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Educational Values of Roadside Trees in Carcar City, Cebu, Philippines: Implications to Environmental Education

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Abstract. Roadside trees along the national highway in Barangay Perrelos in Carcar City are trees that considered a heritage, and yet are affected by urban developments in the province. The study determined the profile of the roadside trees as well as the knowledge, attitudes, and conservation efforts of the locals in the area. Questionnaires and interviews were given to 50 respondents, and data gathered were analyzed using ANOVA, Pearson *r* and thematic analysis. Ecological indices such as abundance percentage and species richness were also used by the study. Results revealed that there are 108 identified roadside trees, where the species richness is 0.962 and acacia trees are the most abundant (46.30%). Knowledge and attitudes of the respondents were high and low-to-moderate, respectively. Conservation practices towards the roadside trees included pruning, no burning near the trees and making of diversion roads, all adhering with existing environmental laws of the country. Tree abundance and richness, knowledge acquisition, attitude inculcation, and conservation efforts are manifestations of the educational values of roadside trees to the people. Research on these educational values of trees is novel as it provides importance on cultural heritage, environmental protection, and sustainable planning in the area. Implications to environmental education are formulated for the Philippine Elementary and secondary education Science eaching.

Key words: attitude and knowledge, conservation practices, roadside trees

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INTRODUCTION

Trees provide environmental, health, social and economic benefits. These tall plants provide oxygen (Mitra et al., 2017), improve air quality (Nowak et al., 2014), give cooling effect (Gupta et al., 2018), mitigate greenhouse effect (Aba et al., 2017), and even beautify communities (Schroeder, 2012). Another benefit of trees is their canopy cover (Paletto & Tosi, 2009). Mature trees in good condition offer canopy cover over an area, and aggregation of trees found along the road provide greater canopy cover that benefit not only the residents but also the riding populace.

In Central Visayas, Philippines, roadside trees used to be found along major streets and boulevards in metropolitan areas. However, these trees have been reduced in numbers to pave for urban development. Though, there are certain areas in the region where roadside trees still flourish. One of these areas is a portion of the national highway along Barangay Perrelos in Carcar City, southern Cebu. These roadside trees cover approximately 3.2 km, starting from Sitio Dunggoan extending up to Sitio Kamagayan. Of the large fruit- and non-fruit bearing trees constituting the roadside trees, the majority are the humongous acacia trees (or raintrees), hence becoming a landmark and heritage trees in the said locality.

However, urban development continues to pose danger to roadside trees (including the 100-year old acacia trees). The trees were threatened to pave way for a road-widening project to be executed by the public works agency. This caused uproar to locals, gathering more than ten thousand signatures to preserve than to them, and eventually the environment department recalled the special tree-cutting permit issued to the public works agency (Mongaya, 2012; Mitgano, 2013; Asutilla, 2014; Abatayo, 2019). These developments on the issue validate that these trees are not only heritage trees but are also organisms that provide benefits to the residents and riding populace (Elmendorf, 2008).

Certain developments pave high to help communities meet their sustenance needs, but it is not sufficient to establish well-being communities. Each person should be offered with activities for continued maintenance and functioning of the communities.

With this, individual's participation is very crucial in any maintenance or conservation effort where local people must be involved in every step of such process. Offering of incentives to the people can increase their participation in relation to governance, management issues, decision-making and activities concerning natural resource conservation. Therefore, it is necessary to integrate education in several areas including the people's knowledge and attitudes on what to conserve, and their development and implementation of conservation strategies.

With this, the study determined the profile of trees along the highway in Perrelos, Carcar City in Cebu, Philippines. It also aimed to determine the extent of knowledge and attitude of the people in the locality, and the conservation practices conducted by both the barangay and municipal officials to prevent these risks and ensure the preservation of these trees. Thus, this study is significant not just for the environment but also to the people in the locality to preserve their cultural heritage, hone their attitude for the environmental protection of these trees, and implement sustainable plans that would be beneficial in the entire community.

METHODS

Study Site and Field Survey

The study was conducted along the national highway in Barangay Perrelos in Carcar City, southern Cebu where the roadside trees flourish. The national highway stretches up to a distance of 3.20 km starting from Sitio Dunggoan extending until Sitio Kamagayan (Figure 1). People living and working near and around the national highway participated in the study. Public officials whose jurisdiction falls under the said village also took part in the study. All of these respondents were of legal age, and consisted of 20 residents, 20 workers, and 10 public officials.

Before the conduct of the study, the researchers sought pertinent research permissions to gather information about the trees on the research site as well as to collect data from the research respondents. After permitted, the researchers gave informed consent to the residents, workers, and public officials if they agreed to participate in the study. Once they agreed, they were given questionnaire. Only ten of the respondents were randomly selected to answer the face-to-face interview.

The study used three research tools. The first tool was called "Profile of the Roadside Trees Questionnaire" that gathered data on tree's common name and scientific name, and its count along the road. All common names were given by the assisting barangay officer, and species names were verified by the agriculture department. The second instrument was known as "Knowledge and Attitude Questionnaire". This instrument obtained the extent of knowledge and attitude of the respondents towards the benefits of roadside trees and their conservation. There were 15 items on Knowledge that can be answered by Yes or No. There were also 15 items on Attitudes that can be answered by Always, Sometimes, Rarely or Never. This instrument was content validated by three experts in Science. The last tool was an interview guide for the respondents. The guide has two questions, which geared towards the conservation practices and perceived risks on the roadside trees. Follow-up questions were asked to deepen their answers.

Figure 1. Study site: Barangay Perrelos (inset) in Carcar City, Cebu in the Philippines

Data Analysis

After gathering the data, three sets of data analysis tools were used. The first set of tools was related to the profile of trees along the national highway (Garces & Flores, 2018; Flores et al., 2020).

Species abundance:

$$\frac{Total\ number\ of\ species\ A}{Total\ number\ of\ all\ species} \quad (1)$$

Species richness:

$$D = \frac{Number\ of\ species}{Square\ root\ of\ the\ number\ of\ individuals} = \frac{s}{\sqrt{N}} \quad (2)$$

Secondly, statistical tools were employed to treat the quantitative data of the study. Weighted mean was used to determine the mean Knowledge and mean Attitude of the respondents towards the roadside trees. The descriptions are presented in Table 1.

Table 1. Qualitative descriptions for knowledge and attitudes of the respondents

Range	Knowledge Description	Range	Attitude Description
1.00-1.50	Not knowledgeable	1.00-1.75	No attitude
1.51-2.00	Knowledgeable	1.76-2.50	Low attitude
		2.51-3.25	Medium attitude
		3.26-4.00	High attitude

The extents of knowledge and attitudes among residents, workers, and public officials were then compared using analysis of variance (ANOVA). If a significant difference resulted from such analysis, a post-hoc analysis using Tukey HSD was further used. Furthermore, the relationship between knowledge and attitudes was tested using Pearson *r* correlation analysis. All of these tests were conducted at α=0.01.

Lastly, the qualitative data derived from the interview results were subjected to thematic analysis. Braun & Clarke's six-phase thematic analysis was specifically used, following these steps: (1) Become familiar with the data, (2) Generate initial codes, (3) Search for themes, (4) Review themes, (5) Define themes, and (6) Write-up (Braun & Clarke, 2006; Maguire & Delahunt, 2017).

RESULTS AND DISCUSSION

Profile of the roadside trees in Barangay Perrelos, Carcar City

The area where roadside trees are located are located between sitios Dunggoan up to Kamagayan, stretching a distance of 3.2 km along the national highway in Perrelos, Carcar City. Figure 2 shows the different roadside trees along the said highway while Table 2 below reflects the profile of the roadside trees found in the research site.

Figure 2. Roadside trees in Perrelos, Carcar City, Cebu: **A**. Samanea saman, **B**. Gmelina arborea, **C**. Azadirachta indica, **D**. Chrysophyllum caimito, **E**. Swietenia mahagoni, **F**. Muntingia calabura, **G**. Mangifera indica, **H**. Artocarpus heterophyllus, **I**. Tamarindus indica, **J**. Terminalia catappa

Table 2. Profile of trees (*N*=108) found along Perrelos in Carcar City, Cebu

Plant Family	Scientific Name	Common Name (Cebuano)	Species Abundance (%)	IUCN Red List Status
Fabaceae	*Samanea saman*	Raintree (Acacia)	46.30	Least Concern
Lamiaceae	*Gmelina arborea*	Gmelina (Gemelina)	12.96	Least Concern
Meliaceae	*Azadirachta indica*	Neem tree	10.39	Least Concern
Sapotaceae	*Chrysophyllum cainito*	Star apple (Caimito)	8.33	Not evaluated
Meliaceae	*Swietenia mahagoni*	Mahogany	7.41	Near Threatened
Muntingiaceae	*Muntingia calabura*	Cherry Tree (Manzanitas)	4.63	Not evaluated
Anacardiaceae	*Mangifera indica*	Mango (Mangga)	3.70	Data deficient
Moraceae	*Artocarpus heterophyllus*	Jackfruit (Nangka)	3.70	Not evaluated
Fabaceae	*Tamarindus indica*	Tamarind (Sambag)	1.85	Least concern
Combretaceae	*Terminalia catappa*	Tropical almond (Magtalisay)	0.93	Least Concern

Note: IUCN=International Union for Conservation of Nature. Total abundance: N=108; Species richness: D=0.962

A total abundance of 108 trees are found along the study site. The species *S. saman*, commonly known as acacia, has the highest abundance in the research site with 46.30% abundance. This result conformed with historical archives that the highway, that stretches up to San Fernando and City of Naga, had been planted with acacia trees under the order of public works engineers Russell and Capt. Segura in 1915; thereby having more acacia trees in the area. Acacias are preferred as roadside trees due to their large canopies that provide shade for the people and the road, as well as their shorter growth time from nursery to roadside transplants (Siong et al., 2012). Such trees also improve air quality along highways since these plants have high air pollution tolerance index [ATPI]; these have high tolerance to air pollution and act as bioaccumulators of air pollutants (Sia Su et al., 2018).

Aside from acacia, big trees are also found along the roads. These trees include *G. arborea* ("gemelina"), *S. mahagoni* ("mahogany"), and *T. catappa* ("magtalisay"), which collectively constitute 21.3% of species abundance in the area. According to residents, the presence of these big trees in the highway was due to the tree planting initiatives conducted by local government units, which was strengthened by the provincial green program. Aside from providing big canopy shades, the three plants are moderate to fast-growing in their early years (Florido & Cornejo, 2002; Thomas & Evans, 2006; Kumar et al., 2016). Hence, these trees are preferred for tree-planting and reforestation programs in tropical regions (US Department of Agriculture, Agricultural Research Service, 2016). These big trees are also important in mitigating air pollution. *G. arborea* has high APTI while mahogany and magtalisay has moderate ATPI, indicating that the former is tolerant to air pollution while the latter are moderately tolerant (Sia Su et al., 2018). In addition, gemelina is a good greenbelt performer while magtalisay is a moderate performer (Ogunrotimi et al., 2017).

Another tree found along the highway is the *A. indica* ("neem tree"). The tree has an abundance of 10.39%, third only to acacia and gemelina in terms of individual species abundance. These plants are known to be moderately invasive (Radji et al., 2010), and grow rapidly in areas with dry, infertile sites (Schultz et al., 1992). Neem trees can be propagated through seeds, and these seeds grow into seedlings that quickly colonize mature trees, which may explain why many neem trees exist together with big trees along the road (Chamberlain, 2000).

Fruit-bearing trees are also found along the highway. *C. cainito* ("caimito"), *M. calabura* ("manzanitas"), *M. indica* ("manga"), *A. heterophyllus* ("nangka"), and *T. indica* ("sambag") have percent abundance of 8.33%, 4.63%, 3.70%, 3.70%, and 1.85%, respectively. These fruit-bearing trees collectively constitute 22.18% of the total abundance of tree species found in the site. These fruit trees may be present in the area because of the residents and passers-by who threw seed/s in the sidewalk; the birds and other animals that get food from the trees and sometimes drop them on the ground; and rain that could have washed the seeds to their present location. Though fruit trees are not intended to be planted in the area, such trees give benefits to the residents and riding and walking populace alike. Caimito trees can grow up to 30.5 m (Crane & Balerdi, 2006), manzanitas up to 12 m (Mahmood et al., 2014), mangga up to 30 m (Strangeland, 2011), nangka up to 15 m (Prakash et al., 2009), and sambag up to 30 m (El-Siddig et al., 2006). With these heights, such fruit trees also offer canopy that could provide shade to the residents and workers of the area. Fruit trees are also active organisms against air pollution. For instance, mangga has high ATPI and is tolerant to air pollution (Sia Su et al., 2018), a good greenbelt performer and has dense foliage that protects it from pollution stress (Ogunrotimi et al., 2017).

Overall, the total abundance of the roadside trees in the research site is 108 while the species richness is 0.962. Trees are planted along roads and highways to give softer sense of the manmade structures (Siong et al., 2012). Moreover, roadside trees become bioaccumulators of air pollutants, thereby making them moderately tolerant or tolerant to air pollution (Ogunrotimi et al., 2017; Sia Su et al., 2018). Furthermore, the presence of trees in the area implies the combined effort of the residents and government officials in implementing environmental programs such as the tree planting and provincial initiatives in one of the green spaces in Cebu (Flores et al., 2020). In order to manage well urban forests, all community stakeholders must be knowledgeable of the local trees, and participate and get involved in the planting, caring, and conservation of trees found along roads and highways (Pincetl, 2010; Alvarico et al., 2019; Flores et al., 2020; Darma et al., 2021).

Knowledge and attitudes of people towards the roadside trees

According to Pincetl (2010), all stakeholders must be involved in any undertaking that could conserve trees found in the community, including those along roads and highways. To be involved, stakeholders must be knowledgeable of how important the issue is, and must have positive attitudes towards such engagement in the community. In this study, both knowledge and attitudes of the people living or

working near and along the highway in Perrelos, Carcar City were determined in order to grasp how well these people know about the trees and how high they value such trees in their locality. Figure 3 presents the extent of knowledge of the residents, workers, and officials towards the roadside trees in the said barangay in Carcar City, southern Cebu.

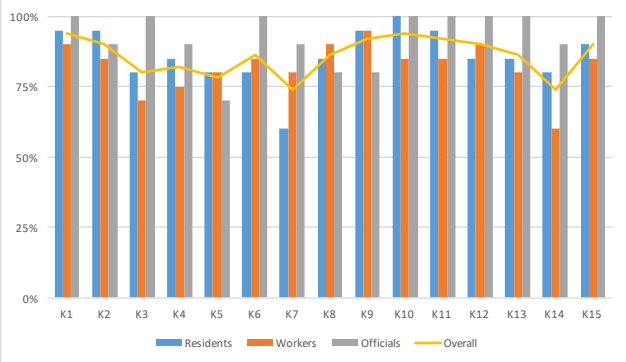

Figure 3. Extent of people's knowledge towards the roadside trees

Based on Figure 3, most of the respondents are knowledgeable about the ideas and concepts of trees. More than 75% of the residents, workers and officials know that trees give them oxygen (K1), provide raw materials (K2), provide food and shelter (K6), can be used for medicine (K8), provide shade and wind buffering (K9), make them good and relaxed (K10), remove pollutants from the air and soil (K11), prevent flood and soil erosion (K12), provide canopy for wildlife (K13), and release water vapor that cools the surrounding areas (K15). This general knowledge about the trees correspond to people's most preferred tree benefits, thus, they know these concepts about trees.

However, there were concepts in which some of the respondents are knowledgeable of. Around 60% of the residents know that trees cannot be cut down anytime (K7); this is the lowest knowledge extent they possess in the context of the study. This could be due to the fact that these residents use wood as fuel for cooking and other essential processes at home; hence, they thought that trees could be cut anytime they want to. Moreover, around 60-75% of the workers know that trees can improve water quality (K3), protect the roadways (K4), and become unhealthy when burning is done underneath these organisms (K14). They have the least knowledge on the concept of burning underneath trees, which maybe explained to their previous knowledge that burning underneath trees could provide more fruits and help them become healthy. Calder et al. (2010) have observed that exposure to smoke impairs photosynthetic functions, and thus hinder attaining good health of plants. Furthermore, the public officials have the lowest knowledge on trees reducing noise pollution (K5). Offices of these officials are made of wood and/or concrete that they might not have noticed the reduction of noise caused by the trees. Various studies have demonstrated that roads with forests can reduce noise pollution (Maleki & Hosseini, 2011).

Despite some concepts not known by some respondents, the respondents' extent of knowledge about trees is high (86%). They have this certain knowledge because of their previous knowledge they had during their school age years, from their family members and friends, or from seminars and trainings they attended. Nevertheless, this knowledge has been obtained from the pursuit of environmental knowledge as well as their future engagements in conservation efforts. Figure 4 shows the extent of attitudes of the respondents towards the roadside trees.

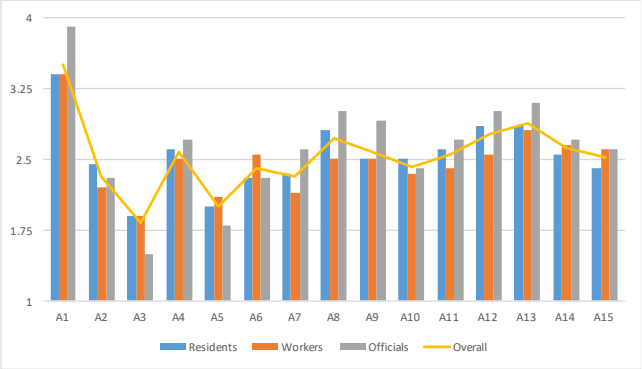

Figure 4. Extent of people's attitudes towards the roadside trees

As shown in Figure 4, the extent of attitudes of the respondents most fall on extents between 1.75 and 3.25, indicating that they have low to moderate attitudes towards the roadside trees. The respondents rarely join tree planting program (A2), monitor pests on the trees (A3), join seminars about illegal logging (A5), remove dead branches (A6), plant new plant to replace the one cut (A7), and conserve water while preserve trees (A10). Respondents have low attitudes towards these actions may be because such actions require more effort to do or need support from other people; this finding is coherent with the study of Heyl et al. (2013) who found out that people less frequently do environmental actions when these actions are perceived to require more effort and support.

The results also show that that respondents sometimes use dry leaves as fertilizer (A4), do not cut branches of the tree for firewood (A8), do not burn dry leaves underneath trees (A9), set aside falling branches to avoid accidents (A11), remove weeds growing around the tree (A12), sweep the leaves

under the trees (A13), help programs in the barangay (A14), and support programs implemented by the government (A15). The respondents do not get birds' nests on the trees all the time (A1). These actions are more frequently done because these actions could have immediate positive result to the trees. Heyl et al. (2013) stated that people usually do such actions as they perceived these actions as having positive results to the environment.

Overall, the residents and workers had lower attitudes towards the trees. Likewise, the government officials also did not have high attitudes towards the roadside trees. The barangay officials or even the city officials should offer the people with activities that can make them active participants, where such attitudes become habits and eventually practices that can benefit the community. Hence, an increase of people's participation in conservation activities may be achieved. Table 3 reflects the statistical comparison of the knowledge and attitude extents among the residents, workers, and officials.

Table 3. ANOVA on people's knowledge and skills towards the roadside trees

Variable	Extent			F-value	p-value
	Residents	Workers	Officials		
Knowledge	0.86 (Knowledgeable)	0.82 (Knowledgeable)	0.93 (Knowledgeable)	1.687 ^{ns}	.196
Attitudes	2.54 (Moderate)	2.48 (Low)	2.63 (Moderate)	0.270^{ns}	.765

Note: ^{ns} means Not significant at α=0.01

Based on Table 3, there is not significant difference that exists in the knowledge among the respondents. This is evident in the same knowledge level (Knowledgeable) of the residents, workers, and officials. Most of the knowledge items are common knowledge, attributing this commonality to learning in school, insights from family and friends, and even conceptions made from using multimedia and the Internet. Environmental knowledge can be promoted through education (El Batri et al., 2019), environmental commitment at home (Payne, 2005), Internet and television (Sadik & Sadik, 2014), and social media activities (Rahim & Jalaladeen, 2016).

Like knowledge, there is a non-significant difference in attitudes among the residents, workers, and officials. The respondents have comparable attitudes towards the roadside trees regardless of their demographic profiles, occupations or knowledge levels. They view actions having positive environmental outcomes as important; therefore, they do such actions frequently. Those they view as adding more effort to do such actions as burden; therefore, they do such actions less frequently (Heyl et al., 2013). This trend is evident in Figure 4, making attitudes of residents, workers, and officials significantly not different from one another.

Knowledge and attitudes towards the environment have been reported to have varied effects depending on the context. Historically, environmental knowledge and attitudes have been found to have weak and moderate correlations (e.g. Makki et al., 2010; Kilbert, 2000). But recent take of the issue has changed to moderate to high correlations (e.g. Bradley et al., 2010; Zheng et al., 2017). In the present study, knowledge and attitudes towards the roadside trees were subjected to correlational analysis. Result of this analysis is revealed in Table 4.

Table 4. Correlational analysis between knowledge and attitudes towards the trees

Group	Knowledge		Attitudes		*r*-value	p-value
	Mean	Description	Mean	Description		
Residents	0.86	Knowledgeable	2.54	Moderate	0.222^{ns}	.346
Workers	0.82	Knowledgeable	2.48	Low	0.551^{ns}	.012
Officials	0.93	Knowledgeable	2.63	Moderate	0.258^{ns}	.472
Overall	0.86	Knowleadgeable	2.53	Moderate	0.364***	.001

*Significant at α=0.01; Not significant (^{ns}) at α=0.01

Based on Table 4, the knowledge level of the residents, workers, and officials is not significantly correlated with the attitude level. This means that there is no significant relationship that exists between knowledge and attitudes towards the trees. For instance, an increase in knowledge level of the residents may not be attributed to the increase of attitudes, or vice-versa. Makki et al. (2010) suggested that the effect of knowledge on attitude and vice-versa is not direct and therefore mediated by other factors.

However, the overall knowledge and attitude levels are significant but weakly correlated with one another. Statistically, this finding is due to the bigger sample (*N*=50, total number of respondents), which reduces the impact of random error (Thiese et al., 2016); this makes the relationship significant. Though significant, the knowledge and attitude levels of the totality of the respondents have weak correlation with one another. In this weak correlation, the attitude level of a highly knowledgeable person cannot be deduced with much certainty. This explains why specific groups have knowledge and attitudes not correlated with one another. The relationship of the two environmental variables may be mediated by other factors (Makki et al., 2010).

People's conservation practices towards the roadside trees

The roadside trees along national highway in Perrelos are important for the people because these plants constitute a part of their heritage, beautify their place, give shade and oxygen, among others for the residents, workers and officials alike. Respondents said:

"Importante jud kaayo ning mga kahoya diri kay mao ni ang nagpuno ug kanindot sa among barangay ug naghatag ug kalandong sa mga lumulupyo ug mga bisita nga ganahan maglakaw- lakaw diri." ("These trees are important because these add up to the beauty of our barangay and give shade to the residents and visitors who like to walk.")

"Of course, nag provide og oxygen, shade ug nag supply sad ni ug tubig. Labina ang acacia gud, dili man ni parehas sa ubang kahoy sama sa gemelina nga though musuyop siya ug kahoy pero para sa iya ra sang consumption. Ang acacia kay iya ra jud nga e store then e supply niya." ("Of course, [the trees] provide oxygen, shade and supply of water. Acacia, in particular, is not the same with other trees like gemelina that gets nutrients [from others] for its own consumption. The acacia tree stores nutrients and supply these in its body.")

"Importante jud kaayo ni kay landmark na man gud ni namo niya nabuhi sad and among festival tungod ani." ("These are very important because these are a landmark where our festival is based on.")

With these accounts, the respondents can really attest the benefits of the trees by experiencing them firsthand. With this, they have conservation practices that would be beneficial for the trees and the entire community. Based on the interview results, three themes emerged: (1) Pruning, (2) No burning near the trees, and (3) Diversion road.

Pruning. Most of the respondents stated that pruning of trees is seen to be a way to preserve the trees. According to the barangay captain,

"Mag-pruning man jud dapat kay dagko man kaayo ning mga kahoya nya grabe ka delikado sa mga taw labi na sa mga mo biyahe nga sige ug agi-agi diri". (We do pruning because these are big trees that could become a danger to the people who travel and walk along [the highway where the trees are located].")

Pruning is conducted upon the recommendation of the city government. Barangay officials and workers monitor these trees, and if they see some dead branches, they will send a letter to the city government requesting for pruning. This practice is anchored on Republic Act of 3571 that permits pruning when necessary for public safety and beauty enhancement upon recommendation from the city government and approval of the Director of Parks and Wildlife. Pruning of urban trees enhance the city view, decrease conflict with buildings, and reduce wind resistance and public risk (Smiley & Kane, 2006).

Aside for public safety and beauty enhancement, pruning has scientifically confirmed benefits to the roadside trees. According to Badrulhisham & Othman (2016), pruning benefits the trees through removing of infested wood, thinning tree crown that decreases pest problems and improves airflow, and eliminating rubbing and crossing branches. In a four-year study by Fini et al. (2015) on *Acer pseudoplatanus*, different pruning strategies modulate tree's morpho-physiological response. Apical control and apical dominance maintenance can preserve the structurally sound structure of trees, as well as their long-term efficiency for photosynthesis. However, other methods may alter branching pattern, promote branch sprouts, and tolerate environmental stress. Therefore, appropriate strategies should be done to urban trees as such strategies influence tree success (Vogt et al., 2015).

No burning near the Trees. Respondents practice to not conduct burning near or underneath the trees as one way of conserving these living things. One said,

"Bawal jud na magsunog karon kay naan a baya na sa atong balaod. Dakpon kung masakpan mao na nga magroving jud ang mga tanod." ("Burning [near the trees] is prohibited because it is the law. You'll be caught if you do such by the roaming barangay patrol.")

The "No Burning Policy" is implemented in Perrelos, and is embodied in Republic Act 9003 or "Ecological Solid Waste Management Act of 2000". The law prohibits the burning of solid wastes that technically include agricultural waste, street sweepings and household debris. Burning such wastes toxic chemicals that pollute the air and contaminate the soil and groundwater, which are all necessary requirements for tree growth and

development (Wisconsin Department of Natural Resources, 2020).

Burning also affects the health of the roadside trees. Adkins (2006) worked on *Eucalyptus* species and found out that fire can accelerate hollow formation in its trunk. Moreover, Calder et al. (2010) have observed that exposure to smoke impairs photosynthetic functions. Furthermore, Shortle & Dudzik (2011) revealed that wood decay through tree injuries caused by fire invites insects and fungi to thrive, leading to damage in trees. Therefore, burning near or underneath trees hinders trees to attain good health.

Diversion road. One of the solutions to preserve the trees is to make a diversion road. In the words of a city councilor,

"Nagplano na ang munisipyo nga ilikay na lang ang himoon nga karsada aron dili maapektuhan ang mga kahoy. So, bale mapatung-an na lang ni sila kung madayon man gali." ("The city government is planning to divert the roads to not affect the trees. So, the trees may be located at the middle of the diversion road.")

Carcar City government is proposing to make diversion road so that the roadside trees would not be affected in the road widening project of the public works, and provincial government is giving assurance to the public that the trees would be spared by conducting solution-based projects (Israel, 2019). This only shows that public officials are thinking community and urban development vis-à-vis environmental considerations. The barangay, city and provincial governments work hand-in-hand to provide a safe and healthy environment for the people. Urban systems that are greener contribute to environmental sustainability, climate resilience and safe, which need to be planned out and implemented by the different government agencies and units with collaboration of the private sector and the masses (Housing and Land Use Regulatory Board, 2017).

Implications to environmental education

Environmental education across levels in the country may derive insights from the study in order to promote environmental protection of the natural resources. Profiling of the trees offers the picture of abundance and richness of species that the country has. This should be integrated in the teaching of plants in elementary and secondary levels, and even in technical-vocation and tertiary courses. Focus on local plants, as well as animals, puts environmental education in context that could provide more meaningful learning experience to the students.

In addition, environmental education should not be contained in the four walls of the classroom. The learning of the students should be applied in certain situations that students can participate in community development of sustainable and greener urban systems. Civic participation may provide meaningful experience, and therefore, could increase their appreciation towards plants and the environment in general. Attitudes coupled with meaning learning experience, motivated teachers and inspired students could lead to effective environmental education to them.

Integrating the conservation efforts of the barangay, city, and provincial government to environmental teaching must be done in order to provide platform for students and teachers alike to respond and follow in their specific levels. Science teaching as well as technology livelihood training should also include proper strategies of pruning, as different strategies give different results to trees: the former guides the students to attain the concepts of such strategies while the latter facilitates the practical application to mature yet smaller plants. Effects of fire/burning to plants may be explored to correct misconceptions regarding the subject matter.

Certain pedagogies may be employed in environmental education. Innovative approaches to teaching such as problem-based and project-based approaches may be implemented to provide solutions to environmental problems relating to urban developments in the community. Tertiary teachers and students may use design thinking to solve problems specific to a certain barangay through deeper understanding of the locality and context, and deliver programs beneficial to the people. Traditional approaches with civic participation are highly encouraged.

The study recommends that the barangay, city, and provincial government work hand-in-hand to preserve the trees and residents and workers cooperate with the officials in order to develop the community sustainably and to provide environmentally friendly solutions that would pave to greener urban systems in Cebu, Philippines. The study is limited to a portion of the national highway where Perrelos, Carcar City has jurisdiction. With this, future researchers may venture the whole stretch of the national highway from Naga City to San Fernando to Carcar City, and include a bigger sample with different groups of people (e.g. residents, workers, public officials) to provide a bigger picture of knowledge vs. attitude relationship. More respondents may be interviewed so to have an in-depth understanding of their conservation efforts and perceived risks that could affect the roadside trees.

The study is novel as it explores not only the tree profile of roadside trees along the national highway but also the knowledge, attitudes, and conservation efforts of the people who reside, work, and serve

around the area. The totality of these variables constitutes the understanding of educational values of these trees, leading to many implications towards environmental education in the country. Thus, this study is significant not just for the environment but also to the people in the locality to preserve their cultural heritage, hone their attitude for the environmental protection of these trees, and implement sustainable plans that would be beneficial in the entire community.

CONCLUSION

The educational values of the roadside tress in Barangay Perrelos, Carcar City in southern portion of Cebu, Philippines lie in the abundance and richness of the trees in the area that paved for culture to bloom. There are 108 identified trees in the locale, composed of acacia, other big trees, and fruit trees, yielding a species richness of 0.962. The educational values are also manifested in the acquisition of knowledge about the roadside trees, as well as their moderate inculcation of attitudes towards these trees. Due to these educational values, they conserve these trees for the future, an indication that the students of tomorrow may still see the beauty and value of the trees not only in schools but also in the wider community and natural environment.

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