Public Knowledge and Perceptions about Urban Forests in a Watershed Context

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Introduction

A large amount of urban population and increases in built-up areas in Puerto Rico put great pressure on forested lands within urban environments. Human well-being and the quality of life of urban populations greatly depend on urban forests and green areas. Forested lands in urban areas are also important for supporting other resources such as water. Hence, it is imperative to increase public knowledge and understanding about the benefits provided by urban forests, the factors affecting them and the means of conserving and making wise use of such forests.

For effective communication and knowledge transfer, it is important for natural resource managers and educators to know what knowledge already exists, and what the gaps in information are or misunderstandings people have. This understanding is useful for the development of environmental education strategies and outreach activities by building upon existing knowledge and providing new information where gaps in information and misconceptions exist.

This publication provides a summary of the findings obtained from questionnaires conducted with residents from the Río Piedras watershed. The main objective of the questionnaires was to assess residents' knowledge and perceptions about the benefits provided by urban forests, the factors affecting benefit provision, the role urban forest have on rivers and water resources, and information needs regarding urban forests and their benefits. The study did not intend to be a comprehensive and exhaustive one, but instead a first, but thorough glance, at local knowledge and perceptions for educational rather than purely scientific purposes. The information provided can help natural resources specialists and educators from governmental and non-governmental organizations to better design educational strategies, awareness campaigns, and outreach initiatives regarding urban forests. The ultimate goal is to enhance existing knowledge about the urban forest, and promote new one that could stimulate behavioral changes, wise use of resources, and conservation practices at different levels.

Data collection

A total of 120 residents from twelve communities within the Río Piedras watershed participated in the study (Figure 1). The communities were randomly selected based on two conditions: communities located at lower elevations (< 100m), in a relatively dense urban setting, and communities at higher elevations (> 100m) , in a more rural and forested environment. Participants from each stratum are referred in this publication as "lowland participants" or "lowlanders" (those from urban communities at lower elevations), and "highland participants" or "highlanders" (those from more rural and forested communities at higher elevations). Eight communities were selected from the lower elevation stratum and four were selected from the higher elevation one. Ten people were interviewed within each community. Data collection took place during August, November, and December 2009.

A questionnaire including closed- and open-ended questions was administered to each participant. The questionnaires were carried out by the research team members using the "face-to-face" technique (Figure 2). Questionnaires took place in the

the homes of the participants and lasted from thirty minutes to one hour each. It included questions regarding participants' knowledge about urban forests, their benefits, and the factors influencing benefit provision, forest visitation, and information needs about urban forests. The questionnaire also included questions about participant's demographic characteristics, level of education, livelihoods, and time living in the communities.

Participants' demographic and socioeconomic characteristics

A total of 120 people took part in the project; 80 from the lowland stratum and 40 from the highland stratum. The average age of all participants was 56.4 years, ranging from 18 to 95. Lowland participants were slightly younger (average age 55.6 years) compared to highland ones (average age 58.0 years). In terms of gender, there were more female (57%) than male (43%) participants. This tendency was the same among strata, but there were relatively more female participation among the highland participants (Table 1).

Overall, 61% of all participants had completed a university degree, but this level of education occurred more among lowland participants than the highland ones (79% versus 25%). Alternatively, lowland participants reflected a lower number of technical and university degrees; the majority had completed either intermediate or high school (68% of those participants). Slightly more than one third of the participants (37%) reported to be working in the service sector; the remaining participants reported to be either retired (33%), housewife (19%), student (10%) or unemployed (2%). In terms of income, most participants belonged to the lowest yearly family income categories; 41% reported to earn less than $15,000, and 25% between $15,000 and $25,000. Lowland participants tended to have higher yearly family incomes, compared to their highland counterparts.

On average, participants have lived 31 years in their communities, ranging from 1 to 83 years. Highland participants have lived a relatively longer time in their communities (45.0 average years) as compared to their lowland counterparts (24.3 average years).

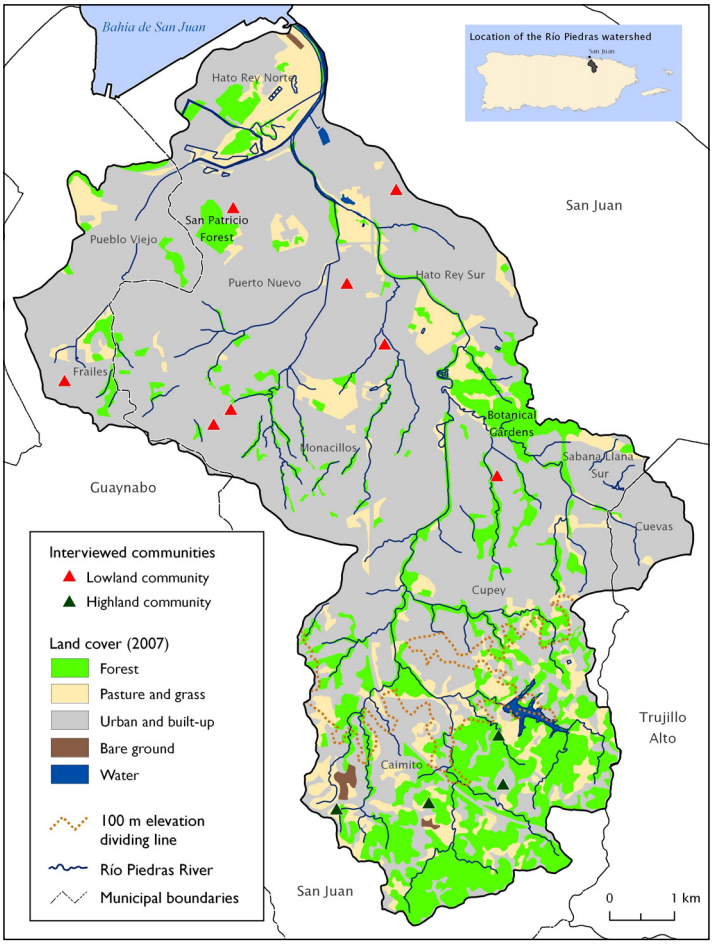

Figure 1. Location of the study area

Figure 2. Research assistant writing down answers provided by participant

Table 1. Summary of participants' demographic and socioeconomic characteristics

Category	Sub-category	Lowlanders (n = 80)	Highlanders (n = 40)	Total (n = 120)
Gender	Female	52.5	65.0	56.7
	Male	47.5	35.0	43.3
Level of education	Elementary school (K-6)	1.3	22.5	8.3
	Intermediate school (7-9)	0	12.5	4.2
	High school (10-12)	8.8	32.5	16.7
	Technical degree	11.3	7.5	10.0
	University degree	78.0	25.0	60.8
Yearly family income ($)	< 15,000	26.3	70.0	40.8
	15 – 25,000	23.8	27.5	25.0
	25 – 35,000	16.3	2.5	11.7
	35 – 45,000	10.0	0	6.7
	> 45,000	23.8	0	15.8

Numbers are percentages in each case.

Findings

Knowledge and use of terminology

More than half of the participants were familiar with the concept "urban forest", being 68% of them able to provide a basic definition or describe the term. They would define it as "a group of trees nearby residential areas", or they would offer a description of the term, such as a "forest surrounded by construction", "a green area in the middle of an urban area", "a conserved area within an urban zone", "forests and parks within urbanizations", or "trees surrounding their home". Otherwise, they would highlight a function associated with urban forest, such as something that purifies the air in urban areas. Other participants would provide an example of a specific urban forest park when referring to the term, like the Botanical Garden, the San Patricio Forest, and the Santa Ana Forest. The remaining 33% of the participants had never heard the term. Lowland participants tended to be more familiar with the term (71% of those participants), compared to highland ones (60%).

Regarding the concept "watershed", although about half said they were familiar with the concept, only 11% of them were able to provide a general definition or description. They defined it as "an area which assembles rain that flows to the river" or as "an area where the water flows". Some of the participants mentioned they had heard the term but did not know its meaning, while others said to be familiar with the term but failed to define it. Lowland participants reported having heard the term more (55% of those participants) than highland ones (30%).

Benefits provided by urban forests

All participants agreed that urban forest were beneficial. Temperature regulation was the most cited benefit among all participants (88%), followed by oxygen production (59%), air purification (58%), and habitat for flora and fauna (53%) (Figure 3). While habitat for flora and fauna was among the most cited benefits of urban forests, overall participants showed limited knowledge of the plant and animal species living in the urban forests, as they mentioned only general categories (for example, birds, ferns), or common species (for example, *flamboyan*, *reinitas).*

Temperature regulation was the most cited benefit by both lowland and highland participants. Oxygen production was less identified by lowland participants, but air purification was more cited by that group. Recreation and human well-being were most recognized by lowland participants, compared to highland ones. On the other hand, forest products were more cited by highland participants and less by lowland ones (Figure 4).

When referring to the list of benefits, and asking which ones participants esteemed most important, temperature regulation, air purification, and oxygen production were the most cited ones (by about half of the participants in each case). These three benefits, however, had medium importance value; when compared to other benefits which were identified as relatively more important. For instance, economic development was considered as the most important benefit provided by urban forests, but by 1% of all participants. Scenic value and habitat for flora and fauna also were among the most important identified benefits, but were mentioned as such by just 11% and 27% of all participants, respectively (Figure 5).

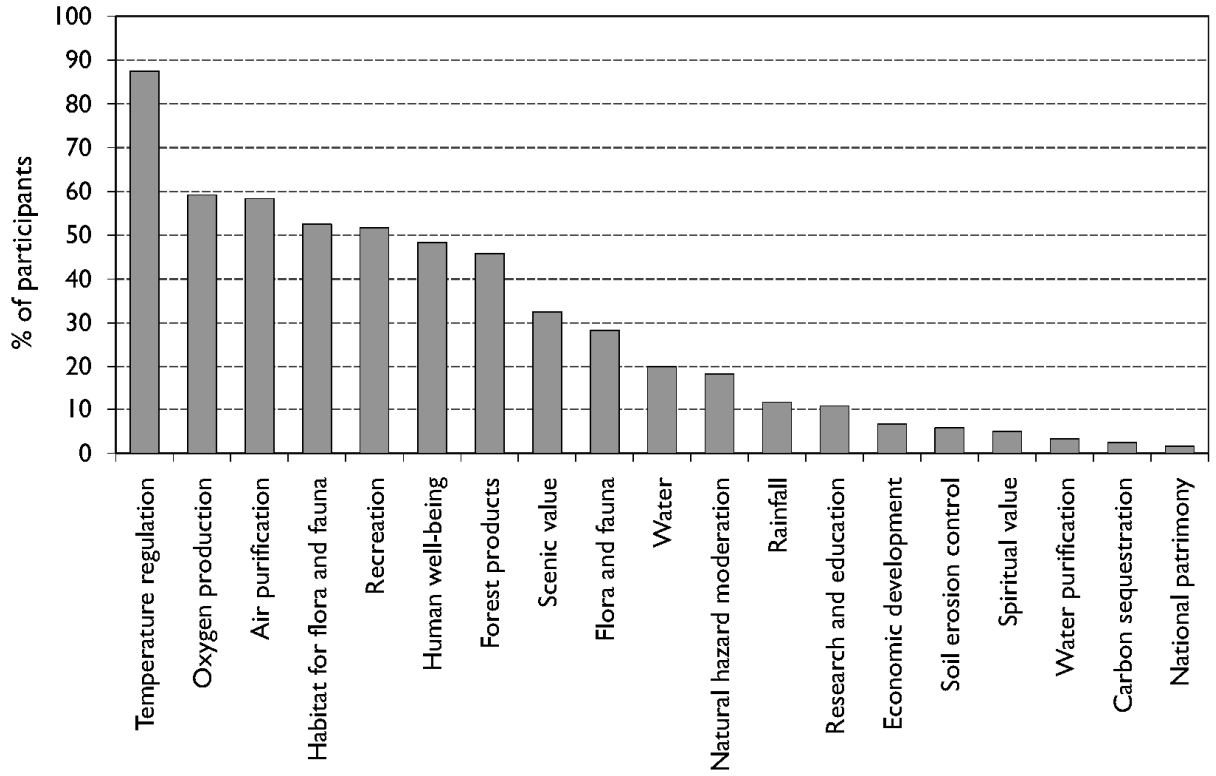

Figure3. Benefits of urban forests mentioned by all participants (Table 2 describes each benefit)

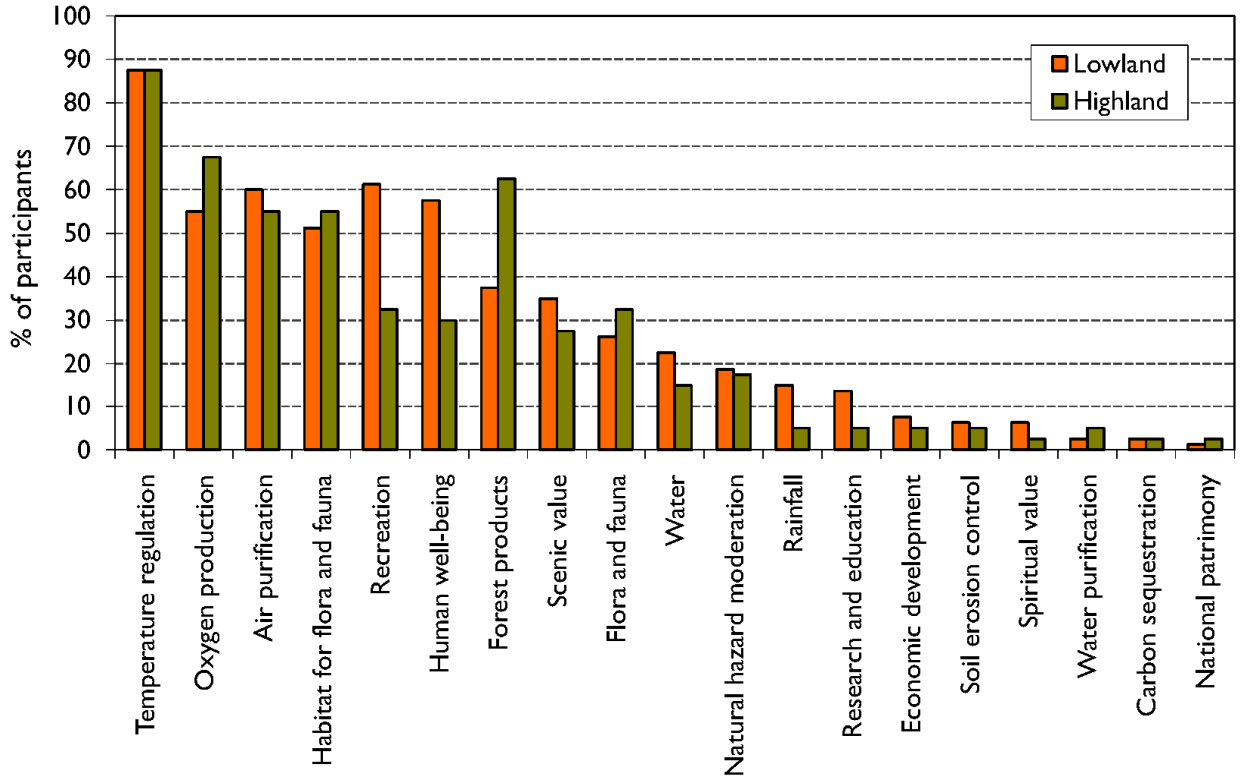

Figure 4. Benefits of urban forests mentioned by participants of different strata

Table 2. Description of the benefits provided by urban forests

Benefit	Description *
Forest products	Forest and plant products, including flowers, ornamental plants, and medicinal plants
Temperature regulation	Shade, cool air, reduction of temperature
Flora and fauna	Animals and vegetation associated with urban forests
Air purification	Filtering and absorption of air pollutants
Recreation	Passive and active recreation, including hiking, camping, picnics, family get-togethers
Oxygen production	Production of air; named by some as "natural lungs"
Human well-being	Mental and physical health, including therapy, tranquility, relaxation, peace, physical exercise
Economic development	Direct and indirect income-generating activities, including ecotourism
Habitat for flora and fauna	Plant and animal habitat, refuge, shelter, and reserve for species protection, specially for endemic and endangered species
Water	Surface water from rivers and streams, water recharge and storage
Natural hazard moderation	Protection against, and damage reduction from, natural hazards, mostly flooding
Rainfall	Production and regulation of precipitation and humidity
Research and education	Advance of scientific knowledge and knowledge transfer; forest use for educational activities, learning about nature
Scenic value	Natural beauty, pleasing landscapes, beautiful views
Water purification	Cleaning and purification of water through sediment reduction and water pollutants filtration
National patrimony	Historic importance for the presence of old trees
Carbon sequestration	Capture of carbon dioxide and its role in reducing climate warming
Soil erosion control	Soil retention and prevention of soil loss
Spiritual value	A place to pray, meditate, seek spiritual fulfillment

* The description of each benefit is based on how participants described the benefits, hence the descriptions do not necessarily follow any pre-established definitions.

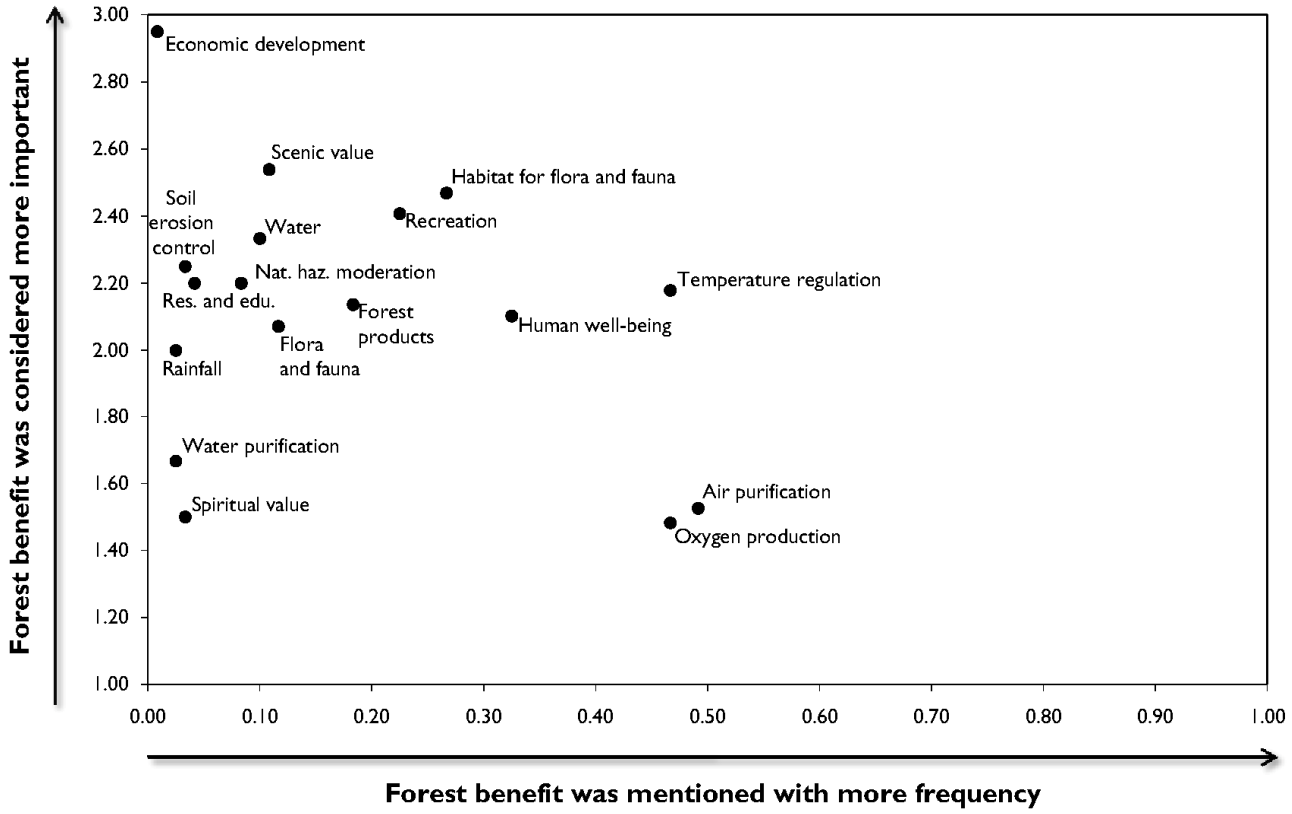

Figure 5. Summary of the three most important urban forest benefits mentioned by all participants

Provision of urban forest benefits and factors affecting the forests and their benefits

Most participants perceived that the provision and quality of urban forest benefits are worsening, and attributed change in land cover –specifically deforestation and construction– as the main factor affecting urban forests and their benefits. After land cover change, pollution was perceived as another important factor. While some participants perceived the provision of some benefits as improving (for example, water, soil erosion control, and rainfall), the perception of the benefits worsening was proportionally greater (Figure 6). Among those factors participants perceived as improving urban forests and benefits provision were environmental education and awareness raising, and forest conservation. Relative to negative factors, positive ones were less cited (Figure 7).

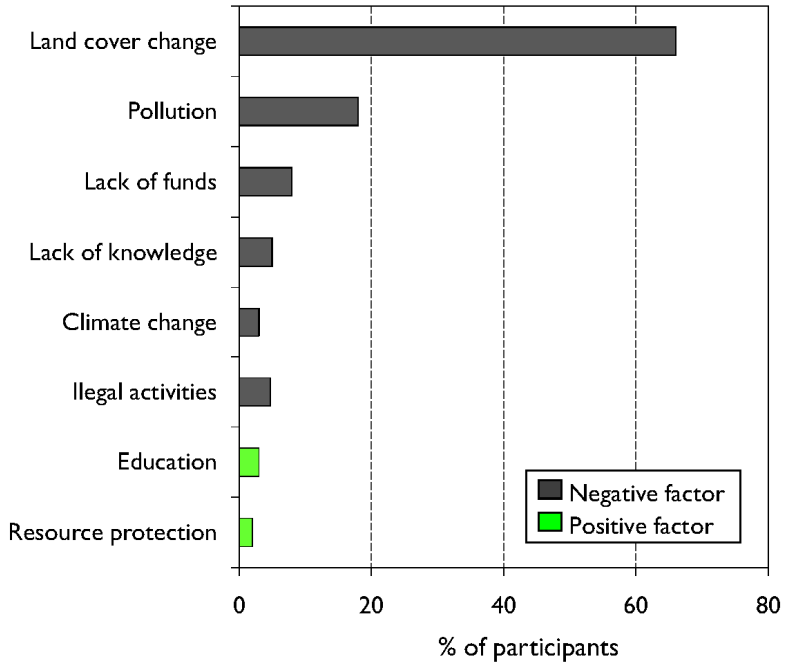

Figure 7. Participants' perception of the factors affecting urban forests and the benefits they provide (Table 3 describes each factor)

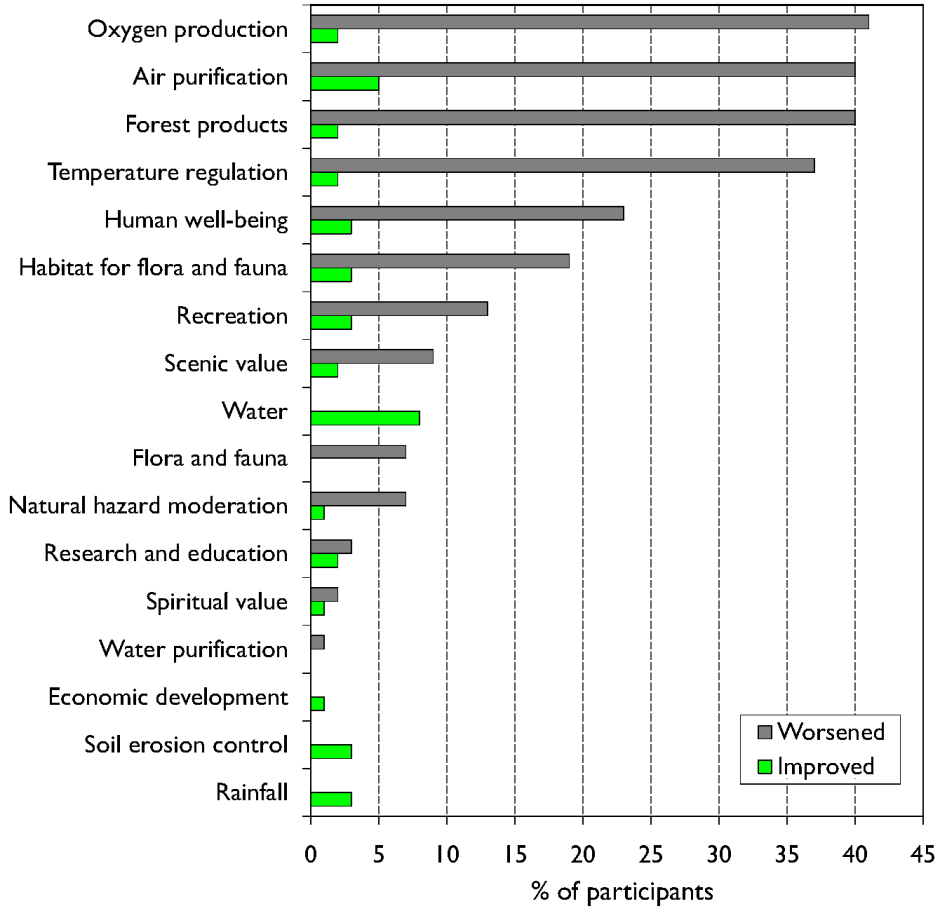

Figure 6. Perceived trends in benefit provision of those benefits identified as most important by all participants

Table 3. Description of the negative and positive factors affecting urban forests and their benefits

Negative factor	Description *
Land cover change	Changes in the vegetation or material that covers the area's surface, mainly associated with forest loss and urban expansion
Pollution	Pollution of air and water resources
Lack of funds	Lack or limited funds to increase personnel to attend forests maintenance and facilities
Lack of knowledge	Lack of or limited knowledge about the benefits provided by urban forests and human actions that affect the forests
Climate change	Local and global climate change and the potential effects on local precipitation patterns
Illegal activities	Lack of security within and around the forest (e.g., criminality)
Positive factor	**Description ***
Education	Knowledge transfer and environmental awareness about urban forests and their benefits
Resource protection	Protection status of forests, and the laws and regulation associated with that protection

* The description of each factor is based on how participants described the benefits, hence the descriptions do not necessarily follow any pre-established definitions.

Benefits of urban forests on rivers

When asked specifically about the benefits urban forests provide to the river (in this case the Río Piedras), nearly half of all participants (46%) recognized that urban forests maintain the river's water flow. Others mentioned the benefits of water purification (27%) and soil erosion control (23%) (Figure 8). Lowland participants were the ones that proportionally cited more functions, including, for example, maintenance of river flow, and absorption and storage of water. The functions of water purification, soil erosion control, water temperature, fauna support, were similarly mentioned by participants from both strata.

Participants from both strata showed limited knowledge of plants and animal species, this time concerning the ones living in, and being sustained by, the river. They mentioned general categories (for example, fish and shrimp) and common species (for example, heron).

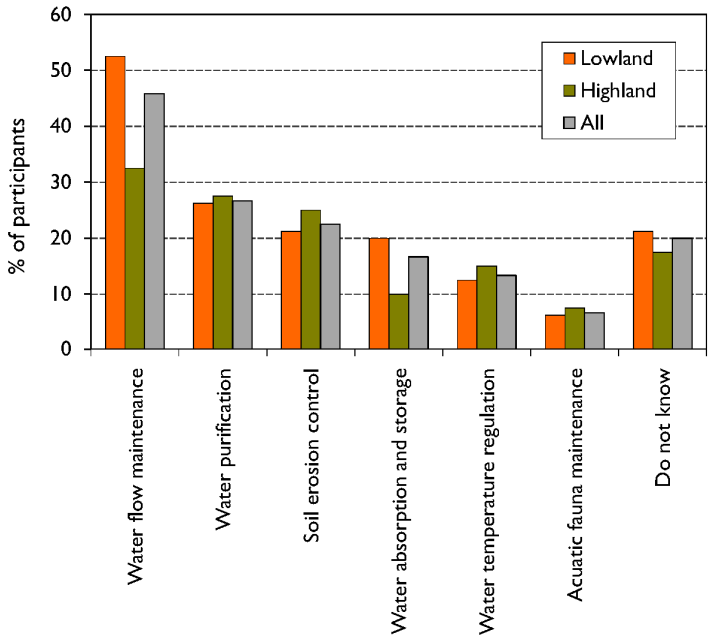

Figure 8. Benefits urban forests provide to river

Negative aspects associated with urban forests

The majority of the participants (73%) did not relate anything negative to urban forests; instead, they considered them beneficial to society. The remaining 27% mentioned, among others, the following negative aspects: being the source of harmful or undesirable animals, potential places for illicit acts, poor maintenance, and potential damage to property caused by trees. Lowland participants perceived more negative elements compared to highland ones (31% versus 20%).

Urban forest visitation

More than half of all participants (57%) said they visit urban forests. A slightly greater amount of highland participants reported visiting the urban forests (58%) versus 56% of the lowland participants. The Botanical Garden was among the most mentioned urban forest people visit (62% of those who visit urban forests), followed by forested areas nearby their residences (32%), and the San Patricio Forest (24%). Other mentioned, but less visited urban forest or parks, were Parque Luis Muñoz Marín, Parque Monagas, and Lago Las Curías.

Less than half of the participants (43%) did not visit urban forests. Reasons given for not visiting urban forests included lack of time, advanced age, and lack of knowledge about which urban forests to visit and how to get there. Other less cited reasons included health problems, lack of interest about urban forests, fear of them (because of perceived spots of criminal activities), and fear of animals that may live in the forests.

Information needs about urban forests

Most participants (80%) had never obtained, nor searched for, information about urban forests. This percentage was slightly higher among highland participants (93%) than for lowland ones (73%). Those who had access to some information, mentioned information about what urban forests are, birds living in urban forests, and the interrelation between deforestation and flooding. Participants mentioning these bits of information were the least, and all of them were lowland participants. The principal sources for this information were schools, universities, newspapers, and the Department of Natural and Environmental Resources.

When offered the possibility of receiving information about urban forests, participants were keen on knowing about the facilities and amenities of urban forests (mostly mentioned by lowland participants), the benefits provided by urban forests, the actions to protect urban forests, and the flora and fauna within urban forests (Figure 9).

The preferred materials for receiving information about urban forests were informational brochures, talks or workshops, and interactive educational videos. Lowland participants, however, preferred receiving information as brochures, whereas highland ones preferred to be given talks or extended information in the form of educational books (Figure 10). As the preferred media to disseminate the information, most participants suggested television, printed materials, and personal communication. Television was preferred among lowland participants, whereas printed materials and personal communication in the form of talks were preferred among highlanders (Figure 11).

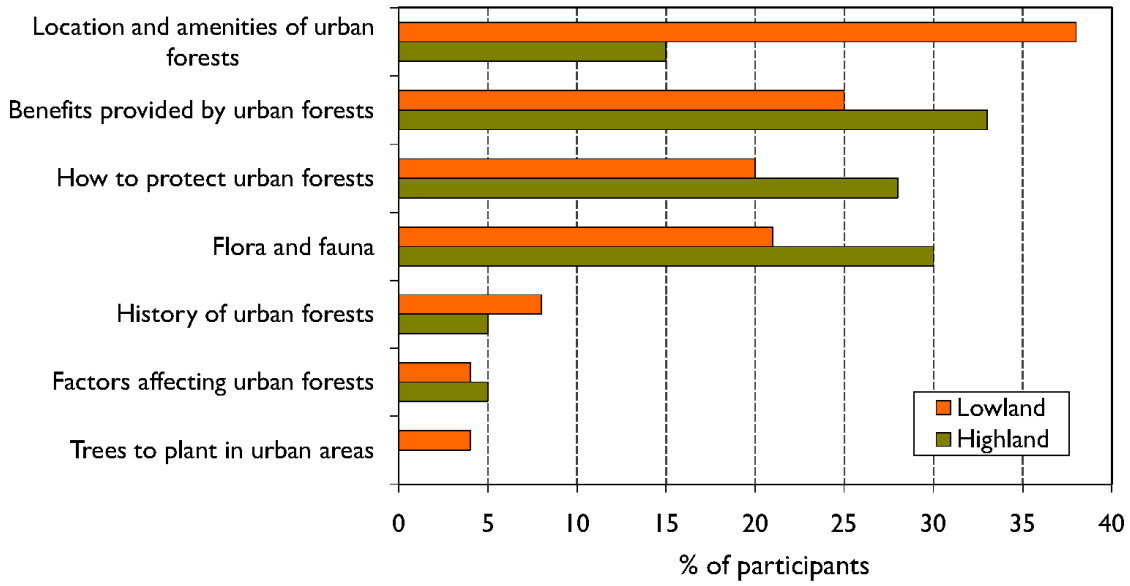

Figure 9. Information participants would like to receive

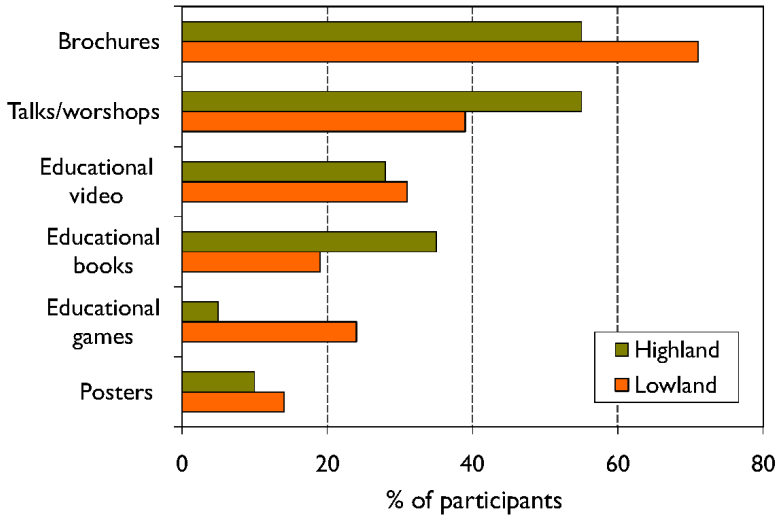

Figure 10. Preferred informational tools

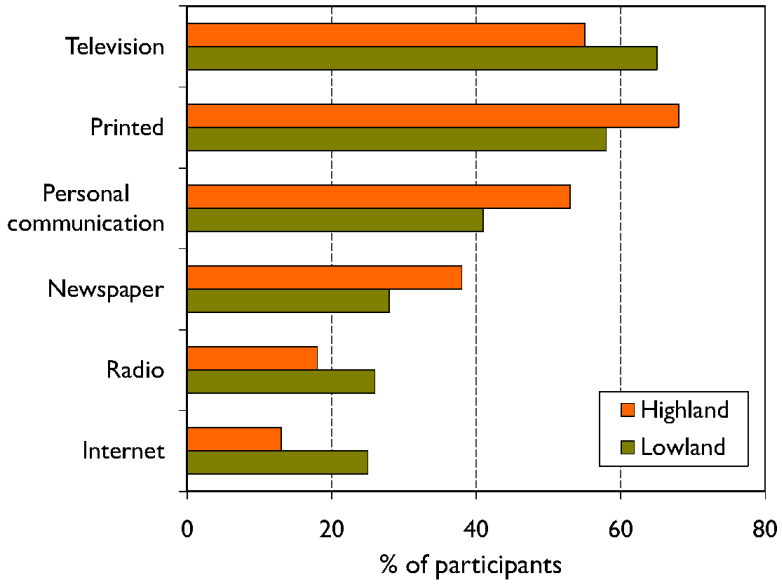

Figure 11. Preferred formats or media for information transfer

Summary and recommendations

The results obtained from the questionnaires with residents from the Río Piedras watershed helped us identify participants' knowledge about the benefits provided by urban forests, the factors perceived as affecting benefit delivery, and information needs regarding urban forests, particularly within the context of a watershed.

The term urban forest was generally known by participants, but the term watershed was less known. Air-related benefits –temperature regulation, oxygen production, and air purification– were the most cited benefits among participants. These benefits were also considered as the most important ones provided by urban forests. These "known" benefits, can be used as a starting point to initiate dialogue and discussion among people and to promote further understanding about urban forest benefits. The role of urban forests on water resources –in this case the benefits urban forests provide to the Río Piedras river– were less known by participants; at least they were not mentioned initially. Consequently, there is a need to increase public knowledge and understanding about the role of urban forests on rivers and water resources. There is, nonetheless, latent knowledge about such relationships; when asked specifically about the benefits and role of urban forests on the river, some participants were able to identify some benefits, while others recognized them once we discussed them during the interview. These benefits included, among others, water flow maintenance, water purification, and soil erosion control. This passive knowledge could be used as a starting point to increase that knowledge and to fill gaps in information and misunderstandings.

There was a general agreement among participants that the benefits provided by urban forests are decreasing over time, and urban expansion and deforestation were perceived as the main cause for these changes. In fact, all participants would be concerned about the clear-cutting of urban forests. These concerns could be used as a starting point to initiate dialogue and discussion with people about such topics, and to increase their knowledge about the factors affecting urban forests and the potential effects on benefits provision. Special emphasis could be given to the process by which forest removal affects water resources, particularly in the context of a watershed. In this respect, it is important to emphasize the potential effects of up stream forest removal, as opposed for example to other locations within the watershed. For communication and education to be effective, however, terms such as watershed and watershed-related processes need to be explained in a way that is easily understandable to people.

The particular information interests and formats expressed by participants should be taken into consideration when it comes to the development of educational strategies and the preparation and dissemination of educational materials. Participants expressed interest in learning about the location and amenities provided by urban forests. They were also interested in learning more about the benefits provided by urban forests, protection and conservation measures, and their fauna. In fact, the fauna of urban forests and the ones present in Río Piedras were widely unknown. Moreover, there was a perception that urban forests, because of their size and surrounding urban environments, did not have much potential for maintaining biodiversity. Additionally, and due to the conditions of the Río Piedras (e.g., polluted, channeled), people believed its capacity to support animal species was limited. Such gaps in information and misconceptions are among the things educational material and awareness raising can fill and demonstrate their importance for maintenance of fauna; along with other benefits.

Residents expressed interest in educational brochures and talks to increase their knowledge about the urban forests and the benefits they provide. Television, printed materials, and personal communication were the preferred means of information dissemination. Educational materials may include, among others, photographs and diagrams to facilitate understanding of concepts such as watershed, and to increase public knowledge about urban forests and the benefits they provide. Information needs and means to transfer such information varied among residents from the two strata. These differences should be taken into consideration for effective dissemination of information and knowledge increase.

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