

Public Knowledge and Perceptions about Karst Forests

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Introduction

The year 2011 has been declared by the United Nations as the “International Year of Forests” to raise awareness about forests, their conservation, and sustainable use. For effective communication and awareness to increase, it is important for natural resource managers and educators to understand public perception and knowledge about forests, their benefits, and the factors affecting them. This understanding can assist in 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 communities within the karst region. The main objective of the questionnaires was to assess residents’ knowledge and perception about the benefits provided by karst forests, the factors affecting benefits provision, and information needs regarding karst 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 karst forests. The ultimate goal is to enhance existing knowledge about the karst forests, and develop new knowledge that could stimulate behavioral changes, wise use of resources, and conservation practices at different levels.

Data collection

A total of 127 residents from twelve communities within the karst region (in the surroundings of Cambalache and Río Abajo State Forests) participated in the study (Figure 1). The communities were randomly selected based on three conditions: communities located in a relatively urban setting, communities within the urban-rural interface, and communities located in a relatively rural and forested environment. Participants from each stratum are referred in this publication as “urban participants” (those from urban communities), “mixed participants” (those from the urban-rural interface), and “forest participants” (those from rural, forested communities). Four communities were selected within each stratum, and ten to eleven people were interviewed within each community. Data collection took place during July 2009.

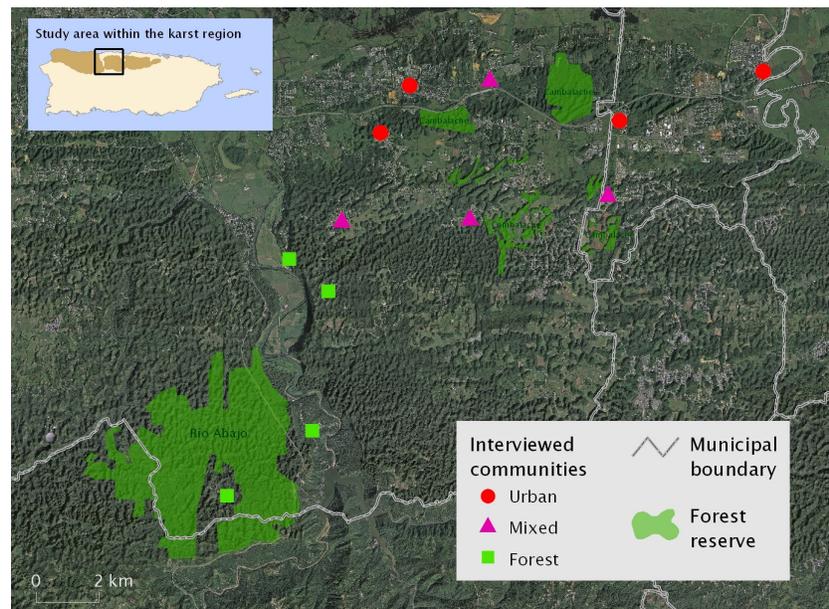


Figure 1. Location of the study area

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



Figure 2. Research assistant shows illustrations of the karst forests to participant

Participants’ demographic and socioeconomic characteristics

A total of 127 people took part in the project; 42 from the urban and forest strata, and 43 from the mixed stratum. The average age of all participants was 50.4 years, ranging from 18 to 81. Urban participants were slightly younger (average age 48.3 years) compared to mixed (average age 51.3 years) and forest participants (average age 51.6 years). In terms of gender, there were slightly more female (54%) than male (47%) participants. Female participation was slightly higher among urban and mixed participants, whereas male participation was slightly higher among forest participants (Table 1).

The majority of the participants (70%) had either finished high school or obtained some technical or university degree. Forest participants reflected a lower number of technical and university degrees; the majority had completed either intermediate or high school (86% of those participants). About one third of the participants (34%) reported to be working in the service sector, whereas less than 2% reported to work in the agricultural sector. The remaining participants were housewives (27%), retired (24%), unemployed (8%), or students (6%). In terms of income, most participants belonged to the lowest two yearly family income categories; 62% reported to earn less than \$15,000, and 24% between \$15,000 and \$25,000.

On average, participants have lived 32 years in their communities, ranging from 1 to 76 years. Participants from the forest stratum, however, have lived relatively longer in their communities (42.3 average years) as compared with 36.6 years of mixed participants and 16.0 average years of urban participants.

Table 1. Summary of participants’ demographic and socioeconomic characteristics

Category	Sub-category	Urban (n = 42)	Mixed (n = 43)	Forest (n = 42)	Total (n = 127)
Gender	Female	57.1	58.1	42.8	53.5
	Male	42.9	41.9	54.8	46.5
Level of education	Elementary school (K-6)	11.9	23.3	14.3	16.1
	Intermediate school (7-9)	4.8	2.3	26.2	11.0
	High school (10-12)	38.1	25.6	45.2	36.2
	Technical degree	14.3	9.3	2.4	8.7
	University degree	28.6	34.9	11.9	25.2
	No formal education	2.4	4.7	0	2.4
Yearly family income (\$)	< 15,000	54.8	60.5	71.4	62.2
	15 - 25,000	28.6	20.9	23.8	24.4
	25 - 35,000	9.5	0	0	3.1
	35 - 45,000	2.4	11.6	2.4	5.5
	> 45,000	2.4	7.0	0	3.1

Numbers are percentages in each case.

Findings

Knowledge and use of terminology

Overall, participants knew what a forest is about; 67% of them were able to provide a basic definition of what a forest is. Some of them referred to a forest as a “*conglomerado verde*”, “*lugar con árboles*”, or “*ecosistema*”. The remaining 33% offered rather a description or mentioned a benefit of a forested area, including for example, something that provides clean air, recreation, habitat for flora and fauna, and a tranquil and beautiful place. Urban participants were the ones that most frequently provided a definition for a forest (83% of them), compared to about 60% of the mixed and forest participants. The term forest, however, was not often used by participants. Instead, “*monte*” was a commonly used term when referring to a forest; it was mentioned by about half of all participants. Other, less cited terms to refer to the forest were “*montaña*”, “*campo*”, “*reserve*” or “*La Forestal*”, “*cerro*”, and “*maleza*”.

The term “karst”, on the other hand, was widely unknown by participants; 71% had never heard the word before. The remaining 29%, although stating they had heard it, did not necessarily know how to define or describe it. Some of these participants related karst to water, to a type of rock, or

to “white sand”. The lack of knowledge about the term karst was general among the three strata; 74% of the urban participants did not know nor have ever heard the word, compared to 70% and 69% from the mixed and forest participants, respectively.

Benefits provided by karst forests

When asked about the benefits provided by the karst forest, participants tended to highlight rather those provisioning services they may have experienced the most, including forest products, which was the most cited benefit among all participants (81% of them) and flora and fauna (mentioned by 75%). Moreover, they also identified benefits related to their quality of life, such as temperature regulation (which was cited by 76% of all participants) (Figure 3). While these three benefits (forest products, flora and fauna, and temperature regulation) generally constituted the most cited ones among participants from the three strata, their rank in terms of mentions differed. Temperature regulation, for example, was the most cited benefit among urban participants (cited by 81 of those participants), forest products was the most cited benefit for mixed participants (88%), whereas forest participants most frequently cited fauna and flora (83%) (Figure 4).

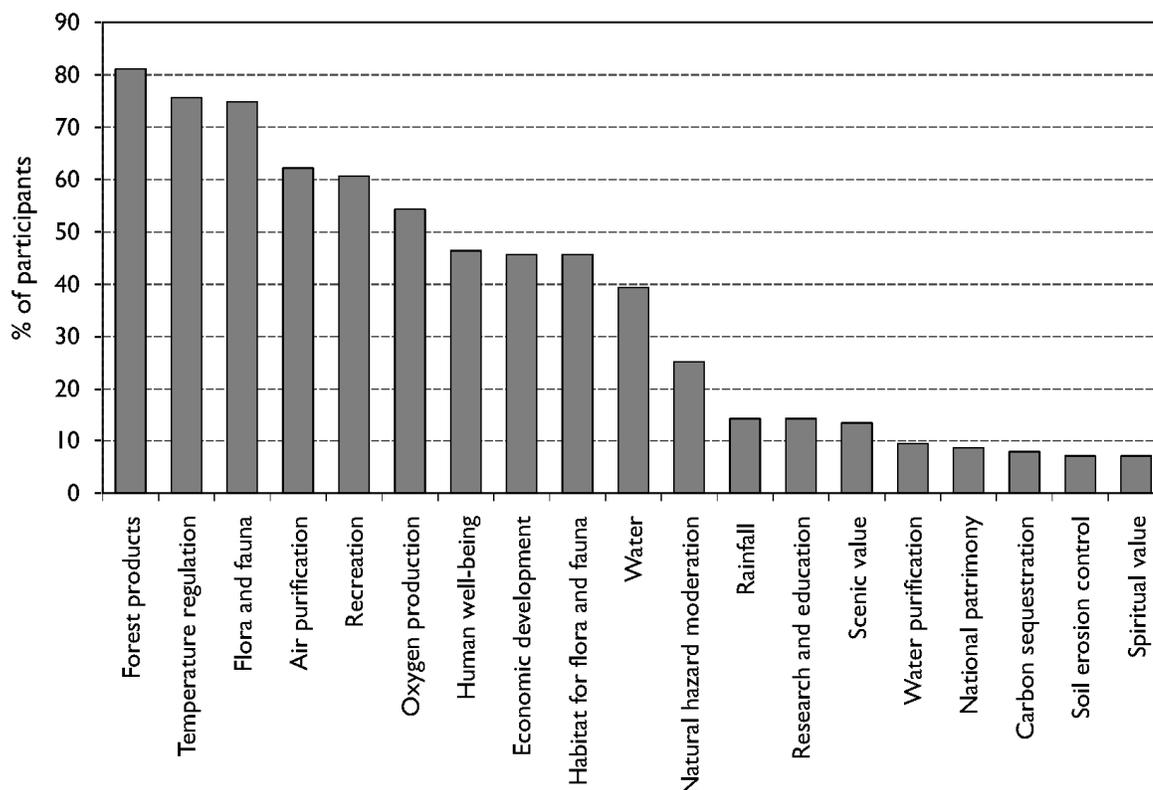


Figure 3. Benefits of karst forests mentioned by all participants (Table 2 describes each benefit)

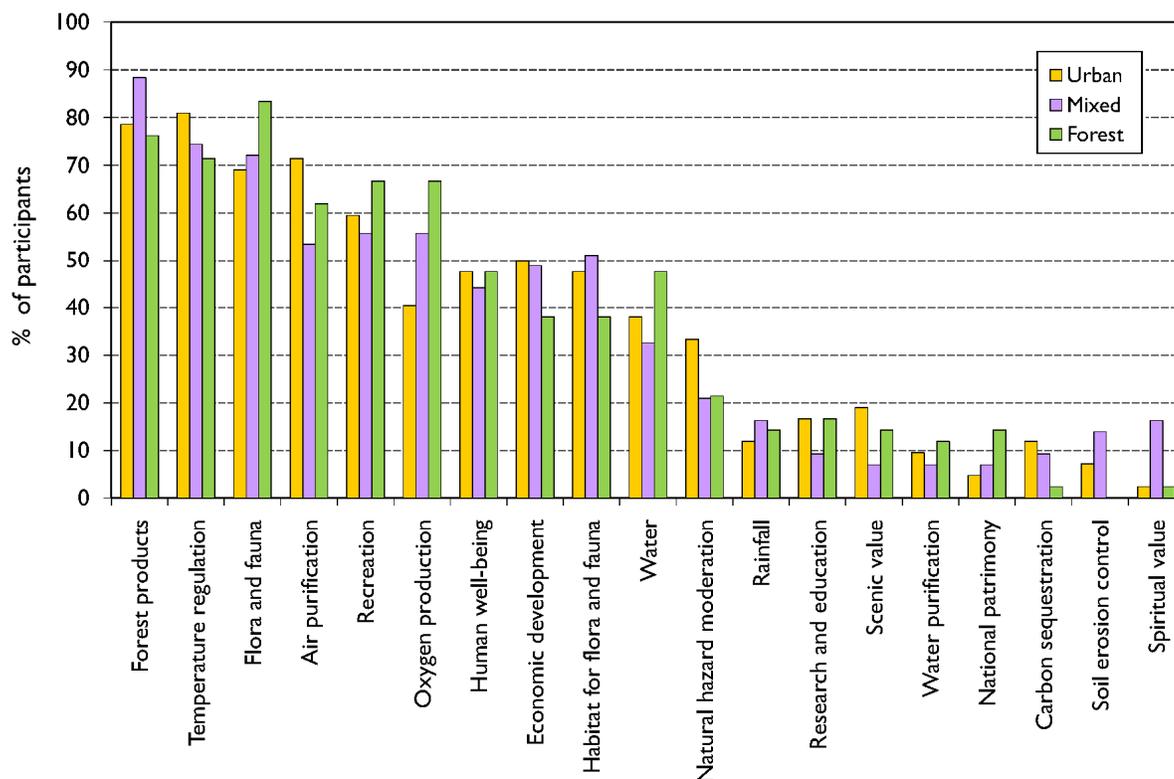


Figure 4. Benefits of karst forests mentioned by participants of different strata

Table 2. Description of the benefits provided by karst forests

Benefit	Description *
Forest products	Forest and plant products, including wood, seeds, flowers, ornamental plants, medicinal plants, and food (e.g., fruit, vegetables, fisheries)
Temperature regulation	Shade, cool air, reduction of temperature
Flora and fauna	Animals and vegetation associated with forests, including endemic and endangered species
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 and handcraft selling
Habitat for flora and fauna	Plant and animal habitat, refuge, shelter, and reserve for species protection, specially for endemic and endangered species
Water	Surface and underground water from rivers, streams, and springs for human consumption; water recharge and storage
Natural hazard moderation	Protection against, and damage reduction from, natural hazards, including tropical storms, flooding, and landslides
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 and archeological importance
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.

When referring back to the list of benefits, and asking which ones participants esteemed most important, the ranking was different from those most generally-mentioned benefits. Air-related benefits –specifically air purification and oxygen production– were among those most cited as the most important benefits (mentioned by 45% and 41% of all participants, respectively) and were considered relatively more important compared to all other benefits. Water purification was considered as the most important benefit, but by just 1% of all participants (Figure 5).

When comparing “old forests” (over 70 years) with “young forests” (20 to 40 years), the majority of the participants (78%), independently of strata, believed that all the benefits they mentioned were provided by old forests. Fewer participants (68%) believed that young forests would provide all the benefits they had mentioned, while 27% believed that the majority (but not all) of the benefits they mentioned were provided by the young forests. Those participants who believed there was a difference in benefits provision between old and young forests acknowledged that they did not perceive a complete lack of benefit provision by the young forests, but rather a provision to a lesser extent. The benefits mentioned as not being provided by young forests included habitat for flora and fauna,

economic development, protection against natural hazards, and spiritual value. They affirmed, however, that if not disturbed by human activity, young forests could eventually provide more benefits and to a greater extent.

A related question regarding the benefits provided by officially-protected karst forests versus private (non-protected) forests showed that the majority of all the participants (90%) perceived that protected forest provided the benefits they mentioned. There were, however, some benefits participants perceived as not being provided by protected forest. This lack of provision was associated with restriction in forest use and included benefits such as food, wood, and ornamental plants. These limits of forest benefit provision were particularly perceived by forest participants who have experienced such restrictions after a natural reserve being declared. Fewer participants (64%) thought that the benefits they mentioned were provided by private forests. There was a tendency to believe that, compared to protected forests, private forests could be at risk because of potential removal due to urbanization. The remaining 36% of the participants believed that some of the benefits they mentioned were not provided by private forests, including, for example, recreation, tourism, and educational and research opportunities. In the case of

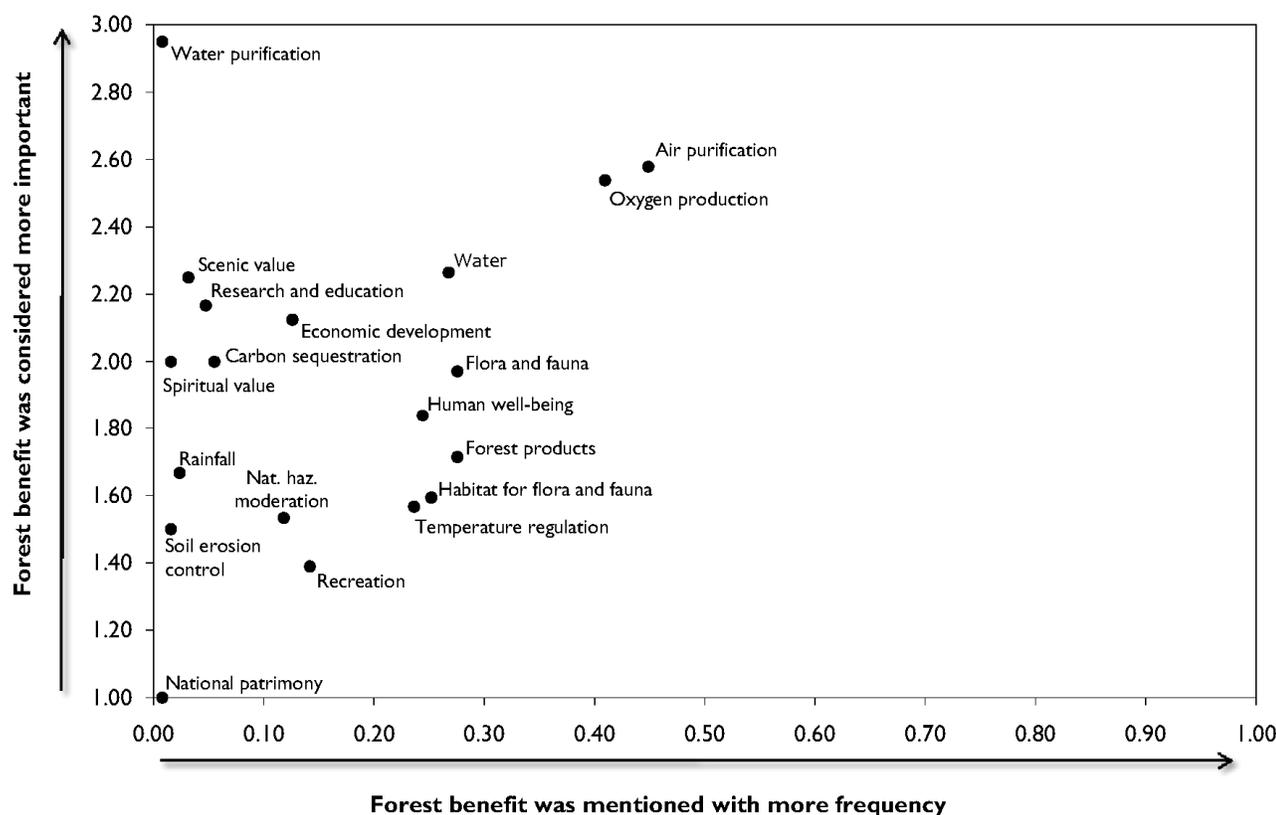


Figure 5. Summary of the three most important karst forest benefits mentioned by all participants

private forests, participants clarified that they did not refer to a lack of benefit provision, but a provision to a lesser extent (compared to the provision by protected forests).

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

Overall, participants perceived that the provisioning and quality of those benefits identified by them as the most important ones were degrading. While some participants perceived the provision of some ecosystem benefits as improving (for example, for oxygen production, habitat for flora and fauna, and economic development), the perception of the benefits being worsened was proportionally greater. There was only one benefit, economic development, to which the same proportion of participants perceived it as worsening and improving over time (Figure 6).

Land cover change (mostly deforestation and construction) along with pollution caused by chemical and pharmaceutical industries and transportation were the most cited causes for the perceived decrease in benefit provision over time. Land cover change was the most cited factor related to the perceived worsening of benefit provision, cited by 71% of all participants. Among those factors participants perceived as improving benefits provision were environmental education and forest protection. Relative to negative factors, positive ones were less cited (Figure 7).

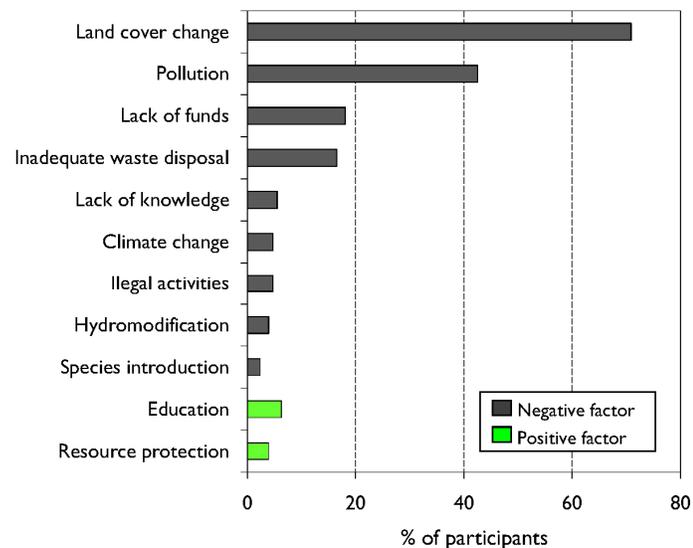


Figure 7. Participants' perception of the factors affecting the karst forests and the benefits they provide (Table 3 describes each factor)

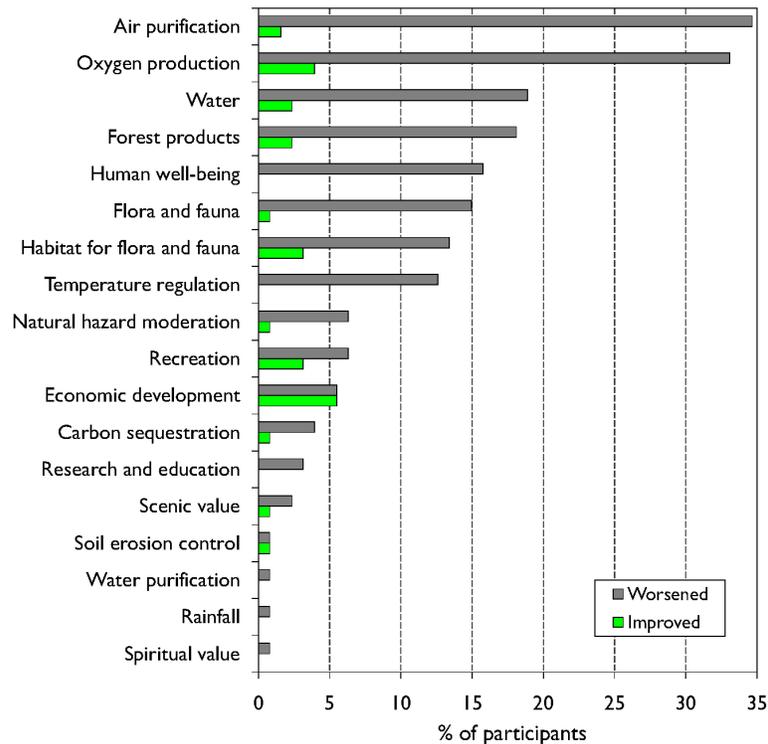


Figure 6. Perceived trends in benefit provision of those benefits identified as most important by all participants

Negative aspects associated with karst forests

Over three fourths of all participants (79%) understood that the karst forest provided a net benefit to them and to society, and did not relate anything negative to that resource. Those who did associate negative aspects (the remaining 21%) particularly mentioned fears of “unwanted” animals; some of which they feared could harm them (particularly snakes, iguanas and insects), fears associated with forests for being solitary places (prone to criminal and even extraterrestrial activities). Other, less cited, aspects were associated with the forest being a potential hazard to people or their property (because of landslides and tree fall), and representing a cause of allergies.

Similar responses were given by participants from the three strata, with mixed participants perceiving slightly more negative elements associated with forests (26% of all mixed participants), compared to 19 and 21% from the urban and forest stratum, respectively.

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

Negative factor	Description *
Land cover change	Changes in the vegetation or material that covers the karst region, mainly associated with forest loss and urban expansion
Pollution	Pollution of air and water resources, mainly associated with industrial, particularly pharmaceutical processes, and transportation
Lack of funds	Lack or limited funds to increase personnel to attend forests maintenance and facilities
Inadequate waste disposal	Inadequate solid waste disposition, including trash disposal in rivers, illegal dumping, and waste burning
Lack of knowledge	Lack of or limited knowledge about the benefits provided by karst 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)
Hydromodification	Change of rivers' natural paths
Species introduction	Introduction of exotic, invasive, domestic, and predatory species
Positive factor	Description *
Education	Knowledge transfer and environmental awareness about the 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.

Karst forest visitation

Many participants (70%) said they visit the forests of Puerto Rico, whereas 30% do not. A slightly greater amount of participants from the mixed stratum reported visiting the forest more (72% of those participants) compared to urban (71%) and forest participants (67%). A similar percentage of participants (69%) tended to visit the karst forest, compared to 31% who do not. The percentage of those visiting the karst forest was higher for the forest participants (76%), followed by the mixed (65%) and the urban participants (64%). Some of these positive responses were given by the fact that participants live in a karst forest. The Cambalache forest was the most visited forest among those visiting the karst forests, followed by the Río Abajo forest, private forests, and the Guajataca forest. Recreation was the most cited reason for participants to visit the karst forests, followed by the celebration of activities (like church activities and birthday celebrations), educational activities, and the collection of forest products (for example, plants and food).

Among those who do not visit the karst forest (31% of all participants), lack of time was the most cited reason. This reason was followed by fear associated to the forest (including fear of criminal activities and lack of security), advanced age, lack of information (including not knowing

what forests there are to visit, where they are, how to get there, and what amenities they offer), lack of transportation, health problems, and lack of services and infrastructure within the forests.

Information needs about karst forests

The vast majority of the participants (86%) reported never obtaining, nor searching for, information about the karst forests. This percentage was higher for forest participants (93%). Of those who had some access to information (14% of all participants), urban participants had relative more access to information, followed by the mixed and forest participants. Among the examples given for information sources were: the internet, newspapers, brochures, the Department of Natural and Environmental Resources, nongovernmental organizations such as *Ciudadanos del Karso*, and schools or universities.

When offered the possibility of receiving information, participants from the urban stratum were the ones most interested in getting information about the karst forests; forest participants, on the other hand, tended to be less interested. Generally, participants were keen on learning more about the benefits provided by the karst forests, including its flora and fauna (Figure 8).

In the case of flora and fauna, for instance, they would be interested in knowing species' scientific and common names (along with photographs of the species), and whether or not they are classified as endemic, exotic, or endangered species. Visual materials –including maps and photographs – representing the physical-environmental elements of the karst region were also mentioned as materials people would like to have access to.

Among the informational tools participants mentioned as being most adequate for receiving information about the

karst forest were brochures, talks to their communities, and educational books; this was generally the same for participants from all three strata (Figure 9). Some participants suggested guided tours and the development of theater plays to present in the communities as other ways of disseminating information about the karst forests. On the other hand, participants identified television (particularly Channel 6), personal communication, and printed materials as the most preferred format or media for information to be transferred (Figure 10).

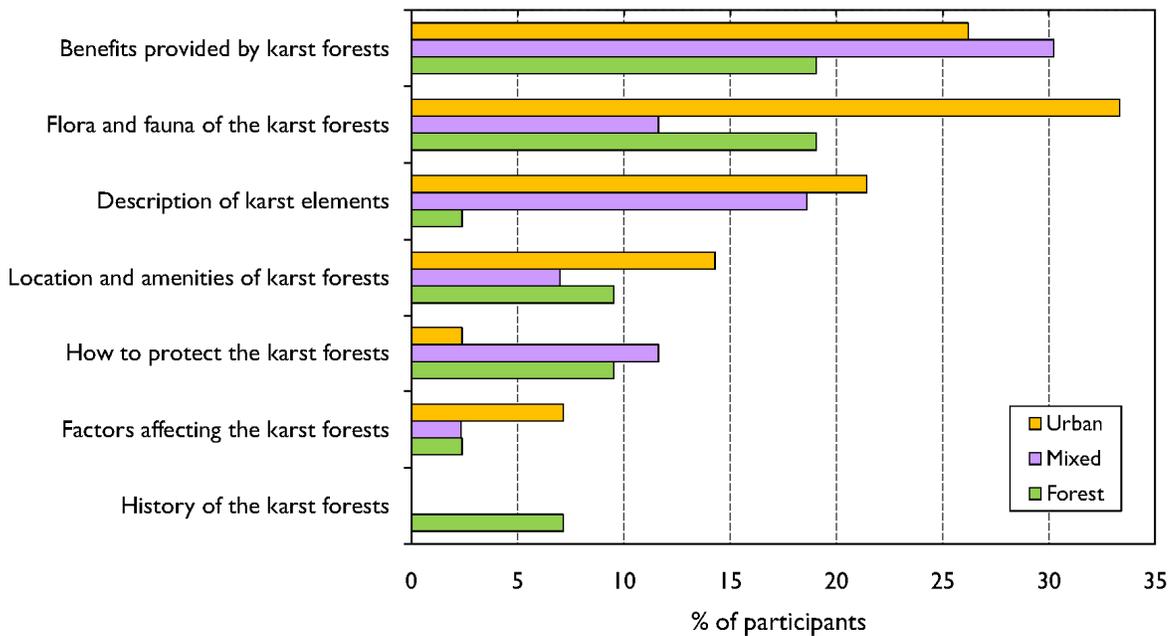


Figure 8. Information participants would like to receive

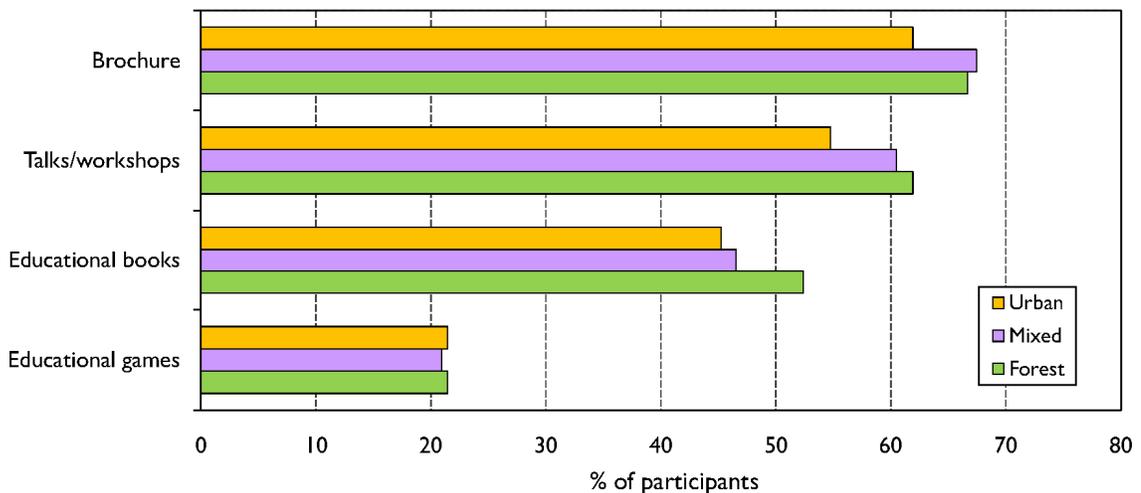


Figure 9. Preferred information tools

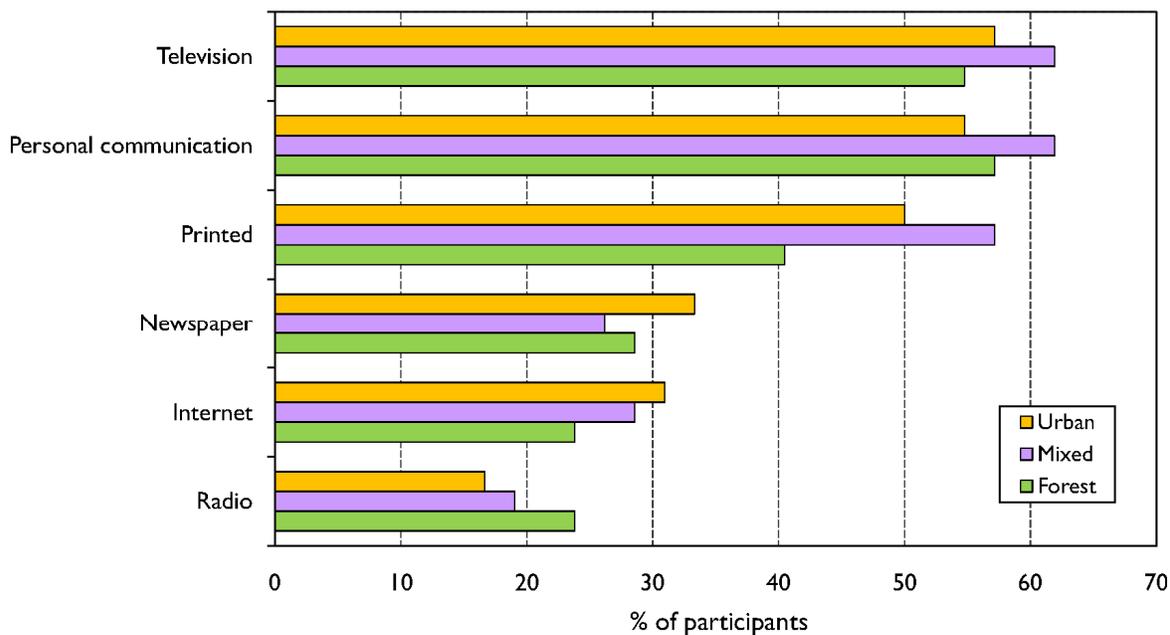


Figure 10. Preferred formats or media for information transfer

Summary and recommendations

The results obtained from the questionnaires helped us identify participants' knowledge and perception about the benefits provided by the karst forests, the factors affecting benefit provision, and information needs regarding karst forests and their benefits.

The term karst was widely unknown by participants; they did, however, recognize karst-related features, such as *mogotes*, *caliche*, and limestone. The term forest, on the other hand, was generally known among them, although other terms (e.g., *monte*) were commonly used to refer to forest. Consequently, developing terminology based on local and known words is key to effective communication. Additionally, introducing and explaining unknown terms to people is also key to effective understanding and to promote knowledge generation among the public.

Forest benefits associated with “day-to-day” activities and benefits people directly experience or sense were the ones more recognized among participants. Forest products, temperature regulation, and fauna and flora were the most cited forest benefits. When identifying the most important ones, however, air purification and oxygen production ranked first. These “known” benefits, and those considered more important to people, can be used as starting point to initiate dialogue and discussion among people and to promote better understanding about karst forest benefits.

While these known benefits should be highlighted in educational materials and learning activities, emphasis should also be given to those benefits that were often unrecognized by people. In this study, for example, participants made less connection between karst forests and water-related benefits. Given the importance of the karst region and water resources, it is critical to increase public knowledge of what the karst region is about, particularly highlighting its benefits regarding water resources.

On the other hand, there is a need to go beyond just explaining what the karst region is and its importance related to water resources; it is also necessary to increase public understanding about the functions forests have regarding water resources – water recharge, filtration, quality, among other functions; particularly within the karst region where water resources are vulnerable to pollution and where some water-related benefits are more difficult to obtain if forest cover decreases.

There was a general agreement among participants that the benefits provided by the karst forest are diminishing. Land cover change was identified as the factor most affecting forest benefits, and almost all participants would be concerned about the clear-cutting of karst forests. The process by which land cover change affect forest benefits was, however, less understood by participants. Educational materials could use these areas of concern to expand on

topics related to the factors affecting forests and their benefits, and also to increase public knowledge on the cause-and-effect aspect associated with such factors.

The particular information interest 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 more about the benefits provided by karst forests, particularly their fauna and flora. For instance, participants showed limited knowledge about the fauna and flora of the karst forests, and expressed interest in learning about the endemic, vulnerable, and endemic species inhabiting the forests. Moreover, unique facts and culturally-related elements regarding the fauna and flora of the karst forests could be given to people as a means to increase their interest in them.

Additionally, there is a need to let people know that the fauna of the karst forests is not harmful, as this was a general pre-conception some participants had which could keep people from visiting the karst forests and learning more about them. Residents expressed interest in educational brochures and talks to their communities to increase their knowledge about the karst forests. Television and newspapers (particularly regional newspapers) were also potential sources of information to disseminate information. It should be noted that participants highly appreciated the explanations given, and the maps and illustrations shown during the interview process. This reinforces the importance of personal communication and the use of visual materials to trigger public interest in learning about the environment and forests. The educational materials may include, among others, photographs, maps, diagrams to aid the explanation and understanding of karst elements, forest benefits, and process-oriented factors affecting the forests and their benefits.

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