	Barranquitas	300	20
UPR Río Piedras	San Juan	30	6
Feria Nacional Parque Luis Muñoz Marín	San Juan	300	40
Feria Artesanal Plaza de las Américas	San Juan	100	29
Fiestas de la Calle San Sebastián	San Juan	300	30
Encuentro de Talladores Aguada	Aguada	30	7

stakeholders, who provided a context for underlying policies, processes, values, and power structures that influence the local handicraft sector.

The analyses of the data were based on descriptive and inferential statistics for quantitative data. Promptly after each field trip the interviews were transcribed into word and the answers codified to calculate the frequency of each category. The open questions were codified following the methods proposed by Hernández-Sampieri, Fernández Collado, and Baptista Lucio (2010), which basically consist in clean, summarize, and categorize the answers to observe the prevalence of certain responses or reactions through the interviews. Omitted, incorrect, and incomprehensible answers were codified as missing values. Since a high number of missing values (i.e., $\geq 10\%$) indicates problems in the instruments, questions with high missing values were excluded from the analyses. This criterion of trustworthiness of the data was applied for all questions except income because this is a sensitive question that people often refuse to answer (Galobardes & Demares, 2003). In this case 12% of the artisans and 9% of the sawyers did not provide information about their income. Missing values were removed to calculate “valid percentages” of each variable (Hernández-Sampieri et al., 2010). In addition, we performed a Pearson correlation analysis between the percentage of income generated by the handicraft activity and the annual household income of artisans to evaluate the economic importance of the handicraft sector. This analysis was not performed for sawyers because of restrictions of sample size.

Results

Current use of local forest products in the handicraft market of Puerto Rico

The artisans used a great variety of forest products including 187 wood types (125 locally grown and 65 imported) and NWFPs such as seeds (32 species), calabashes (2 species), fibers (2 species), vines (4 species), bamboo (*Bambusa vulgaris* Schrad. ex J.C. Wendl.), coconut (*Cocos nucifera* L.), stones, shells of snails, and pieces of wood and glass polished by the sea (Table 2). Only eight tree species comprised more than 50% of the observations, and most of the species were native to Puerto Rico. Nonetheless, some naturalized species of fine hardwoods such as mahogany (*Swietenia* spp.), mahoe (*Talipariti elatum* (Sw.) Fryx.), and teak (*Tectona grandis* L.) were among the most frequently used woods (Table 2).

The artisans made a variety of products including wood sculptures (religious art and birds), wood turning (bowls and pens), toys, jewelry, furniture, musical instruments (stringed and traditional), and several decorative objects such as replicates of typical scenes, paints on wood, masks, and mosaics (Table 3). The price of the products ranged from \$US 1 for minimally elaborated handicrafts to \$US 40,000 for unique and finely crafted pieces of popular art such as wood sculptures, paints, and mosaics (Table 3).

The artisans either buy the raw material or collect it in private forests, state forests, urban forests, or farms. The majority of the artisans (98%) used local wood; 66% exclusively used local wood, 32% used both imported and local wood, while only 2% exclusively used imported wood. Half of the artisans that worked with local wood purchased it at local sawmills, 30% purchased and collected it; while 18% always collected the wood and never purchased it. Most of the artisans (70%) that work with NWFPs

Table 2. Use of forest products by local artisans in Puerto Rico.

Forest product	Common name	Species	Craft products	No. of observations
Wood	Mahogany	<i>Swietenia</i> spp.	Wood sculptures, furniture, turned wood, string instruments, paints, mosaics and jewelry	191
	Spanish cedar	<i>Cedrela odorata</i> L.	Wood sculptures, furniture, and string instruments	150
	Mahoe	<i>Talipariti elatum</i> (Sw.) Fryxell	Wood sculptures, furniture, turned wood, string instruments, and jewelry	120
	Spanish elm	<i>Cordia alliodora</i> (Ruiz & Pav.) Oken	Furniture, turned wood, string instruments, paints, and mosaics	111
	Lignum vitae	<i>Guaiaacum</i> spp.	Wood sculptures and turned wood	100
	White cedar	<i>Tabebuia heterophylla</i> (DC.) Britton	Furniture, turned wood, and string instruments	76
	Teak	<i>Tectona grandis</i> L.	Wood sculptures, furniture, and turned wood	75
Bastard stopper	<i>Petitia domingensis</i> Jacq.	Wood sculptures, furniture and turned wood	70	
NWFPs				
Seeds	34 species		Necklaces, bracelets, and earrings	79
Bamboo		<i>Bambusa vulgaris</i> Schrad. ex J.C. Wendl	Jewelry, lamps, vases, and other household items	63
Coconut		<i>Cocos nucifera</i> L.	Jewelry, masks, cups, candelabums, and piggy money boxes	52
Calabashes	<i>higüera</i>	<i>Crescentia</i> spp.	Containers, cups, maracas, pyrography, and masks	58
	<i>marimbo</i>	<i>Lagenaria siceraria</i> (Molina) Standl.	<i>güiros</i>	8
Fibers	<i>enea</i>	<i>Typha domingensis</i> Pers.	Chairs and tables	
	<i>maguey</i>	<i>Furcraea tuberosa</i> (Miller) W. T. Aiton	Baskets	
Vines	<i>bejuco de paloma</i>	<i>Paullinia pinnata</i> L.	Baskets, hats, lamps, and bottles	4
	<i>bejuco prieto</i>	<i>Hippocratea volubilis</i> L.		
	<i>bejuco de calabaza</i>	<i>Philodendron lingulatum</i> (L.) K. Koch		
	<i>cupey de altura</i>	<i>Clusia gundlachii</i> Stahl		
Others	Stones, shells of snails, pieces of wood and glass polished by the sea		Jewelry, decorative objects	50

Note: The number of observations did not add up to the total number of interviewed artisans (271) because some artisans used various types of forest products.

collected the raw material, less than 5% cultivated seeds or calabashes, and only 25% purchased NWFPs

Most of the artisans (95%) worked individually, operated from their home, and mainly marketed their products in public festivals organized by the artisans-FOMENTO program. The remaining 5% were furniture makers who sold their products in their own workshops.

Table 3. Type of products crafted by local artisans in Puerto Rico.

Segment	Purchasing categories	Price range \$US	Key product characteristics	Type of product	No. of observations
Luxury/high-end term	Design and quality	200 > 1000	Ethnic crafts	Popular art (wood sculptures, paints, mosaics)	108
				Very high quality	Traditional furniture
			Crafts with artistic design	String musical instruments (guitars, <i>cuatros</i> , <i>bordonudas</i>)	9
				Baskets	4
				Percussion instruments (drums)	4
Middle-end term	Design, price, and quality (price must meet design and quality)	75–200	Crafts with artistic design	Decorative accessories (wood sculptures, paints, masks, mosaics)	137
				Utilitarian accessories (turned wood, toys, baskets)	42
				Traditional musical instruments (<i>maracas</i> , <i>güiros</i> , drums)	8
				Baskets	4
Low-end term	Price and design	<75	Inexpensive Low quality Simplified traditional crafts	Souvenirs	235

Note: The total number of observations did not add up to the total number of interviewed artisans (271) because many participants crafted more than one type of product.

Only 15% of the artisans had a permanent place to market their products, 6% supplied retailers, and 3% sold their handicrafts by Internet or catalogue. The majority of the artisans (70%) considered that the demand for their products had decreased in the last five years. According to 33% of the artisans, the cost of food, transportation, and accommodation associated with the festivals can exceed revenue through sales. In their need to increase sales, several artisans indicated that they had offered inexpensive products. Only 24% of the artisans considered that the demand for their products has increased. This group included wood carvers, luthiers, and craftsmen that made toys, jewelry, and other home accessories with innovative designs at accessible prices.

The age of the artisans ranged from 18 to 83 yr with a mean of 52.3 (SE 0.8), 36% were retired, and more than 50% were older than 60 yr. All the artisans, except one, had some degree of formal education. Three quarters of the artisans that work with wood were male, while more than half of those working with NWFPs were female. In terms of economics, for the majority of the artisans (60%) the production of crafts represented less than 50% of their income, whereas merely 37% indicated that they made a living from this activity. There was a significant negative correlation between the percentage of income generated by the artisan activity and the annual household income ($R = -0.25, p < 0.001$). In addition, near 10% of the families lived under Puerto Rico’s poverty line, broadly defined by the United States Census Bureau (2016) as those families with an average of 3.2 members and a household income of less than \$10,000 a year, or less than \$250 a month per household member. Merely 25% of the artisans indicated that they had received incentives for tools or grants from the artisan development program, and some considered that the process of application is complicated

and/or ineffective because they must purchase the tools in advance to receive a reimbursement from the program.

Production of local wood

The local sawmills were small-scale businesses operated by their owner and no more than two permanent employees. Only two of the establishments were primarily dedicated to the production and sale of wood; the other nine sawmills belonged to furniture makers or carvers who process wood for their work and occasionally sell it. The sawyers were all adult men between 39 and 68 years of age, with a mean of 53.8 (SE 2.5). All have some degree of formal education. A third of them were retired and 50% indicated that their income is totally derived from wood sales. Ninety percent of the establishments had been operating for more than 20 yr, their equipment was in general not replaced during this time period, and they lacked ovens to dry and season wood properly. Annual wood production did not exceed 12,000 board feet (28.8 m³) for any establishment and only half of them operated full time (Table 4).

The sawyers processed a total of 37 timber tree species (Table 5). In general, they collected the wood from public areas when trees are removed or trimmed. Sometimes they harvested undesired trees in private properties taking the wood in exchange for labor and rarely purchased stand trees from farmers. The price per board foot (0.0024 m³) ranged from \$US 2.50 for low-demand woods such as tropical almond (*Terminalia catappa* L.) and antilles calophyllum (*Calophyllum antillanum* Britt.), considered low-quality woods by some artisans because they have relatively poor machining properties, to \$US 13.50 for highly valued and scarce woods such as teak and mahoe. In general, the sawyers considered common woods such as mahogany and American muskwood (*Guarea guidonia* (L.) Sleumer) as abundant, but several species such as teak, mahoe, lignum vitae (*Guaiaacum* spp.), maga (*Thespesia grandiflora* DC.), grandleaf seagrape (*Coccoloba pubescens* L.), bulletwood (*Manilkara bidentata* (DC.) A. Chev.), and yellow sanders (*Zanthoxylum flavum* Vahl) were considered scarce. Likewise 35% of the artisans considered that the local wood is expensive and not available in standard measurements. Both artisans and sawyers attributed the low availability of wood to scarcity of some fine hardwoods that were overexploited in the past and to difficulties in obtaining permits from the DNER to harvest forest products.

Discussion

Local artisans and sawyers in Puerto Rico are home-based family microenterprises. They harvest, process, and trade a wide variety of local forest products including several types of

Table 4. Sawmill production, income, and age of the equipment in Puerto Rico.

	Volume processed (BF/yr)	Total income (US\$/yr)	Equipment age (yr)
Average	6,160	21,400	19.63
Maximum	12,000	37,000	40
Minimum	3,000	5,000	5
Median	3,600	20,700	19.63

Note: BF, board feet (0.0024 m³).

Table 5. List of woods harvested and milled by local sawmills in Puerto Rico.

Wood	Species	No. of observations	Average price US\$ BF
Mahogany	<i>Swietenia</i> spp.	10	4.4 ± 0.54
Spanish elm	<i>Cordia alliodora</i> (Ruiz & Pav.) Oken	10	4.6 ± 0.52
Spanish cedar	<i>Cedrela odorata</i> L.	8	4.5 ± 0.64
Teak	<i>Tectona grandis</i> L.	8	6.6 ± 1.85
Mahoe	<i>Talipariti elatum</i> (Sw.) Fryxell	7	5 ± 0.63
American muskwood	<i>Guarea guidonia</i> (L.) Sleumer	6	4 ± 0.87
Laurel geo	<i>Ocotea leucoxydon</i> (Sw.) Laness.	6	3.5 ± 0.41
Maga	<i>Thespesia grandiflora</i> DC.	6	5 ± 0.82
Capa blanco	<i>Petitia domingensis</i> Jacq.	5	4.6 ± 0.59
Higüerillo	<i>Vitex divaricata</i> Sw.	4	4 ± 0
Laurel espada	<i>Ocotea floribunda</i> (Sw.) Mez	4	4.5 ± 0.71
Stinkingtoe	<i>Hymenaea courbaril</i> L.	3	4
Siamese cassia	<i>Senna siamea</i> (Lam.) H.S. Irwin & Barneby	3	3.5
Cedro macho	<i>Hieronyma clusioides</i> (Tul.) Muell.-Arg.	3	4.75
Laurel amarillo	<i>Nectandra sintenisii</i> Mez	3	3.5 ± 0.71
Cabbagebark tree	<i>Andira inermis</i> (W. Wright) Kunth ex DC	3	3.4 ± 0.53
White cedar	<i>Tabebuia heterophylla</i> (DC.) Britton	3	4.3 ± 0.58
Tropical almond	<i>Terminalia catappa</i> L.	2	3.0 ± 0.71
Bulletwood	<i>Manilkara bidentata</i> (DC.) A. Chev.	2	NA
Jagüilla	<i>Magnolia portoricensis</i> Bello	2	NA
Antilles calophyllum	<i>Calophyllum antillarum</i> Britton	2	2.5
Grandleaf Seagrape	<i>Coccoloba pubescens</i> L.	2	NA
Amboine	<i>Pterocarpus indicus</i> Willd.	2	4.3 ± 1.1
Gregorywood	<i>Bucida buceras</i> L.	2	NA
Lignum vitae	<i>Guaiaacum</i> spp.		NA

Note: BF, board feet; NA, not available for sale.

wood and NWFPs. The production of handicrafts is an important form of self-employment and a main means to supplement the livelihood of low-income families. However, the local handicraft sector is severely inhibited by a number of challenges that are linked to the business environment and to the internal capacities of the enterprises for organization, business management, and marketing. A summary of the most serious challenges for the local handicraft sector include (a) low production and variable product quality, (b) low demand for local handicrafts and severe competition from imported products, (c) weak organization into associations to overcome scale and cost inefficiencies, (d) ineffective technical assistance and poor access to marketing and financial services, and (e) complicated process to acquire permits to harvest forest products. Let us consider each in detail to provide specific recommendations to help overcome them.

Local sawyers supply most of the wood that is consumed by local artisans, but low production and reliability of supply precludes them from participating in other important sectors of the market for solid wood products, such as construction and carpentry. Local artisans produce a variety of items for the domestic market, including both authentic and high-value handicrafts, as well as cheap and poorly designed souvenirs. The demand for local handicrafts is low and they face severe competition from imported crafts and souvenirs, which are in general inexpensive and sometimes depict local cultural symbols. Even though the Law for the Development of the Artisan Program (Law 64 of 20th June 2016) prohibits resale of handicrafts at the festivals that are organized by the artisan-FOMENTO program, imported crafts and souvenirs were sold in a third of the festivals that we attended. Few customers might be able to distinguish authentic traditional handicrafts from imported products (López, 2003, 2004). In addition, Puerto Rico's formal economy has been on a consistent decline from 2007 to 2016 (Junta de Planificación

Gobierno de Puerto Rico, 2016); and as part of the U.S. it has the same tariff system and is a member of all free trade agreements negotiated by the U.S., thus Puerto Rico is one of the most open economies of the world (Collins, Bosworth, & Soto-Class, 2006). With increased globalization, markets for handicrafts are becoming more and more commoditized, with artisans facing increased competition from producers of all over the world, but particularly from China, India, and Vietnam, which dominate the market because they are characterized by high production capacity, consistent quality, and low prices (United States Agency for International Development (USAID), 2006). In contrast, most of Puerto Rico's handicrafts are decorative objects that do not have a functional use today. Wood as a raw material for making handicrafts has remained very traditional, and the products exhibit high-quality variability.

The competitive nature of globalized markets brings new challenges to handicraft producers because they must be more responsive in adapting designs to buyer requirements and improving quality and efficiency in view of increased price competition and consumer expectations (United States Agency for International Development (USAID), 2006). The success of SFEs mainly depends upon the degree to which they can overcome scale disadvantages (Donovan et al., 2006; Macqueen et al., 2006). Grouped in associations, small forest enterprises can increase product reliability, secure training opportunities, and attract donor support that would be less accessible to individual enterprises (Macqueen, 2006). The handicraft sector in Puerto Rico, however, is extremely individualistic. Even though several artisan associations are organized to represent the group's interests, there is no collaboration to achieve appropriate production scales. Local sawyer's networks could facilitate wood harvesting, distribution, and seasoning to increase local wood production, supply, and reliability. Working in association it would be possible for sawyers to pursue certification of the Forest Stewardship Council to target U.S. markets for certified tropical hardwoods or supply suitable sawn wood to local cabinet and construction sectors. Artisans could also network among themselves to set quality standards for their products, supply retailers, and create online stores to sell their products over the Internet.

An effective strategy for small enterprise development needs to build the capacity of locals to become entrepreneurs, as well as increase the competence of all support structures involved in helping them (Lecup, 2011; Macqueen, 2008). In Puerto Rico, the Artisan Development Program is implemented by FOMENTO in cooperation with other agencies and programs that also provide services to artisans under their particular missions. The program currently certifies between 800 and 1000 artisans per year and supports the organization of more than 10 festivals where they can sell their products directly to customers (H. Rodríguez-Torres, personal communication, May 10; 2017), but it lacks institutional capability and resources to provide effective technical assistance to help artisans increase competitiveness, market their products, and preserve traditions. Therefore, to help artisans develop profitable microenterprises there is a need for building linkages to improve collaboration between government institutions, NGOs, and artisan associations to facilitate information-sharing and skills reinforcement. To enhance awareness and appreciation of handicrafts, the Puerto Rican Tourism Company could help promote handicrafts as articles of cultural and traditional value. Hotels, airports, ports, and souvenir shops could be used to display and sell local handicrafts. Given the scarcity of local agents, active engagement of the private sector is essential to improve marketing. Organizations such as export firms, charitable groups, and development agencies are necessary to handle communication, oversee production, carry out financial transactions,

and manage the packaging and shipping of orders (United States Agency for International Development (USAID), 2006; Richard, 2007). Financial institutions are also needed to provide credit to local artisans and sawyers. Microcredit is the best instrument to improve income generation capabilities of small producers (Richard, 2007). Legal and regulatory reforms can create incentives for microfinance by simplifying registration, abolishing artificial caps on interest rates, loosening regulations governing non-mortgage collateral, and reducing the cost of property registration (Tomaselli & Hajjar, 2011).

Another key strategy element needed to support the development of forest-based enterprises is the simplification of the licensing process to harvest forest products and the supervision of their sustainable use (Lecup, 2011; Scherr et al., 2002). Even though Puerto Rico's forests are still too young to sustain extensive wood production, a substantial volume of trunks and branches is cut and trimmed for maintenance and development of infrastructure, or is lost through tropical storms and hurricanes. Most of the wood including valuable timber trees such as mahogany is shredded (Forero-Montaña, 2015). Rather than waste the wood of valuable timber trees, sawyers and artisans should be able to access this resource. To address this uncertainty, tree-harvesting legislation needs to be revised to reduce undue bureaucratic delays to acquire permits for harvesting forest products. Although the demand by artisans working with woods and NWFPs doesn't appear to exceed the current supply of forest products, to ensure sustainable harvest rates a sound permitting process must be informed by a survey on the ecological health of the most frequently used species.

Conclusions

Handicrafts are a major form of cultural expression and play a key role in promoting human development through income generation and employment (United States Agency for International Development (USAID), 2006; Richard, 2007; Grobar, 2017). The handicraft sector can create jobs at a minimal cost because it is a home-based industry that requires minimum expenditure and infrastructure to establish (Richard, 2007). Artisans in Puerto Rico, as part of the U.S., have access to the largest markets of tropical woods (Robbins, 2000) and home accessories in the world (Richard, 2007), but a number of scale disadvantages hinder their competitiveness in globalized markets. Thus to take advantage of market opportunities and raise incomes significantly artisans must improve quality and efficiency. To overcome human capital and information constraints, artisans need access to better business development services. Cooperation and linkages between all support organizations (i.e., government institutions, NGOs, and local associations) are essential to provide better services to artisans. A particular effort should be made to facilitate networking and exchanging of information at all levels. Strengthening associations of artisans is essential to improve market information, reduce isolation, and link artisans with financial and business development services. Marketing local handicrafts by the Internet is a strategic tool to raise public awareness. Through a website, artisans could access training modules and marketing services. Accessible financing support to SFEs is essential to improve the infrastructure of sawmills and artisan workshops. Effective monitoring is needed to discourage sales of imported crafts and souvenirs in public artisan events. It is important to develop a product-specific label to distinguish authentic Puerto Rican handicrafts from imported products. Simplification of the process to acquire permits to harvest

forest products and supervision of their sustainable use is critical to ensure industry feasibility.

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