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AN ECONOMETRIC PLANNING MODEL OF URBAN FORESTRY AS A MEASURE OF SUSTAINABILITY: A MATRIX OF ACTION AND CHANGE

Anthony M. Rodriguez [1]
G. Solomon Osho [2+]
Lalita Sen [3]

[1,3] *Texas Southern University, USA*
[2] *Prairie View A&M University, USA*

(+ Corresponding author)

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ABSTRACT

The urban forest holds several important positions within the built and unbuilt environments. Those positions include economic, health, sustainability, quality of life measures, and overall protection of the environment, including air, water, and soil. The points are highlighted by Wolf (2005;2007); McPherson (2005) and Rowntree and Nowak (1991). This research references the four socio-economic sectors; the public or government sector, for profit or market sector, philanthropic or nonprofit sector, and the household or private sector (Biggs and Helms, 2007). The common purposes and role of each sector with respect to the urban tree cover takes on importance as they interrelate with concerns for public health, economic viability, tree coverage, tree placement, ecological relationships, and public policy. Harris County and its 52 heterogeneous sub-governmental units serve as the study area and the base for the administration of a random internet-based survey. Additionally, the research used urban tree canopy data to relate socio-economics, household preferences, sustainability measures, and overall environmental consciousness to gauge the sectors' connection to the urban forest. The research used multiple correlation analysis and regression modeling with secondary data. The research incorporated the results of the primary data collected, employed hierarchal linear modeling to address the perceived problem of a lack of concern for the urban forest and sustainability in respect to sectoral frame of reference in answering the survey questions. The element of willingness and receptivity serves as independent variables and overall environmental sustainability. The results can help policy makers promote sustainable initiatives that enhance the urban forest and protect the overall natural environment for the benefit of all, now and in the future.

Contribution/ Originality: This study is one of very few studies that examined the urban forest resource as a critical element of our overall ecosystem with values and benefits that far outweigh the cost of maintainance and or expansion. The study also demonstrated that awareness and knowledge precipitates action. How we act though, may require clarity of understanding of the various roles of all the sectors and how each sector, may or may not, take, or be willing to take responsibility for our urban tree canopy's future. There is a need for a balance within the ecosystem in order to enhance as well as retain our natural heritage of our homes, communities, and regions, by protection of the urban forest, both its resources and benefits. The public in general may not perceive the urban forest as an economic good, but often as an abstraction and not accounted as real property.

1. INTRODUCTION

The problem area focuses on the Urban Tree Canopy (UTC) within the Urban Forest (UF), and the stewardship of this resource as it relates to the entire ecosystem. Urban forest includes the trees, the shrubbery, and the living creatures, which share the natural habitat. The interrelations of the components provide the basis to explain the varied elements. In this context, urban has its roots in history referring to a city place where, government, commerce, non-profits, and households relate on a variety of scales. The tree canopy encompasses the amount of limbs, the leaves, leaf type and placement, which together create a covering for the land surface and is the foundation of the spatial scale of interest. Shade for streets, parking lots, roofs, commercial enterprises, infrastructure, and people located on the surface are all possible or not due to the present or lack of the tree canopy. Urban forest which encompasses the canopy, collectively impacts infrastructure cost savings, reduction in utility cost, pollution control measures, physiological benefits, aesthetic values and a myriad of health benefits due to the latter positive values (Gangloff and Moll, 2003). The significance and values of the overall natural environment assessed, understood, and developed, can provide positive values and support sustainability for all sectors and along all spatial scales; the corollary is the rampant depletion (McHarg, 1971).

The study shows that the urban forest resource is a critical element of our overall ecosystem with values and benefits that far outweigh any cost to maintain and expand. The study also demonstrates that awareness and knowledge precipitates action. How we act though, may require clarity of understanding of the various roles of all the sectors and how each sector, may or may not, take, or be willing to take responsibility for our urban tree canopy's future. There is a need for a balance within the ecosystem in order to enhance as well as retain our natural heritage of our homes, communities, and regions, by protection of the urban forest, both its resources and benefits. The public in general may not perceive the urban forest as an economic good, but often as an abstraction and not accounted as real property. Even though the urban forest has a degree of abstraction, its influence within the overall ecosystem creates varied measures of push and pull on all the sectors. The varying measures are central to the matrix and populate the interior boxes. The influences and measures provide the theoretical basis for interpreting how the sectors interrelate and recognizes the potential of making choices in the midst of conflicting positions. The interplay of the varied elements determines outcomes, impacts, public policy, civil action, and/or positive and negative support, as it relates to the urban forest.

Our choices, knowledge base, and preferences need to help determine policy with respect to what happens to the urban forest and environmental sustainability. It is likely that amidst the conflicting positions, households have an affinity to what happens to the urban forest. As such, policy makers can take direct steps to maintain and influence urban forest outcomes. According to related literature (Wolf, 2005) and Tyrvainen and Miettinen (2000) urban users demonstrated a positive relationship in their merchandising and house choices with the overall density of tree cover. Even though the literature indicates a positive outlook for green spaces where people live, work, and shop; the same research states that general unwillingness exist with respect to funding urban tree improvements (Wolf, 2005). Since it is possible that the awareness of the varied benefits of the urban forest is not commonplace, systematic steps towards its protection may also require uncommon approaches and a deeper understanding of how all sectors may view the natural resource. Some additional benefits of the urban forest include its health benefits to communities and positive effects on children's cognitive skills and wellbeing in general (Perdue *et al*., 2003) and (Wells, 2005) respectively.

Additionally, the urban tree cover if properly placed helps to reduce surface temperatures in parking lots and acts as a sump for carbon monoxide and other noxious gases (Scott *et al*., 1999). Other values of the urban forest include carbon storage and sequestration (Rowntree and Nowak, 1991). The urban forest improves water quality (McPherson, 1993) boost consumer patronage and commercial land values (Wolf, 1998) and provides solar heat management for summer and winter months based on leaf coverage (Wolf, 2007). Over the previous years, many cities have taken on the Tree City USA designation. According to the Tree City USA web page, they boast 3400

communities; three cities within Harris County are within that group. Houston is a 25-year Tree City member, its urban forest and the number of trees within its boundaries faces grave challenges. Although tree ordinances from the public spectra have increased, the private reach of those ordinances are still very limited, and as such, the depletion of the tree cover continues unabated (Zhang *et al*., 2009).

Currently land owners with extensive acreage can participate in the carbon sequestration value of trees, but such extensive acreage stands rarely exist within the urban area. Just the same, the urban tree cover and the corresponding natural form have a collective inventory that warrants attention and economic valuation.

The strategies, processes, and results flow developed by Akbari *et al*. (2001) indicate a three dimensional relationship between implemented actions, effects, and beneficial outputs. The positive benefits for all circumstances of an urban tree-planting program include multiple returns on investment, which consistently outperform the cost of implementing a strategic tree-planting program. Hence, to determine the necessary public willingness, contingent valuation research may help identify support for policy that reaches every private tree (Endres and Radke, 1999; Garrod and Willis, 1999). As such, the values of sustainable communities and aspects of livability were part of the same conversation. A very important dictum in all change, particularly change that involves urban sustainability, is the need for open public participation (Berkes, 2004). No evidence exists that the tree ordinances of the 1980's and 1990's provided the type of public participation encouraged by advocacy planners and defined by Hancock and Gibson (1996) who indicated inclusionary democratic practices is the key towards joint outcomes with the human development component at the front. The points of emphasis hinge on three areas of governance, which are community conviviality, environmental viability, and economic prosperity (1996). The operational emphasis of the expression is governance that shares its power with its constituents rather than over them, this has the better chance to realize change.

Additionally, interconnections and continuous relationship between all sectors are readily available depicting benefits, values, inputs, and outputs all from the central artifact, the urban forest. The challenge is, can all sectors give back to the natural environment in order to retain its value and improve our overall sustainability. A central aspect of the research is the data gathered from the community survey that will probe for values and sensibilities from the public as it relates to the urban forest. The data can provide persons that make decisions from all sectors, a basis to challenge existing modes of operation, give new choices, and provide information on taking action towards urban forest protection, enhancement, and overall sustainability.

2. LITERATURE REVIEW

In the context of this research study, the urban forest includes places that display both built and unbuilt ecologies, and includes all the aspects of the ecosystem within those environments. The policy context of the term is the ability for the built and unbuilt to co-exist such that the natural environment can flourish amidst the built (the city) whereby the value and benefit to those that dwell in city places can be realized. The urban forest includes all the public spaces that have and can accommodate trees but must have an expanded definition to include private landscapes and places with trees, a challenge for policy makers (Elmendorf *et al*., 2003). From a historical perspective, the American Forest in 2000 restated the concerns of 125 years ago, its establishment, are ever present and issued its 'state of the urban forest 2000' report. The report delineates values and significance of the urban forest in a macro scale looking at 100 communities of at least 100,000-population base. Several studies have preceded the state of the forest, but the household as a sector and its inter-connections with the other three sectors, public, for profit, and non-profit; the research is wanting in respect to the interchange respecting sustainability measures tied to the urban tree cover. The relationship will also lend to the overall discussion on other issues of sustainability.

2.1. Values and Awareness

When one thinks of the forest, images of vast tracts of land with dense cover and a range of tree types, and entry to such a space conjures varied dangers and omens. In children's stories, the bad things always come out of the forest. Such being the case, the joint term urban forest conjures also bad things such that the two should not meet. The analogy defines one going to the city away from the forest in the country. The work by Hammitt (2000) provides quantitative research to the notion of city dwellers being away to natural environments even when those spaces are not the distant forest. The idea is being away from the hustle and bustle and to the quiet and serene among trees and the forest. Such escapes can occur within blocks of the originating point. The idea of being away from (the hustle and bustle) has implications for policy makers in how we design walkable communities. The value and awareness of the urban forest according to Endres and Radke (1999) operates at several levels of sustainability thinking which takes into consideration both forest and biodiversity of the same. Sustainability cannot only consider the forest in the context of its economic replacement value, but the sustainability conversation must include the link between land development and biodiversity (1999). Human interdependence and actions as it relates to the forest transcends, influences, and makes connections within the urban environment whereby, individual actions have broader collective effects. For example, within the context of an urban residential or even a commercial environment, the removal of *my* tree can immediately affect the climatic and exposure to great heat effects on *my* neighbor's property. Such an effect can work in either directions positive or negative (Endres and Radke, 1999).

Therefore, from an urban forest's context: measuring, sensitizing, and understanding households and other sectors' consciousness to common effects, provides means of developing policy that reaches from one property to the other. Such notions allows for consideration of the forest or forested components, the urban tree cover, (UTC) at the micro scale to take on a different more integrated view between private lot owners. This gives credence to the thought that the urban forest has standing, when taken as an entire component, and speaks to the idea that one man's land has an intrinsic relationship with the other. As Cronon (1996a) states, a central challenge to all urban forest concepts are the value systems developed over time and established variant realities. He contends that environmentalism and environmental thought are as much about nature as it is about our cultural underpinnings. The questions of what are natural and unnatural and recognizing how we rank, rate, and position issues of the environment ties to our values and have little to do with the environment in its truest sense. In this discourse the considerations of environmentalists and how that vision directs the aspirations of a natural urban landscape takes on significance, and this study takes steps towards measuring that reality. As indicated in Chapter 1, a Judeo-Christian ethic of the urban environment does exist, even though that environmental underpinning is described in negative terms by some including (White, 1967; Cronon, 1996b; Merchant, 2006) all claiming the Christian ethic generally takes the overall environment for granted. The notion itself forces the recognition that our cultural notions color our perception of nature. The questions raised by Cronon (1996b) serve as a backdrop in the survey instrument, particularly the expanded definition of environmentalism. A comprehensive view of nature and our cultural norms may require re-assessing the western view of things natural. The latter expanded view of environmentalism may serve as the initial stages of a paradigm adjustment towards a value system where the urban forest motif promotes a cultural norm where the user and the natural environment have shared purposes. As such, the community survey, Section II: Awareness, has its foundation, and provides a broader realm for interpretation of responses and their potential influence on actionable change.

2.2. Land Use

The concept of the urban forest, when framed in relation to the overall land use alignments is likely limited by such standard approaches. The discussion on land use requires a retrospective view on land use change of our

nation and all nation states in general. According to the report, 'Our Common Future' the global change from the rural to the urban (city) outstrips the population growth in general. The world population has more than doubled in the previous fifty years. The more developed regions have seen its urban population represent over 75% of our total national population. The same trend is true of lesser-developed countries but at a slower pace, World Commission on Environment and Development (WGED) (1987). With such a transition, how natural spaces are considered within the urban environment is very important towards our continued quality of life and sustainability. Given the urban change in population densities with its impact on the environment, the forest which many new urban dwellers departed from, is now within their back yards, on the streets, within small areas, and sometimes municipal projects for recreational spaces for play and reflection. What then, are the varied attributes of this urban forest? The following pages will look at specific attributes and benefits of the urban forest, how the forest and trees can coexist among city dwellers, examples of major tree projects within urban settings, and finally a discussion of a new discourse, paradigm, that connects the relationship of the tree with the city's existence.

The urban forest according to Elmendorf *et al.* (2003) encompasses the public spaces, right of ways, parks, and private landscapes of trees and other natural resources related to the urban area growth and development. A broad definition holds-off the possible degradation of the overall health of the urban forest compared to policy only viewing the urban forest at a micro or on a limited scale (Elmendorf *et al.*, 2003). According to the American Forest Executive Director Gangloff, the health of the city depends on the tree canopy cover. The non-profit group states that a healthy city needs a 40% of canopy cover to enhance the overall well-being of a city and commercial areas need a minimum tree cover of 15%. In one study, Wolf (2003) indicated the commercial cover is about 5%. Beyond providing shade and its calming effects (Wolf, 2002; Wolf, 2004) trees provide significant cost reduction to energy usage based on their relative location to buildings (Simpson, 2002). Trees, in general and specific trees particularly, well placed and clustered correctly; can have significant positive effects on overall infrastructure, cost reductions for building retention ponds, and storm water management. Beyond acting as carbon sequesters and protecting the ozone, trees also function as water sumps, reducing the cost and impact of storm water. Simpson (2002) states "large scale effects, especially larger trees, as they manipulate wind, effects vapor pressure, and mainly affect air temperatures". The latter are all typical values and benefits from trees on urban lots. In conjunction with roof designs and as previously indicated tree placement, direct positive effects on energy loss, smog, heat gain and loss, cost of electricity, and overall benefits to micro environments have all been empirically proven.

2.3. Commercial Uses

Commercial and retail spaces are another area of the value of the urban forest.

Trees in the built\unbuilt environment provide enhanced customers' experiences, including providing higher satisfaction when shopping (Wolf, 2003). Wolf's study further indicates that consumers were willing to travel further, visit longer, more often, and pay more for parking, when the surroundings supported trees and landscaping. Another study by Wolf (2004) dispels the notion that clear-cutting trees and natural landscapes to provide unabated views of walking and driving pedestrians is economically wise. Business owners indicated (Wolf, 2004) objected to trees due to the potential additional cost of pruning and cleaning up leaves. Overall, trees provide a positive view for consumers and even influence cognitive behavior in how they feel when they visit certain sceneries created by landscapes. Both business and policy makers can use the understanding of the effect on users by the presence of trees. This information will improve knowledge and awareness and is useful in establishing guidelines for placement and protection of trees. The capitalist mode of operation notwithstanding the presence of planning, zoning, subdivision ordinances, and a variety of other legislations, generally does not measures the negative impact of business, as a whole, upon the natural environment. Businesses and commercial

enterprises are the largest consumer of natural resources and open space degradation. Within the urban environment, the entrepreneurial force, which seeks value within the urban community, drives what happens with the natural (Logan and Molotch, 1987). As such and as per growth machine and elitist theorists, the natural environment itself will take second or some lower level of importance after the values important to elitist and growth machine theorists (Harding, 1995). Those values will include prime space to locate enterprises, maximizing transportation routes, and providing easy connections. Tree patches, natural flora, and fauna are not crucial elements in respect to land values and space for commercial enterprise. In order for the urban forest to have a different stand it is necessary to tie its placement, if not value, to the corporate bottom line (Beheiry *et al.*, 2006). The recent trends towards green applications in the design of roofs and parking lots two sources of very negative effects on the urban environment, are only relevant in accordance with the use and potential value. As such, environmental benefits must provide positive values. According to elitist and growth machine theorist, it is unlikely that we will see large-scale implementation of measures that support substantial urban tree cover unless cool techniques drive values in a positive direction or subsidies to offset incurred cost.

As per Beheiry *et al.* (2006) commercial enterprise will pay closer attention to issues of sustainability and, more specifically, the urban forest if and when the relationship is tied to the corporate bottom line and losses are demonstrated when they do not. The notion of connecting the corporate urban responsibility to rates of return (Dias-Sardina and Reijnders, 2001) and Dias-Sardina *et al.* (2002) promote linking performance evaluation with the strategic environmental goals of organizations. The consideration hinges on organizations including pollution prevention, eco-efficiency, eco-innovation, eco-ethics, and sustainability in the corporate strategies. Connecting corporate responsibility in respect to urban sustainability, the urban forest, and specifically the urban tree cover is one of the measures identified by Epstein and Roy (2003). When an organization moves towards meeting the tree cover standard, identified by the American Forest of 15% for business uses, such should be rewarded and the reverse should occur when those goals are not met or sought after.

2.4. The New Urban Environment

The urban environment and the way the public participated saw dramatic change from the 1960's and continues today. The sixties saw massive public unrest and a resurgence of the public's push in areas of civil rights, freedom of speech, due process, and urban renewal projects. Entering the 1970's the public's voice spoke loudly in respect to the environment. Generally, the times provided planners within the public, nonprofit, and market sectors great opportunities to grasp the new direction and take on the positions of experts and as advocates for the public and, at other times, special interest. Practicing planners did not initiate the change in thinking that required some restructuring of the urban environment. Academics, both in public policy and planning, were discussing a new dimension that required the recognition of the public as a viable participant in decision-making, especially in areas that directly affected them and the communities in which they live (Friedman, 1993). Using a communicative approach to planning, whereby planned actions that affected or could affect the masses, required involving those persons in the process. Communicative actions considers the process as equally important as the plans themselves, an emergence from the ideas of 1&1984) and as Niemi (2005) points out, a necessary aspect of the strategic process.

In Habermas's view, the public as a whole must have the ability to participate in a reciprocal way in areas in which they are affected (1984/1981). The participation of the public will demonstrate the highest level of public freedom that permits the participant to address issues from their own worldview and having the opportunity to challenge the inputs as varying or different perspectives. The mandates for public participation in environmental impact statements, criteria for participation in federal urban renewal grants, and the new freedoms spurred by the civil rights laws did set the stage for planning professionals to interject the values of the field in urban restructuring. The participatory approach to planning is clarified and expressed by democratic societies and

suppose to provide a semblance of social justice and some level of equal outcomes (Judge, 1998; Young, 2000). In order to realize the full potential of any democratic process (Young, 2000) argues further, civil society must come to grips with two opposing realities, aggregate and deliberative, which rest on the notion that most democracies operate and function on the trappings and not the meat of true democracy. Much of recent planning theory promotes deep democracy that recognizes the values of the household sector, and every other sector as instrumental in planning processes and decisions (Krumholz, 1999).

This research hinges on the theoretical possibilities in planning that lends itself to methods that are slightly outside the rational quantitative model and may require approaches that consider public perception and values, not tied to capitalistic outcome scenarios, but focuses on achieving means and ways that lead to spatially inclusive sustainability measures. The approach recognized the value of the society as a benefactor that can influence change via a regime that acknowledges the autonomy of the individual, while recognizing the need of the state. Such is the case pointed out by and Peet (1975;1979) in order to counter unjust aspirations upon civil society; this includes the negative impact upon the natural environment due to capitalist economies.

The recognition that planners did not hold the key to the one best way argued (Lindblom, 1959) provided the opportunity for other participants to present their take on situations. The technocrat and the city plans that adhered to a rigid structure gave way to open concepts that saw the development of 'New Towns' in opposition to existing structures that were not necessary designed for the users themselves; such as Irvine in California, Columbia in Maryland and to some degree the Woodlands in Texas. These towns were not prescriptive but were market oriented, as a response to existing community needs. The developments were not Euclidian, but followed an environmentally sound design that kept tuned to the human scale.

As the governmental objectives identified aspects of public participation, Davidoff (2003) promoted planners as advocates for the communities they serve. As advocates, planners were to strive to release the value of the public stakeholder as a reflective thinker that had views and consideration on how best to empower and serve their communities. This advocacy in planning led to citizens as community stakeholders vying directly for government grants under the Community Development Block Grant programs; and as such, much of the funding originated at the grass root level. The various public operators, including planners, led many communities in competitive grant submissions in the previous three decades acquiring millions in dollars for community projects from New York to Dallas. The aspect of planners as direct participants and at times promoter of neighborhood values, opened doors for greater involvement as stakeholders in decision making that affected the lives of many. With the efforts of planners and the community as a whole recognizing a joint value system, knowing how the household and the other sectors view issues of sustainability, will lay the ground work for meaningful improvement towards urban forestry and sustainability measures for communities. This was also designed to introduce greater equity among and between neighborhoods, introducing the ability of individuals to be advocates with knowledge and understanding of the interplay been the various sectors.

2.5. Harris County Urban Forest

Opportunities exist to expand the urban forest, creating corridors and tree stands from adjoining backyards, while intersections of four and three properties can make small wedges. When residential corridors connect to public street open spaces, extended tree stands and tree clusters are possible. The incentive to the landowner can come in the form of tax rebates or property tax discounts for areas dedicated to urban reforestation and design improvements. The urban forest policy will need design elements that take into consideration building height and placement in order to maximize the solar value in balance with placement of trees based on those elements (Capeluto and Shaviv, 2001) & (Tombazis and Preuss, 2001). Buildings of varying heights and design using both active and passive solar elements are possible when planned with the various elements of location and normal climatic conditions in mind. Another design element along the line of solar volume and solar radiance is

to expand upon wind tunnels for climates that will benefit from air movement especially in the hot months and for circulation (Sharples and Bensalem, 2001). Maximizing the urban forest and incorporating ecology into the city said Newman (1996) envisions a compact city with maximized uses and high pedestrian traffic. Such is a city reminiscent of the Old Testament a city that is compact together (Psalms 122:3).

3. METHODS

The research study area encompasses all of Harris County, utilizing property owners as the population base.

3.1. Study Background and Methods

Previous research (Dwyer *et al.*, 2000; McPherson, 2005; Wolf, 2005; Heynen, 2006) all confirmed that the intrinsic value of urban tree cover and urban trees themselves have a positive relationship with quality of life variables. In addition, Heynen and Lindsey (2003) demonstrated the value of public officials' knowledge and awareness in promoting urban tree cover. The connection with quality of life variables and urban tree cover provides the basis for developing the primary survey collection instrument. The initial phase of the study confirmed and evaluated the findings of Heynen and Lindsey (2003) from data collected in the state of Indiana from 64 cities, and demonstrated that the urban forest correlates positively with household factors including, income, median house price, education, and tenure. The research study area encompasses all of Harris County, utilizing property owners and the urban tree canopy as its population bases.

Harris County is predominantly urban land dominated by Houston, the major metropolitan center and the fourth largest city in the United States, as such, high percents of urban land in adjoining cities is expected. With urban expansion the tree cover is easily destroyed if not protected. The potential to retain spaces and places for both the built, unbuilt, and population expansion is possible. Planners and policy makers must keep abreast of change and the determinants of change. It is clear that space is still available for a merging of all concerns and as McHarg (1971) indicates; it requires building with nature, and not one first and then the other. This research helps policy makers do the former.

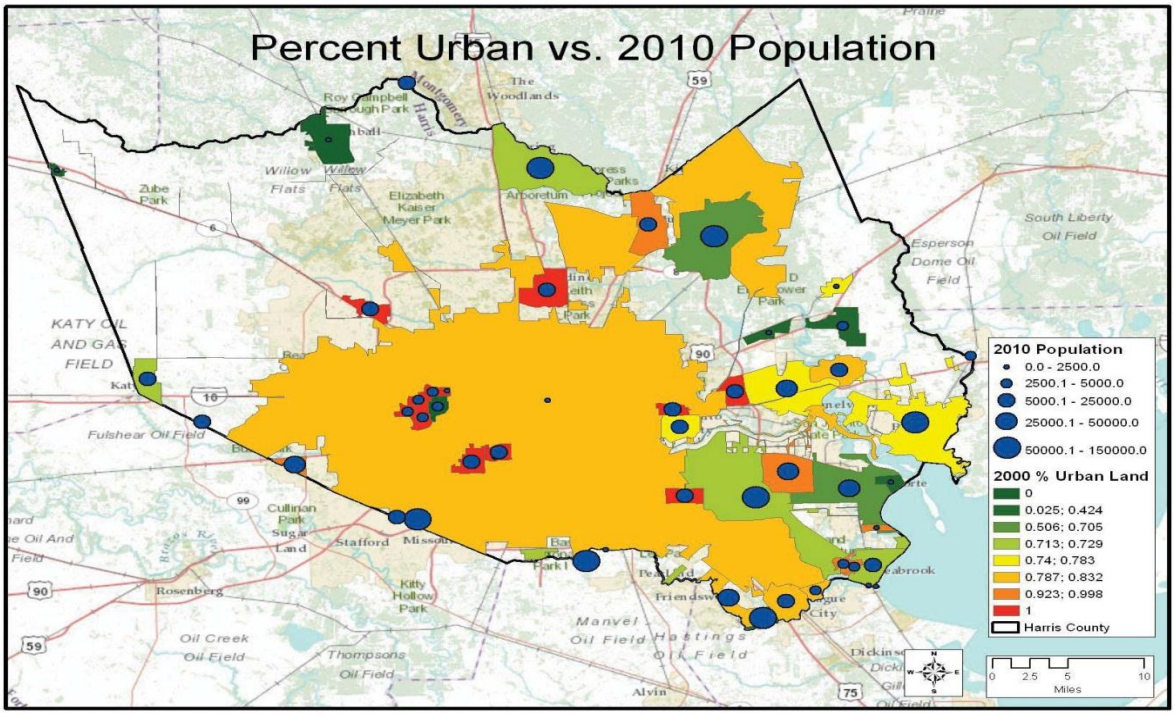

Figure-4. Urban Land Compared to Population

Source: ESRI (2010) basemap, Map Analysis, Rodriguez (2012).

3.2. Sample Size and Data Collection Method

The survey reach included the entire Harris County population base with the only criteria being the responder being eighteen years old or older. The map depicts all the possibilities for respondents within municipalities of Harris County. The requisite sample size was established by evaluating minimum sample size requirements according to Champion (1993) and Field (2005). The sample size of 399 met the statistical demands necessary when utilizing a Hierarchal Linear Modeling (HLM) approach (Field, 2005). The basic premise required 20 respondents for each dependent variable and 10 respondents for each independent variable. Since each model is an independent layer of the other, the sample size met and exceeded all sample size requirements. The additional respondents will help in providing strength in the analysis.

The crux of this study lies in assessing the behavior of the household sector in relationship to the sustainability issue including the urban forest and how that behavior connected with the other sectors. The analysis of the primary data followed the premise that the household sector is a key participant in the domain of groups important to our social fabric (Biggs and Helms, 2007). As such, the survey questions from Rodriguez (2012) are extrapolated and used for this analysis. Several researchers, including McPherson (1993) and Wolf (2005) considers households' relationship to the urban forest in respect to commercial experiences, willingness, and quality of life variables. The approach of this research is unique in that it considers actionable change, receptivity for action, and the relationship of the sectors along a multiplicity of predictor variables and receptivity over spatial scales. The countywide survey does not limit its results to the cities in the study area, but uses the entire population base of Harris County to gather the requisite sample and data. As indicated, the survey questions provide independent, dependent, and control variables used to accept or reject the corresponding null hypotheses. The data and consideration of the sectors and frames of reference opens itself to the hierarchal approach to analysis. The sectors are all members of society but with various perspectives and according to the impetus of this study has different frames of references, but may also have commonalties as previously announced. In hierarchal modeling, the concept is nesting of properties within a common domain. Within this study, we have members of civil society within Harris County identified along four referent points, and we have spatial claims from the lot to the neighborhood to the city; all which are within a region, again the concept of nesting.

The method of analysis incorporates hierarchal linear modeling in conjunction with analysis of variance (ANOVA) to address the questions.

- the sectors are different in how they relate to knowledge and awareness of the urban forest.

Given the population sample are within a domain made of sectors (reference points), the HLM method best addresses the question as previously described. The null hypothesis aligns with the analysis of HLM by Albright and Marinova (2010) and stated as follows:

Hypothesis 1

$$H_{0_1}: \sigma^{J1\text{-}4}_{\beta 1\text{-}4} = 0$$

Where $j_{1..4}$, the sector's variance, is equal zero. The overall analysis goes beyond variance and relationship of means effects. The analysis crosses and intersects relationships and effects with and across sectors. Shown in Figure 5 are the main primary data elements, the model levels, and the equation depicting the primary statistical model in applying the Hierarchal Linear Model (HLM)

HLM General Equation for the hypothesis:		
Level II	**Level III**	**Level IV**
B0j=G00+G01*W1j+u0j B1j=G10+G11*W1j+u1j	B0j=G00+G01*W1j+u0j B1j=G10+G11*W1j+u1j B2j=G20+G21*W1j+u2j	B0j=G00+G01*W1j+u0j B1j=G10+G11*W1j+u1j B2j=G20+G21*W1j+u2j B3j=G30+G31+G32*W1j+u3j

Substituting level 11, III, and IV into the general equation will produce the grand model equation:

$$= GOO_{S21(sectors_{intercept})} + GO1_{s21(sectors\ slope)} * W1_{Control\ Variables} + u0_{j(specific\ effect\ at\ sector\ levels)} + G10 + G11 * W1_{jSector-d1} + u1_{sector-d1}\ X1_{ij(sectord1_{individuals}\&groupDV)} + G20 + G21 * W1_{jsector-d2} + u2_{j\ sector-d2}\ X2_{ij} + (G30 + G32 * W1_{j[sector\ at\ d3]} + u3_j)X3_{ij} + r_{ij}$$

Y_{s23_s26} $G31$

Where
Y=dependent variables X= independent variables
i=individuals j=groups
G=population and levels within model [SPSS assigns sectors randomly in the operation]
W=control variables
u= effects of model r= error factor

Dependent/criterion* –	Section 2: Urban Forest Awareness
S2Q3: Urban forest and reducing your cost S2Q4: Conservation of the urban natural environment S2Q5: Respondent level of awareness 12 choices on sustainability matters S2Q6: Relative awareness	
Independent/predictors	S2Q1: Frame of reference
Public Sector Non Profit Sector	For Profit/business Sector Household Sector
Control\Dummy variables	Section 8: Demographic Questions
S8Q12 - property ownership S8Q1 - tenure	S8Q9 - income S8Q11 - nine employment S8Q4 - education

Figure-5. Hypothesis 1. Statistical Model and Corresponding Survey Questions

Note: My lot ranged from a possible minimum of 0 to a possible maximum of 3. My neighborhood ranged from a possible minimum of 0 to a possible maximum of 8. My city ranged from a possible minimum of 0 to a possible maximum of 9.

Based on the primary notion of the research, that the urban forest and more specifically the percent of urban tree canopy is vital to our quality of life; the overall sustainability measures of its protection are preeminent. The work explores the intersectoral/intrasectoral relationships and differences when it comes to matters of the urban forest and its elements. This research question predicts that the sectors will have different levels of awareness and knowledge. Identifying the sensitivity of each sector to the issues of sustainability provides measures for policy choices based on knowledge. This research expects to identify which sectors drives, or can most likely drive the discussion on urban forestry and sustainability as a whole.

Hypothesis 2

The natural environment and the urban tree cover is an important element within the ecosystem to the Harris County residents. In order to test this hypothesis the research will use S3Q1 through S3Q4 (Appendix A) with a 95 confidence level, and a confidence interval of 5 to accept or reject the null hypothesis. The questions from the survey that were necessary to address the second research question are shown in Figure 6, with the corresponding model formula of the one-way ANOVAs utilized to test the null hypothesis

The general one-way analysis of variance -
The four sectors S2Q1 of the survey and the relationship and operation in respect to the four elements of Section 3 of the survey, which make up the independent and dependent variables respectively. The null hypothesis is stated as:

$$H_{0_2}: \mu_P = \mu_{FP} = \mu_{NP} = \mu_{HH}$$

Where P – is public, FP – for profit, NP non-profit, KK- kith and kin household.
= variation explained by model.

Dependent/criterion	S3Q1 - At least one large tree in every yard is S3Q2 - Outdoors, including parks with many trees and other natural features S3Q3 - Clusters of trees growing throughout the neighborhood is
Independent/predictors	S2Q1 – (Respondents Selected one of four Frame of references) Public Sector For Profit/business Sector Non Profit Sector Household Sector

Figure-6. Hypothesis 2 – Statistical Method One-Way ANOVAs depicting all variables

{* Section 3 questions measured sensitivity towards the natural environment and the urban tree cover. It used a scale of 1to5 where 1 is very important to 5 very unimportant}

To address Hypothesis 2, the mean ratings of section three items are compared with the ratings of each sector asthe first step in the analysis. Then computing the confidence intervals to check population level of importance is followed by using an analysis of variance, one way ANOVAs, and comparing the four sectors. When overall significant differences exist, Bonferonni Post Hoc comparisons will be conducted in order to determine specifically where the differences occurred (Field, 2009).

4. RESULTS

The research began with the idea that the urban forest is an indicator of quality of life. As such, the research examined urban tree cover (UTC) percent and how it correlates with the census household quality of life variables. Initially the entire census's data set was included in a correlation matrix with the census variables in the columns and the UTC of each city in each row. The entire analysis with all tables and outputs is included Appendix 1. Using a multiple correlation matrix of 25 by 45 variables, with a 95 confidence variables with mathematical significance were identified. The Excel program produces a total of seven variables that showed positive correlation and relationship to urban tree cover values. At the initial stage the analysis did not provide clarity or any causal relationships between urban tree canopy cover and quality of life variables that were not expected. As discussed the relationships, even with those showing significance, did not lend any new knowledge for planners in respect to the overall sustainability consideration nor did it provide a basis to expand on the issues of sustainability.

The issue of the overall eco-system and urban tree cover are critical to our continued livability, as such, it became imperative to delve deeper into the perceptions, and views in respect to urban forestry and sustainability itself across levels of civil society. This is especially true based on the work of Biggs and Helms (2007) which depicts the evolving of the sectors, such that the roles and influences of one has expanded into the other. From a planner's perspective and in accordance Yearwood (1971) the advocacy role planners should take requires a deeper understanding and recognition of norms, values, and sectoral differences within this new urban ecosystem. Such additional knowledge requires a turn in the approach and the questions needed to get this understanding required the primary data collection instrument. Even the method of deployment is crucial in this highly technical and fast pace urban communities.

4.1. Descriptive Data for the Independent Variables

The participants' reported sector was the primary independent variable of interest in this study. Table 3, depicts the sample composition by sector. The results indicate that the majority of the participants were part of the household sector, with the non-profit, for profit, and the public sector having sufficient responses to meet statistical methods requirements.

Table-3. Sector Composition of Sample

Sector	Frequency	Percent
Public	61	15.3
For profit	32	8.0
Non profit	29	7.3
Household	271	67.9
Unknown	6	1.5

Note: My lot ranged from a possible minimum of 0 to a possible maximum of 3. My neighborhood ranged from a possible minimum of 0 to a possible maximum of 8. My city ranged from a possible minimum of 0 to a possible maximum of 9.

The sector variable was transformed in order to create dummy variables for the regression analysis. Specifically, a dummy variable (1 or 0) was created for the public sector, for the profit sector, and for the non-profit sector while the household sector served as the reference category. An analysis of Survey questions for Hypotheis 2 indicates that the overall relationship of the sectors in respect to awareness of the energy cost benefits of the urban forest. The data identifies that all sectors awareness threshold, (based on adding choice 1, Yes I knew that and choice 3, It is good to know that) exceeded 70%, with the overall average threshold for all sectors at 76.1%.

In Figure 7, the second and fifth columns show that overall Harris county residents have a positive outlook based on their responses in respect to conservation of the natural environment as important and willing to do something to protect the same.

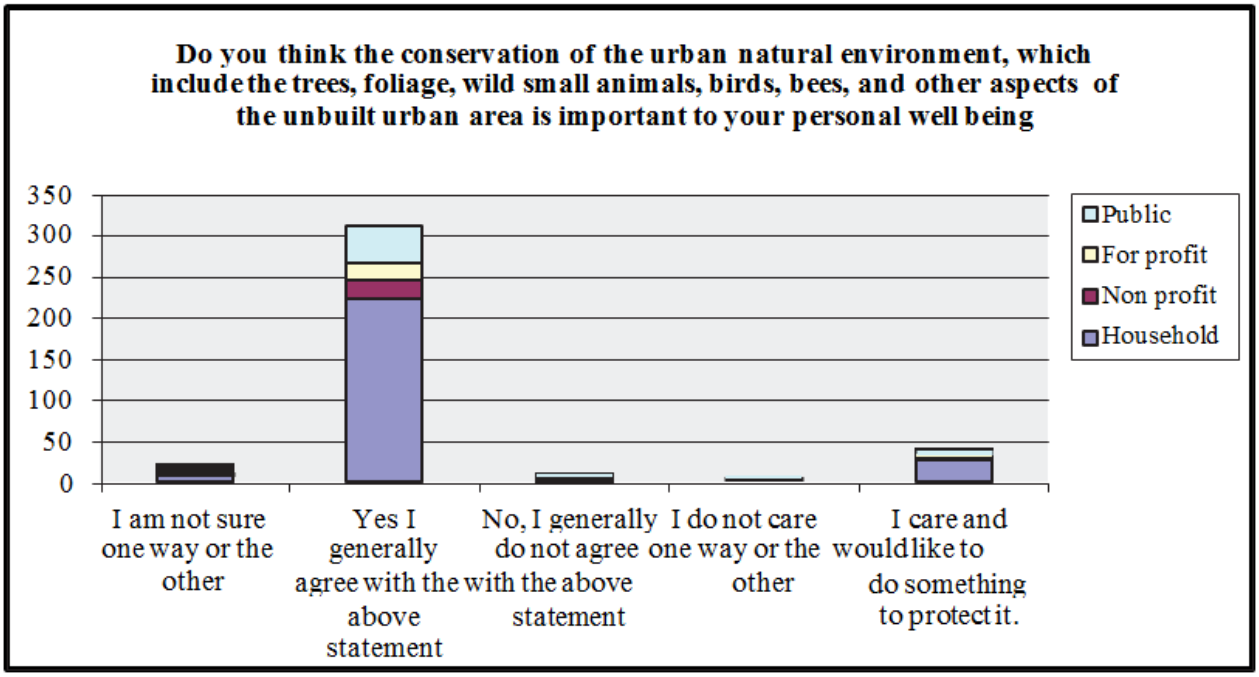

Figure-7. Conservation of Natural Environment

Source: Rodriguez (2012)

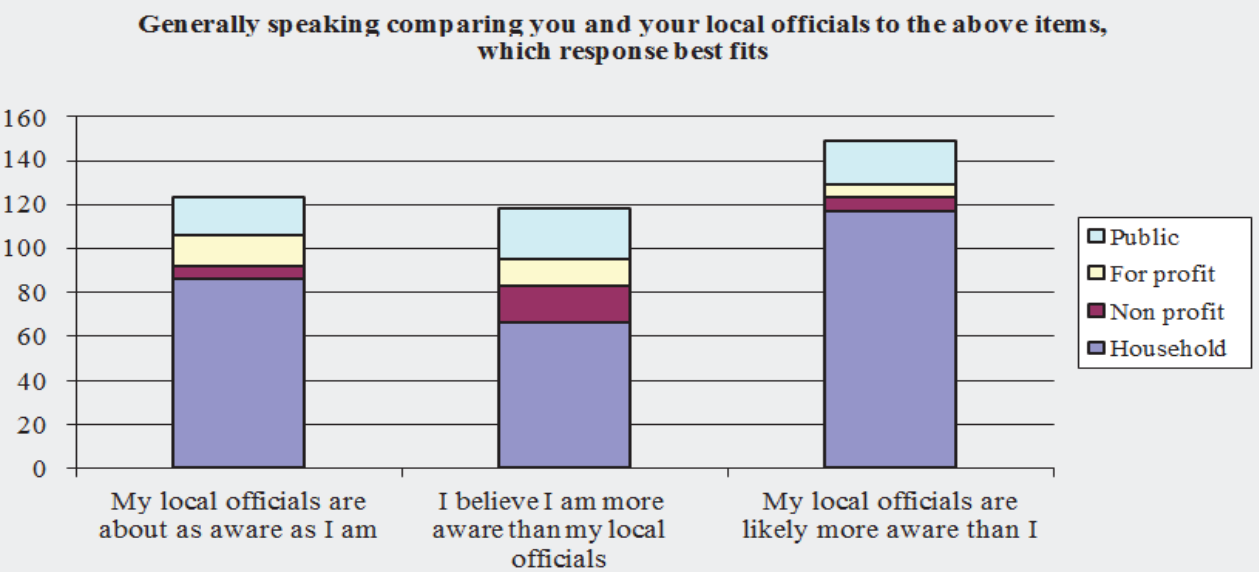

Figure-8. Relative Awareness Section 2. Question 6

Source: Rodriguez (2012)

Figure 8, details relative awareness based on perceptions of respondents and their local officials. A telling response is the household frame of reference expectations of their local officials more aware as a whole. Table 5, is an aggregate of Harris County residents, notwithstanding frame of reference of response, in respect to the 12 elements of sustainability. Columns one and three are key responses in this question.

Table-5. Level of Awareness on Measures of Sustainability

	Very Aware	Unaware	Do not Care	Will like to Know more
Acid rain	201	108	24	94
Water pollution	324	38	6	60
Aquifer protection	132	174	17	96
Runoff from parking lots	186	142	22	62
Global warming	282	30	56	48
Air pollution	332	23	8	46
Trees reduce air pollution	291	60	12	58
Rain gardens	117	191	17	107
Wet lands	238	89	16	64
Trees benefit to clean water	217	116	9	73
Recycling programs	329	27	12	58
Value of trees	314	41	7	54

n=380 to n=393

4.2. Descriptive Data for the Control Variables

The participants' status in terms of whether or not they owned the property in which they resided was also one of the five control variables in this study. Table 7, provides the composition of the sample based on ownership status.

Table-7. Ownership Status Composition of Sample

Owner of residence	Frequency	Percent
Rent	250	62.7
Own	149	37.3

Note: My lot ranged from a possible minimum of 0 to a possible maximum of 3. My neighborhood ranged from a possible minimum of 0 to a possible maximum of 8. My city ranged from a possible minimum of 0 to a possible maximum of 9.

The results indicate that 37.3 of the participants in this study said that they owned the property in which they resided and therefore the majority of the participants represented in this study were not the owners of their residence. Educational attainment was another control variable. The descriptive results featured in Table 8 indicate that participants were most likely to have between some college (27.6) and a four year degree (26.3) with 64.4 falling somewhere in between those two parameters.

Table-8. .Educational Composition of Sample

Education	Frequency	Percent
Less than high school diploma	8	2.0
High school diploma	60	15.0
Some college	110	27.6
Associate degree or technical degree	42	10.5
Four year degree	105	26.3
More than four years of college but no graduate degree	17	4.3
Master's degree	39	9.8

Table-9. Income Composition of Sample

Income	Frequency	Percent
Less than 30K	86	21.6
Less than 45K but more than 30K	65	16.3
Less than 60K but more than 45K	65	16.3
Less than 75K but more than 60K	48	12.0
Less than 100K but more than 75K	63	15.8
Over 100K	62	15.5
Unknown	10	2.5

Note: The control variables consisted of a property ownership dummy variable, income, education, tenure, and nine employment dummy variables. $*p < .05$; $**p < .01$; $***p < .001$.

Income was another control variable. The frequencies and percentages by income level are presented in Table 9. The results indicate that participants were most likely to report that their income was less than $30,000 (21.6). However, the distribution of income was relatively wide and evenly distributed between the levels of income with many participants indicating that their income was over $100,000 per year (15.5). The next control variable was employment, which consisted of 10 dummy coded variables. The results indicate that while participants were most in the "other" category the overall types of employment represented were diverse. Office worker was the most selected specific employment type. Several respondents included check marks did not permit coding of the employment data doe descriptive purposes. Table 10, provide the overall details of the employment question.

Table-10. .Employment Composition of Sample

Employment	Frequency	Percent
Trades person including carpenter, plumber/electrical	13	4.08
Office worker, administrative/clerical	46	14.42
Retail sales	23	7.21
Construction laborer helper	3	0.94
Management retail or manufacturing	9	2.82
Health or education support services	21	6.58
Medical professional practitioner	11	3.45
Educator (classroom including higher education)	20	6.27
Upper management	17	5.33
Food service	12	3.76
Other	144	45.14
Total	319	100

Note: The control variables consisted of a property ownership dummy variable, income, education, tenure, and nine employment dummy variables. $*p < .05$; $**p < .01$; $***p < .001$.

The final control variable was tenure in one's respective residence. The descriptive statistics for tenure, as well as for the other two control variables that were in rank form, are provided in Table 10. The results indicate that on average, participants lived in their current residence for 8.71 years; although one year was the most common response. The results also indicate that on average, participants had the equivalent of an Associate's degree or technical degree (4.09) with the most common response being some college. Finally, the results indicate that on average, participants made between $45,000 and $75,000 per year with the most common income being under $30,000, as previously indicated.

The first dependent variable pertained to the Likert scaled items in Section 2 (S2) of the survey. Table 11, provides the descriptive statistics for each of those items, which references the questions (Q) and variables as follows: Variable 1 = S2 Q3; Variable 2 = S2 Q4; Variable 3 = S2 Q6 (Relative Awareness); Variable 4 = S2 Q5 (Level of Awareness). The results indicate that participants were most likely to say that they were very aware that trees correctly placed on their lot can specifically reduce their energy cost both in the winter and the summer. In addition, participants were most likely to state that they generally agree that the conservation of the urban natural environment is important to their personal well-being.

Table-11. *Section 2 Measures of Central Tendency and Dispersion: Awareness and Knowledge*

Section 2	N	Mean	Median	Mode	SD	Skew
Trees reduce energy cost	396	3.39	4.0	4	0.84	-0.83
Conservation is important	398	3.93	4.0	4	0.68	-2.18
Relative awareness	399	-0.09	0.0	-1	0.83	0.17
Level of awareness	396	3.37	3.5	4	0.50	-1.04

Note: The control variables consisted of a property ownership dummy variable, income, education, tenure, and nine employment dummy variables. *$p < .05$; **$p < .01$; ***$p < .001$.

The first variable was measured on a four-point scale ranging from I do not care one way or the other (1) to yes I knew that (4). The second variable was measured on a five-point scale ranging from I do not care one way or the other (1) to I care and would like to do something about it (5). The third variable was measured on a three-point scale ranging from my local officials are likely more aware then I (-1) I believe I am more aware than my local officials (1). The fourth variable was measured on a four-point scale ranging from do not care (1) to very aware (4). Overall the results suggest that while participants were most likely to be aware of these urban forest issues, they tended to believe that they were less aware when compared to their local officials. Also, there was a relatively large degree of variability in participants' perceptions as indicated by the standard deviations. Table 12, decomposes the 12 factors from Item 5. All of the items were based on a four-point scale ranging from do not care (1) to very aware (4). The results indicate that participants were most likely to be unaware of aquifer protection and rain gardens. On average, they were most aware of air pollution (3.78) and least aware of rain gardens (2.82). However, there was a relatively large degree of variability in participants' perceptions as indicated by the standard deviations.

Table 13, identifies the third dependent variable which came from Section 3 of the survey and provides the descriptive statistics for the four items associated with that section of questions. The results indicate that participants were most likely to select "very important" for all items and therefore they were most likely to feel that, having outdoors (including parks) with many trees and other natural features, having clusters of trees growing throughout the neighborhood, and having trees and shrubbery cover to support small wildlife are very important. On average, participants rated having outdoors with many trees and other natural resources as most important (3.99) and having a large tree in every yard as being least important (3.79). However, there was a relatively large degree of variability in participants' perceptions as indicated by the standard deviations.

Table-12. Level of Awareness

Section 2.5	*n*	Mean	Median	Mode	*SD*	Skew
Acid rain	390	3.19	4.0	4	0.95	-0.73
Water pollution	393	3.74	4.0	4	0.61	-2.36
Aquifer protection	380	2.88	3.0	2	0.94	-0.05
Runoff from parking lots	384	3.06	3.0	4	1.00	-0.44
Global warning	387	3.41	4.0	4	1.07	-1.52
Air pollution	386	3.78	4.0	4	0.59	-2.88
Trees reduce pollution	388	3.59	4.0	4	0.78	-1.75
Rain gardens	389	2.82	3.0	2	0.91	0.05
Wet lands	383	3.35	4.0	4	0.92	-1.01
Trees benefit water	386	3.27	4.0	4	0.90	-0.71
Recycling programs	391	3.75	4.0	4	0.63	-2.77
Value of trees	386	3.71	4.0	4	0.65	-2.18

Note: The control variables consisted of a property ownership dummy variable, income, education, tenure, and nine employment dummy variables. *p < .05; **p < .01; ***p <.001.

Table-13. View of Nature

Section 3	*n*	Mean	Median	Mode	*SD*	Skew
Tree in every yard	399	3.79	4.0	5	1.40	-0.99
Outdoors	397	3.99	5.0	5	1.51	-1.23
Clusters of trees	396	3.84	4.0	5	1.36	-1.02
Support small wildlife	398	3.93	5.0	5	1.40	-1.14

Note: The control variables consisted of a property ownership dummy variable, income, education, tenure, and nine employment dummy variables. *p < .05; **p < .01; ***p <.001.

The final dependent variable pertained to the participants' willingness to take action, which aligned with Section 6 of the survey. The participants' descriptive results for the six Likert scaled items associated with Section 6 of the survey are presented in Table 14. The responses were based on a five-point scale ranging from a very bad idea (1); to a very good idea you have my full support (5). The results indicate that participants' responses tended to vary based on the specific action. For example, on average, participants were most likely to want to take action if the action pertained to a property tax reduction or credit for every tree on their property (4.02), but least likely to want to take action if the action pertained to an ordinance requiring a permit to remove trees from private property (2.55).

Table-14. Taking Action

Section 6	*n*	Mean	Median	Mode	*SD*	Skew
Give up small corners	396	3.10	3.0	2	1.24	0.00
Minimum tree ordinance	395	3.03	3.0	4	1.34	-0.05
Property tax reduction	394	4.02	4.0	5	1.16	-1.05
Require permit ordinance	394	2.55	3.0	1	1.37	0.30
Show to will protect	395	3.82	4.0	5	1.17	-0.72
Identify tree coverage	395	3.39	4.0	4	1.14	-0.35

Note: The control variables consisted of a property ownership dummy variable, income, education, tenure, and nine employment dummy variables. *p < .05; **p < .01; ***p <.001.

The statistical analysis of Hypotheis and Hypothesis 2 included the composition of multiple items that were combined into two separate composite scores (Section 2, and Section 3). These factors included the 12 factors associated with Item 5 in Section 2 and Items 1-4 in Section 3. Since these items were combined into one overall composite rating, the internal reliability of the items was evaluated by computing a Cronbach's alpha. The results featured in Table 15, indicate that the 12 awareness factors associated with Item 5 in Section 2 yielded good to

excellent internal reliability (.83); the four items in Section 3 yielded excellent internal reliability (.93) (Ponterotto and Ruckdeschel, 2007).

Table-15. Internal Reliability for Composite Ratings

Source	*n*	Mean	SD		Potential	Actual	Skew
S2: awareness	399	3.37	0.5	0.83	1-4	1.0-4.0	-1.04
S3: care/importance	399	3.89	1.31	0.94	1-5	1.0-5.0	-1.21

Note: The control variables consisted of a property ownership dummy variable, income, education, tenure, and nine employment dummy variables. *p < .05; **p < .01; ***p <.001.

The first hypothesis predicted that the sectors are different in how they relate to knowledge and awareness of the urban forest. The complimentary null hypothesis states that there are no differences between the sectors as it relates to knowledge and awareness of the urban forest. Therefore the sectors were included as the primary predictor variable in step two of the hierarchical linear regression model (HLM) and the five control variables were entered in step one of the model. The dependent or criterion variables included each of the four Section 2 items relating to awareness. A total of four separate models were run; one for each applicable item from Section 2 on the survey. The HLM results for the first item pertaining to knowledge that trees correctly placed on one's lot can specifically reduce energy costs both in the winter and the summer (Item 3), are presented in Table 17. The results indicate that the control variables accounted for 9 of the variability in participants' responses, which was statistically significant, $F(13,370) = 2.73$, $p = .001$. However, the results also indicate that when adding the three sector dummy variables into the model, the model explained less than 1 of additional variability in participants' responses, which was not a statistically significant increase, $F(3,367) = 0.56$, $p = .683$.

Table-17. Hierarchical Linear Regression Results for Section 2, Item 3 Composite Rating

	S2.3 composite	
Predictor	ΔR^2	
Predictor	ΔR^2	β
Step 1	.09**	
Control variables		
Step 2	.004	
Public sector		-.01
For profit sector		.04
Non-profit sector		.05
Total R^2	.09**	
n	384	

Note: The control variables consisted of a property ownership dummy variable, income, education, tenure, and nine employment dummy variables. *p < .05; **p < .01.

The results for the second item pertaining to the extent, to which participants think that the conservation of the urban natural environment is important to their well- being (Item 4), are provided in Table 18. The results indicate that the control variables accounted for 5 of the variability in participants' responses, which was not statistically significant, $F(13,372) = 1.58$, $p = .089$. However, the results indicate that when adding the three sector dummy variables into the model, the model explained an additional 2 of the variability in participants' responses, which was a statistically significant increase, $F(3,369) = 2.86$, $p = .037$. Specifically, the public sector was statistically significantly associated with lower importance ratings, $\beta = -.12$, $p = .019$, as was the for profit sector, $\beta = -.11$, $p = .040$.

Table-18. Hierarchical Linear Regression Results for Section 2, Item 4 Composite Rating

	S2.4 composite	
Predictor	ΔR^2	
Control variables		
Step 2	.02*	
Public sector		-.12*
For profit sector		-.11*
Non-profit sector		-.004
Total R^2	.07*	
n	384	

Note: The control variables consisted of a property ownership dummy variable (S812), income (S89), education (S84), tenure (S81), and nine employment dummy variables (S811). *$p < .05$.

Table 19 provides the results for the third item pertaining to participants' overall level of awareness (e.g., composite rating for Item 5). The results indicate that the control variables accounted for 6% of the variability in participants' responses, which was not statistically significant, $F(13,373) = 1.71$, $p = .058$. In addition, the results indicate that when adding the three sector dummy variables into the model, the model explained less than 1% of additional variability in participants' responses, which was not a statistically significant increase, $F(3,370) = 0.33$, $p = .802$.

Table-19. Hierarchical Linear Regression Results for Section 2, Item 5 Composite Rating

	S2.5 composite	
Predictor	ΔR^2	
Step 1	.06	
Control variables		
Step 2	.003	
Public sector		.00
For profit sector		.04
Non-profit sector		.04
Total R^2	.06	
n	384	

Note: The control variables consisted of a property ownership dummy variable, income, education, tenure, and nine employment dummy variables.

Finally, the results for the fourth item pertaining to relative awareness (Item 6) are provided in Table 20.

Table-20. Hierarchical Linear Regression Results for Section 2, Item 6 Composite Rating

	S2.6composite	
Predictor	ΔR^2	
Step 1	.10***	
Control variables		
Step 2	.03**	
Public sector		.08
For profit sector		.09
Non-profit sector		.16*
Total R^2	.13***	
n	384	

Note: The control variables consisted of a property ownership dummy variable, income, education, tenure, and nine employment dummy variables. *$p < .05$; **$p < .01$; ***$p < .001$.

The results indicate that the control variables accounted for 10% of the variability in participants' responses, which was statistically significant, $F(13,370) = 3.03$, $p < .001$. In addition, the results indicate that when adding the three sector dummy variables into the model, the model explained an additional 3% of the variability in participants' responses, which was a statistically significant increase, $F(3,367) = 4.00$, $p = .008$. Specifically, the non-profit sector was statistically significantly associated with higher awareness ratings, $\beta = .16$, $p = .002$.

Hypothesis 1

The results for Hypothesis 1 indicate that the sectors are different in how they relate to knowledge and awareness of the urban forest. Specifically, the public sector and the for-profit sector were statistically significantly associated with lower importance ratings, and the non-profit sector was statistically significantly associated with higher awareness ratings. Therefore the null hypothesis was rejected. The methods used depicts that the household sector is quite different from the other sectors in reference to the sustainability awareness and knowledge questions and the potential view for positive change. As shown the model depicts alignment and positive relations between sectors as it relates to S2.3 and S2.5 with slight variability between sectors compared to the household. The public sector demonstrates negative concerns in the former and looks like the household in the latter. The for-profit and the nonprofit are quite similar in their views and insignificantly more positive in both cases. In respect to the importance of well-being due to the urban forest S2.4, the data indicates strong negative concerns from the public and for-profit sector while the nonprofit sector has stronger positive concerns with the household sector having concerns in general. Finally, the relative awareness as a whole is important among all sectors but significantly rated as much more important by the non-profit sector compared to all others.

Hypothesis 2

The second hypothesis predicted that the natural environment and the urban tree cover is an important element within the ecosystem to Harris County residents. The complimentary null hypothesis stated that the natural environment and the urban tree cover is not an important element within the ecosystem to Harris County owners. Figure 8, illustrates the sector profiles across the four items in Section 3. The results indicate that the four sectors had similar profiles, although the household sector had higher mean ratings across all four items, indicating that on average, those participants' view of nature is more positive when compared to the other three sectors (greater perceived importance). The four sectors were most different with regard to their perceived level of importance relating to having clusters of trees growing throughout the neighborhood. Specially, the for-profit sector had more favorable views of nature than the public and non-profit sectors while those in the for-profit sector had the least favorable views. The three sectors (public, for profit and non-profit) were relatively similar with regard to their mean ratings on the remaining three items associated with Section 3 on the survey.

Table-21. Mean, Standard Error and Confidence Interval by Sector for View of Nature

				95% CI	
Source	***n***	**Mean**	**SD**	**Lower**	**Upper**
Public	61	3.46	0.16	3.14	3.79
For profit	32	3.643	0.23	3.19	4.08
Non-profit	29	3.39	0.24	2.92	3.86
Household	271	4.06	0.08	3.91	4.22

Note: The control variables consisted of a property ownership dummy variable, income, education, tenure, and nine employment dummy variables. *$p < .05$; **$p < .01$; ***$p < .001$.

Table 21, provides the composite mean rating for Section 3 for each of the four sectors along with the

standard errors and confidence intervals. The results indicate that the confidence interval around each mean includes values that do not reflect general perceived importance (values less than 4.0) and therefore we can't be 95 confident that the natural environment and the urban tree cover is an important element within the ecosystem to Harris County residents.

The one-way ANOVA results comparing the four sectors in their mean composite ratings are featured in Table 22. The results indicate that there were overall significant differences, $F(3,389) = 5.66$, $p = .001$. In addition, partial-eta squared, which is a commonly used measure of effect size in ANOVA models (Field, 2009) indicates that 4 of the variability in participants' views of nature can be explained by their group association. The Bonferonni comparisons indicate that the only significant pair-wise comparison was between the household sector and the public sector, $p = .007$.

Table-22. One-Way ANOVA Results Comparing Sectors on View of Nature

Source	Sum of squares	*df*	Mean square	*F*	*p*	Partial eta squared
Between subjects	673.80	392				
Group	28.19	3	9.40	5.66	0.001	0.04
Error	645.60	389	1.66			

Note: The control variables consisted of a property ownership dummy variable, income, education, tenure, and nine employment dummy variables. $^{*}p$ .05; $^{**}p < .01$; $^{***}p < .001$.

The results for Hypothesis 2 indicate that while there was a significant difference between the sectors, there was no statistical evidence that the natural environment and the urban tree cover is an important element within the ecosystem to Harris County residents. Therefore the null hypothesis was retained. From the results, a broad spectrum of positions, views, concerns, receptiveness, and interrelationships are apparent. Frame of reference within the institutional sectors as the basis posits a legitimate approach of inquiry. With that, environmental and sustainability issues as postulated by the artifact of urban tree cover, and the urban forest itself provides a springboard into the overall urban sustainability discussion with facts. From a planning perspective, the research encourages a multidisciplinary approach of the profession in this current era. Public operators and planners, serving within varied types of agencies are themselves influenced by frame of reference. Giving consideration to Habermas (1987;1981) and the influences of worldviews, public operators and planners' actions are somewhat predictive using sectoral trends identified by the study.

5. CONCLUSION

In general, the results provide some insight into the three broad statements indicated as follows: the natural environment and the urban tree cover is an important element within the ecosystem. From the frame of reference stand point, the sectors that are willing to take actions to increase the urban tree canopy and positively influence sustainability is somewhat predictable. Environmental awareness and knowledge of the urban forest has positive effects.

An ancillary question based on the previous three, and the foundation for future work; are public operators and planners specifically uniquely postured and positioned with this information to break through barriers of change based on knowledge. In respect to the first statement, the results on its face indicates that the natural environment and the urban tree cover is not important to Harris County residents based on the results of Hypothesis 2, the null being retained. The overall negative response seems balanced by the overwhelming positive responses by the household sector with overall mean scores exceeding 4.0, an indication of environmental importance.

Taking the positive view provided by the household sector responders amidst all other negative views, with

the most significant differences between the public and household sectors; the obvious question then is who will lead. This is especially sensitive in that the results also indicate the household frame of reference generally expects their local officials to know more than they do and consequently to do not just more, but likely what is right.

Along the line of importance, an ancillary position is to take action in respect to those things that are important.

Although neither the analysis nor the data provided a basis to speak directly to the planning profession, the historical values and underpinnings of planning are within the scope of planners from the overall findings. Public operators and planners can help in filling the gap based on facts that seem to support positive concerns for the environment that are motivated by awareness and knowledge. A corollary though, no clear indication as to whom could lead in bringing about positive change when results also seem to indicate such is wanted.

The overall inclination of all sectoral frames of references is positive; just the same, the worldviews and life world aspirations according to Habermas (1984) require expanding the level of consciousness and acting upon knowledge. Such a movement requires connecting the positive aspirations with positive actions. However, the results also indicate no clear frame of reference to lead. This point is an area for expanded study and consideration in respect to the role and modus operandi of the different public operators and planners. It would seem that the planner, generally, could function in multi-sectors with knowledge and influence to promote positive change in respect to our environment and issues of sustainability. The overall positive trending provides a glimmer of hope for reckoning with pockets of negative abstractions. This postulation, from insufficiency of evidence was not statistically viable to reject the Null Hypothesis 2, that the natural environment was not important.

The second area for future study is expanding the research to gain a broader emphasis pertaining to the elements of knowledge and awareness. Then look at how such information operates in a spatial context across groups in such a manner as to influence change. The third area for future study is to explore the relationships of the 'for-profit' sector and the household sector in that similarities seem to exist below the surface; that may prove important towards a new approach to a long-range urban sustainability agenda.

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