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Exploring Stakeholders' Perceptions of Urban Growth Scenarios for Metropolitan Boston (USA): The Relationship Between Urban Trees and Perceived Density

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Exploring Stakeholders' Perceptions of Urban Growth Scenarios for Metropolitan Boston (USA): The Relationship Between Urban Trees and Perceived Density

Achieving multiple goals rather than trading one goal off for another is the essence of sustainability. Visualizing alternative futures in a participatory planning process helps disentangle complex planning issues particularly when stakeholders may perceive key goals as imposing potential tradeoffs, such as increased housing for a growing population and availability of green space. This study explored the effects of using visualization and scenarios as planning tools in a workshop with stakeholders in the Boston Metro Area, Massachusetts (USA), in achieving multiple benefits of sustainable future growth of the region. We applied mixed methods sequential explanatory design and a survey instrument with a landscape preference survey designed to garner stakeholders' preference and acceptability of perceived urban density versus urban greening in four future growth scenarios reflecting multiple goals in sustainability. The results of the landscape preference survey demonstrated that increasing tree canopy appears to ameliorate the low ratings of high-rise buildings for the region's urban development. In addition, the scenario planning process, especially the use of small group discussions, represented an effective tool in facilitating stakeholders' discussion about achieving the multiple benefits of the three goals of sustainability: *Environment*, *Economy*, *Equity*. This study provided theoretical and applied insights for planners in the use of visualization and scenario planning methodologies to engage stakeholders in the participatory planning process. It revealed the potential for a policy decision shift among stakeholders in the Boston region, namely that higher density urban development would likely be more acceptable to them when combined with a simultaneous increase in tree canopy cover. Through practices like these, stakeholders are more likely to consider policies and designs that embrace a variety of goals for their community's future instead of simplistically placing one goal in opposition to another or trading them off against each other.

Keywords
urban greening, landscape preference, scenario planning, stakeholder participatory planning, visualization, sustainability

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1. INTRODUCTION

Engaging stakeholders in planning processes has been identified as one of the critical strategies for achieving sustainable urban development (Polk 2014; UNCED 1992). A key challenge for this engagement process is to bridge institutional boundary (e.g., inter, trans-, governmental, non-governmental, formal and informal institutions) in action gaps and to meet multiple development goals rather than trading one goal against another (Polk 2014; Wang et al. 2014). Elkington (1997) envisioned sustainability as the overlapped area of a Venn diagram of the three 'E's: *Environment*, *Economy*, and *Equity*, which emphasized achieving multiple benefits in all aspects of environmental quality, economic prosperity, and social equity. Yet, the three 'E's are often seen as mutually exclusive or in competition, requiring one objective to be traded for another (e.g., Campbell 1996) or that one area must be prioritized in a hierarchical way over others (Lowe 1994). In addition, other components of sustainability have been suggested as important, such as cultural (e.g., Hawkes 2001), or institutional sustainability (e.g., Brinkerhoff 1992). While the three 'E's framework has some limitations in its integration of the sustainability concept for policy-making and practice (Zaccai 2012), we examine here its utility as a widely understood framework that can facilitate stakeholders' decision-making for achieving multiple benefits (Oels 2003). In particular, we examine stakeholders' perceptions of the benefits achieve under four urban growth scenarios for metropolitan Boston (USA), focusing on relationships between urban greening and housing density.

1.1. Urban greening vs. density: Challenges for planning

Planners have called for increased density within urban areas that already have built infrastructure (i.e., infill redevelopment) as a solution to the inefficiencies and environmental impacts of low-density development (i.e., sprawl) (Campoli and MacLean 2007). However, density is not a straightforward construct to discuss or even analyze (Churchman 1999). Perceptions of density may differ from actual density and can be affected by building height, massing, setbacks, and local context (Groat 1984; Wohlwill and Harris 1980). For example, residents from a high-rise and dense neighborhood were more accepting of high-rise development proposals than the residents living in a low-rise neighborhood (Herzog and Gale 1996). West (2008) found that suburban residents in the metropolitan area of Boston, USA, were more accepting of low-rise (two to three stories) residential developments with ample amount of open space, and perceived more negatively mid-rise (four to five stories) and mixed use buildings. Furthermore, the suburbanites' acceptance for perceived residential density was ameliorated by the amount of trees or vegetation around buildings (Kearney 2006; Ryan 2002, 2006; West 2008).

Increasing urban greening investment, such as urban tree canopy, community gardens, parks and greenways, is seen as an opportunity to improve the ecological health of cities, while providing social benefits for urban residents. However, implementation of such policies faces several challenges including public opposition to high-density infill development, limited physical space to create greenways and other urban greening projects in densely populated areas (Lindsey et al. 2001), and inequitable distribution of common goods such as parks and urban tree canopy (Boone et al. 2009; Danford et al. 2014). Planners therefore need to adopt a process whereby the complexity of achieving the multiple goals of sustainable development can be fully

explored by stakeholders and this process can be used to inform stakeholders about the environmental, economic, and social equity implications of land use policies.

1.2. Research questions

This paper examines the effects of using landscape preference surveys and scenarios as visualization tools and the process of a workshop itself to facilitate stakeholders' understanding about perceived tradeoffs and potential mutual benefits of increased density and greening in sustainable urban development in the metropolitan Boston in the Commonwealth of Massachusetts, USA (Figure 1). We broadly defined stakeholders as those who can affect or are affected by the achievement of the organization's objectives (Freeman 1994). The participants invited to the workshop were targeted as those with some level of decision power in their organization, especially those in managerial positions. Each organization that attended the workshop had interests in shaping Boston Metro Area's future growth and sustainability goals. As part of a scenario planning process for study area, our research team applied four future growth scenarios: a scenario of continued low-density sprawling development plus three alternatives to those current trends. The overarching goal was to explore potential social-ecological outcomes for each of the respective scenarios and thereby to evaluate tradeoffs between multiple sustainability-oriented goals (e.g., open space preservation, environmental equity, housing density). The scenarios and the stakeholder discussion focused on urban greening and density, but were not limited to those topics.

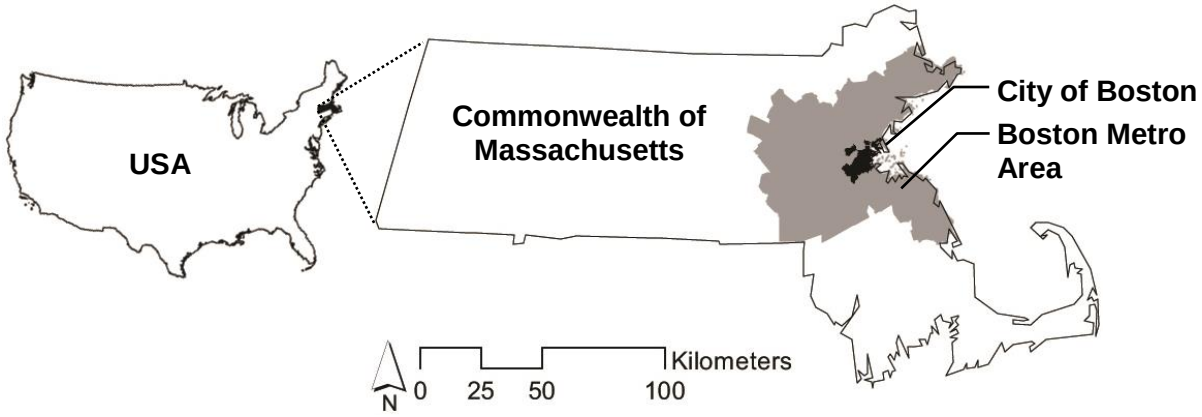

Figure 1. Study area of Boston Metro Area, Commonwealth of Massachusetts, USA

Two central research questions were investigated: 1) To what degree does using a landscape preference tool facilitate stakeholders' understanding that increasing urban development density and increasing urban greening are not mutually exclusive? 2) To what degree does using scenarios in a participatory planning process help to facilitate stakeholders' understanding that the multiple goals in sustainable development are not mutually exclusive? We tested the hypotheses that: 1) increases in urban greening (i.e., urban trees) increase stakeholders' acceptance for higher density urban development, 2) the participatory planning process (i.e., stakeholder workshop) facilitates the acceptance of multiple sustainability goals rather than trading one off with another.

1.3. Visualization

Landscape preference research that uses photographs to elicit the public's opinion (Kaplan and Kaplan 1989) is one of the several approaches to visualizing the landscape for garnering public feedback. Kaplan and Kaplan (1989) have revealed that people prefer more natural landscapes than more built landscapes. However, housing density and buildings alone do not lower preference; the ratio of built to vegetated landscape is the key. Residential satisfaction is influenced by views of nature and access rather than amount of open space, especially in suburban settings (Kaplan and Austin 2004; Kearney 2006). In urban settings, Herzog and Flynn-Smith (2001) found that combining vegetation and buildings can increase landscape preference. In addition, White and Gatersleben (2011) found the public had a stronger preference for residential buildings with green roofs and green walls. These urban studies have been less conclusive than those in more natural settings where preferred landscape patterns exhibit consistent characteristics of coherence, complexity, legibility and mystery (Kaplan and Kaplan, 1989). Preference for urban environments, on the other hand, does not follow such consistent patterns and is influenced by factors such as architectural styles, building age, and neighborhood context (Groat, 1984; Herzog and Gale, 1996), demonstrating the need for further research on how landscape preference applies to urban settings.

Moreover, the landscape preference aspect of our study allowed us to begin exploring what Hosey (2012, p. 6) describes as the "visible" and "invisible" aspects of green design. He makes the argument that sustainability advocates have focused on the "invisible" aspect of green design such as energy use and material choices to the detriment of aesthetics and beauty. According to Hosey, the public judges a building or city on its aesthetic qualities derived from the "visible green" aspects of "form, shape, and image." By incorporating visual images of potential infill development, our study was able to visually represent the urban design implications of sustainable practices related to urban greening and density.

1.4. Scenario planning

Scenario planning is a holistic tool that permits planners to address both spatial and temporal scales in planning while anticipating future change by disclosing future risks and investigating multiple alternative futures (Myers and Kitsuse 2000). Scenarios serve as a bridge between scenarists (e.g., scientists) and scenario users (e.g., stakeholders) in communicating planning issues (Xiang and Clarke 2003) by identifying critical forces that shape development, allowing the future to be studied through various strategic development processes, and enabling planners and decision-makers to prepare for and respond to these conditions at various stages (Klosterman 2007). Scenario planning allows innovation and increased adaptability in coping with uncertainty in the decision-making process (Gunder 2008), which enables organizations to be resilient and sustainable (Shearer 2005). Scenarios have been widely employed as a tool in landscape planning (e.g., Shearer 2005; Steinitz et al. 2003), land use planning (e.g., Xiang and Clarke 2003), transportation planning (e.g., Zegras et al. 2004), and conservation planning (e.g., Peterson et al. 2003). Future scenarios can be developed through two strategies: one is to define alternative futures first and then develop scenarios to achieve those outcomes; the other is to design alternative scenarios and then ask what futures it may become (Steinitz et al. 2003). In this study, we adapted the first strategy and worked with stakeholders to identify four urban

growth futures for the metropolitan area of Boston and then developed scenarios to achieve multiple benefits of sustainability.

1.5. Analytic–deliberative planning process

An influential Natural Resource Council report in 1996 advocated for decision-making that brings together two distinct but linked processes: analysis and deliberation. Analysis involves the rigorous use of replicable methods to provide information about factual questions to bring new information into the decision-making process, thereby informing the deliberation. Deliberation involves discussion, reflection, and persuasion when issues are raised and considered by a group of people, and their collective understanding. The two processes—analysis and deliberation—are iterative: deliberation brings new insights, questions, and ways of formulating a problem, and in turn, new analyses are called for and undertaken (NRC 1996).

The analytic-deliberative process in practice has been widely adopted as a "participatory" or "collaborative" process for policy-making (Douglas 2009, p164-167). The goal of deliberation is to facilitate substantive decisions by engaging stakeholders in the process of "consensus-building…that brings together for face-to-face discussion a significant range of individuals chosen because they represent those with differing stakes in a problem" (Innes 1996, p461). Therefore, the analytic-deliberative process has been widely applied for resolution of environmental conflicts and risk analysis (Renn 1999). In recent years, climate-related risks have increased interests in using this framework for climate adaptation planning (Webler et al. 2014). Building on this framework, the study described in this article applied visualization and scenarios as participatory tools in a stakeholder workshop that facilitates the analytic-deliberative process in resolving seemly conflicting goals of sustainability in landscape and urban planning.

2. STUDY AREA AND GROWTH SCENARIOS

The Boston Metro Area of the Commonwealth of Massachusetts in the USA (Figure 1) is the tenth most populous in the nation with 3.16 million people (US Census Bureau 2010) and is expected to convert upwards of 61,500 hectares of open space into urban development for accommodating 52,000 new residents by 2030 (MAPC 2009). Planning efforts have been undertaken to address future growth and sustainable development goals. At the regional scale, the Metropolitan Area Planning Commission (MAPC) developed the *MetroFuture* plan to counter the prevailing *Current Trends* of low-density housing sprawl in the suburban areas (MAPC 2009). At the city scale (i.e., Boston with a 2010 population of 617,680), the Mayor's office of Boston in 2007 aimed to increase urban tree canopy from 29% (2005 estimate level) to 35% by 2020 by planting 100,000 new trees.

Our team used MAPC's analysis as the basis for our four scenarios using the same population projects yet differ from distribution between the inner core cities and non-core cities (Figure 2) based on various growth policy goals (Table 1). In addition to *MetroFuture* and *Current Trends*, our research team designed *Green Equity*, a scenario with Boston Mayor's tree planting initiative—Grow Boston Greener—as the desired policy goal, since it was a well-publicized policy during our study period yet ultimately discontinued in 2014 due to funding cuts. During the process of developing scenarios, we evaluated available space for tree planting and the potential number of trees that could be planted in Boston as well as whether mutual

benefits could be achieved between environment and equity in low-income neighborhoods (details provided in Danford et al. 2014). Moreover, we developed *Compact Core*, a scenario with the desired outcome of encouraging transit-oriented development and focusing redevelopment on currently built areas (i.e., infill development).

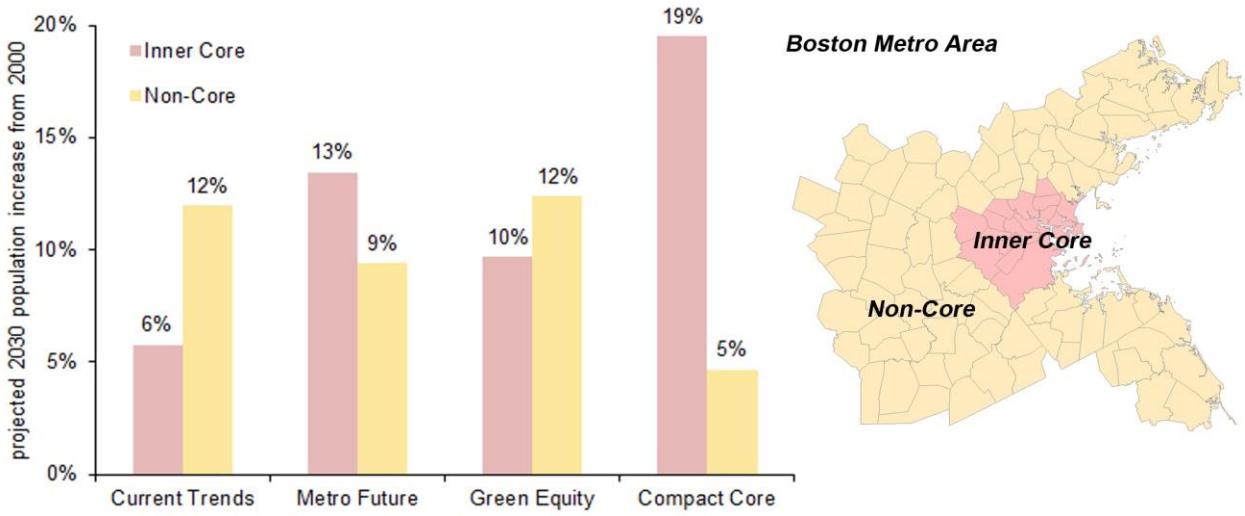

Figure 2. Distribution of projected 2030 population increase between inner-core and non-core cities of the Boston Metro Area varied among four urban growth scenarios

Table 1 summarizes growth strategies applied and compared among four scenarios. The *Current Trends* scenario followed MAPC's assumption of increased low-density growth in suburban communities, consumed significantly more open space and agricultural lands (i.e., greenfill development), and had the effect of increasing socio-economic inequities between suburbs and the central core cities. In contrast, the other three alternative scenarios—*MetroFuture, Green Equity*, and *Compact Core*—all assumed transit-oriented development and infill development but differed from each other in the distribution of projected new housing units allocated within the metropolitan area. *MetroFuture* was based on MAPC's existing plan that includes densification of the inner cities and regional centers, which slows the rate of suburbanization and protects more open space and farmland than *Current Trends*. *Green Equity* prioritizes greening lower-income communities over urban density or protection of open space and farmland outside the urban core, while reducing inequalities in tree canopy cover. *Green Equity* therefore assumed more infill development in the suburbs in order to allow more capacity for greening in the inner cities than would be available under the conditions in *MetroFuture*. Finally, *Compact Core* concentrates population and economic investment infill in inner cities such as Boston at a higher density than *MetroFuture* and downplays urban greening efforts. This strategy slows development in the outer-ring suburbs, which protects the large tracts of connected open space and farmland.

Table 1 Summary of qualitative comparison among growth strategies applied in the four future growth scenarios for the Boston Metro Area in 2030

Growth Strategy	Future Growth Scenarios			
	Current Trends (CT)	*Metro Future* (MF)	*Green Equity* (GE)	*Compact Core* (CC)
Sprawl (Greenfill)	Much More	Less	More	Much Less
Urban Densification (Infill)	Much Less	More	Less	Much More
Farmland Preservation	Much Less	Much More	Less	More
Environmental Equity	Much Less	More	Much More	Less

Each scenario varied by its allocation of projected increase of population. Figure 2 shows the distribution of projected 2030 population increase between inner-core and non-core cities of the Boston Metro Area varied among four urban growth scenarios. To illustrate the increased housing development and associated land use change among scenarios, we applied assumptions to a range of housing density varied by MAPC's community type for each scenario (e.g., *Current Trends* scenario applied 10% of land for urban infill development and a maximum of 32 dwelling units per acre in regional centers, 16 dwelling units per acre in developed suburbs in residential land use). The detailed methodology and assumptions for developing each scenario are described in a separate document (Cheng 2013). With these scenarios being developed, we then used stakeholders' input to explore mutual benefits or tradeoffs among sustainability goals as part of the NSF-funded Boston Metro Area Urban Long-Term Research Area-Exploratory (BMA ULTRA-Ex) project (umass.edu/urbaneco).

3. METHODS

3.1. Mixed methods sequential explanatory design

This study applied mixed methods—using both quantitative and qualitative data—sequential explanatory design that is characterized by a collection and analysis of quantitative data followed by qualitative data collection and analysis (Ivankova et al. 2006). Using mixed methods allows researchers to navigate their findings by gathering quantitative data that can be analyzed and generalized to a more general population, while using qualitative data for more in-depth reasoning and contextualization of the research issues (Hanson et al. 2005). Mixed methods are particularly useful in social and behavior research to understand the complexity of human behaviors (Tashakkori and Teddlie 2003). Two interventions were examined in this study during a stakeholders' workshop: visualization intervention through a landscape preference survey and scenarios presentation, and process intervention through small group discussions (Figure 3). It is considered a 'quasi-experimental study' (Cook and Campbell 1979) since there were no random sampling designated in this study in lieu of traditional experimental design with randomized samples. Quantitative data was collected using a survey instrument. Qualitative data was collected from small group discussions and the conversations were transcribed for content analysis. Survey questionnaires and quantitative results were first used to test hypotheses. Subsequently, qualitative findings were used to compare, contrast or relate the quantitative evidence for an integration of quantitative and qualitative results (Hanson et al. 2005).

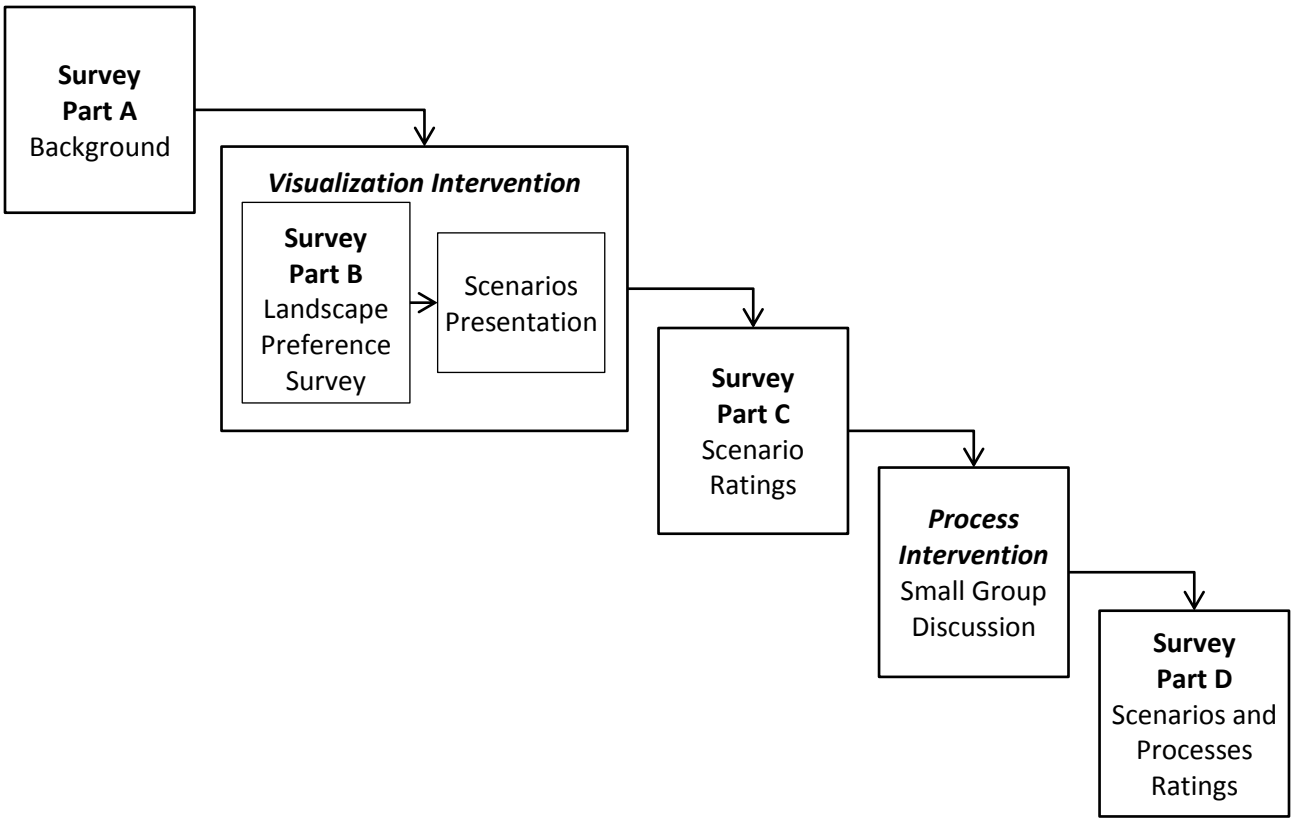

Figure 3. Survey instrument and stakeholders' workshop procedures and research design

3.2. Survey instrument and stakeholders workshop procedures

A survey instrument was designed to garner information before and after each intervention in order to evaluate the outcomes of reaching sustainability goals during the workshop (Figure 3). A five-point Likert scale: 1) not at all, 2) a little, 3) somewhat, 4) quite a bit, 5) very much (Kaplan and Kaplan 1989) was used throughout the survey and for the landscape preference section.

The stakeholders' workshop procedures included a landscape preference survey, a Prezi presentation, small group discussions, and a survey of 22 questions in four parts, which were given to the same group of stakeholders minus attrition for those who left the meeting early. Survey *Part A* included 14 questions regarding background information such as whether they attended the previous workshop, their level of concern for current issues in the Boston Metro Area over the next 20 years, their core values in evaluating future scenarios, their motivation for attending the workshop, and demographic variables. Survey *Part B* consisted of a photographic landscape preference survey (see Section 3.3). After conducting the survey *Part B*, we presented the four growth scenarios in a forum using a Prezi slide show (Figure 4). The content of the presentation included descriptions of the scenarios and quantitative estimates of density outcomes, as well as some possible outcomes for each scenario regarding tree canopy cover, social equity in access to trees, and effects of tree canopy on biodiversity. The presentation lasted about 30 minutes including a question and answer session, immediately followed by the survey *Part C* to evaluate what stakeholders perceived to be the benefits of each scenario. After a lunch break, the workshop continued with semi-structured small group discussions.

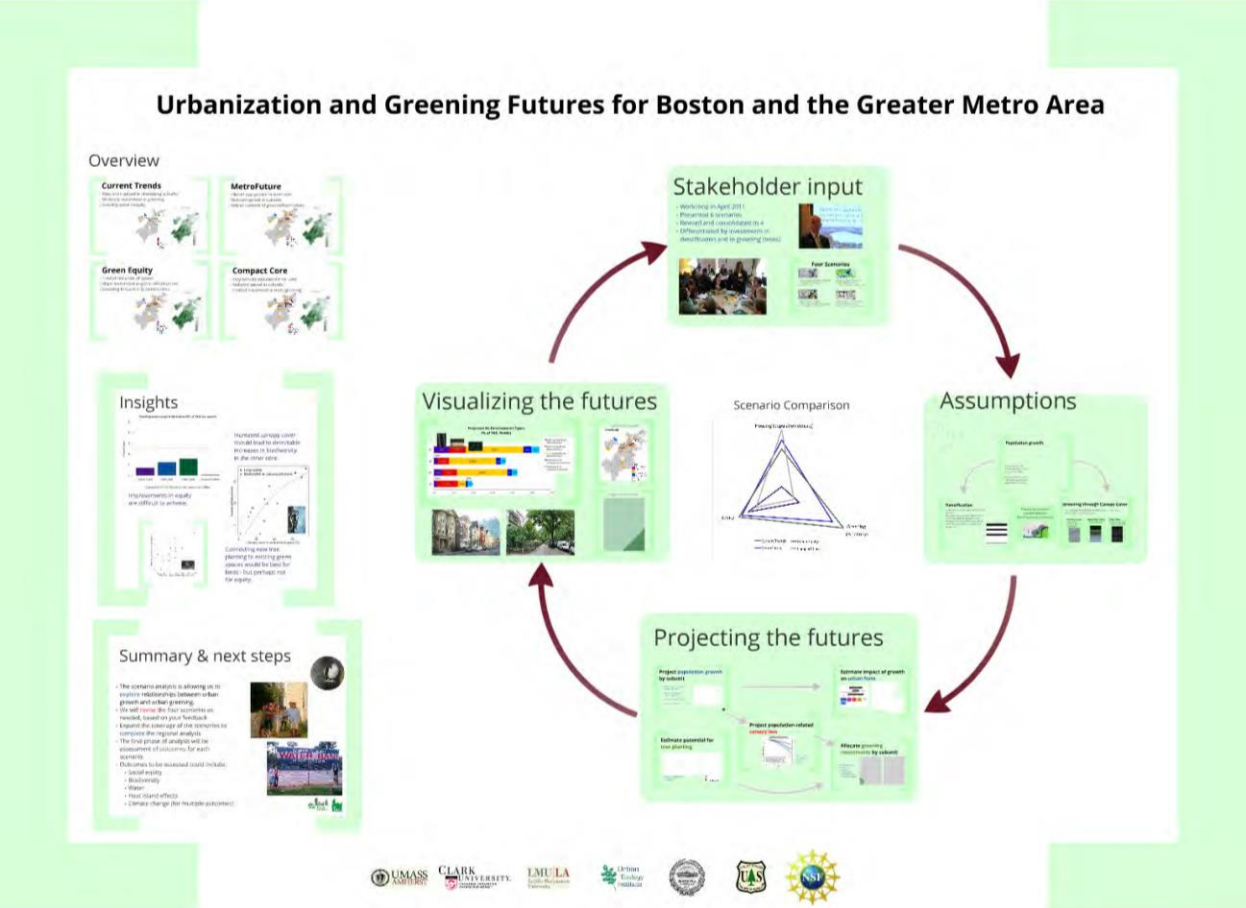

Figure 4. An overview of the scenarios presentation using a Prezi slide show

The room for the small group discussions had four tables with assigned seats with the intention to have an even distribution of stakeholders that represented different interest groups (e.g., environmental, economic, social/cultural) as identified in the pre-registration information. However, due to limited representation, there were more stakeholders from environmental interests than the other groups (see Section 3.4). Each table was assigned one facilitator and one note-taker. The same three questions regarding scenario feedback, implementation, and the next steps were used to guide discussion at each table. Participants were informed before coming to the workshop that a tape recorder would be used to record the conversations. The small group discussions session was lasted about 45 minutes plus another 25 minutes for each group to present their group summary. At the end of the workshop, participants filled out survey Part D with six questionnaires—two open-ended and four ranked—regarding their new insights gained from this workshop, evaluating the perceived benefits for each scenario, and assessing the effectiveness of various techniques applied in the workshop in facilitating their understanding of scenarios and encouraging their participation.

Two questionnaires (*Survey Part C* and *D*) relating to perceived benefits of each scenario were used before and after the small group discussions as the basis for analyzing the three primary goals of sustainability discussed in this study—*Environment*, *Economy*, and *Equity* (Table 2). Each of the different attributes was ranked separately in the questionnaires and was categorized into the three ’E’s by the research team after the workshop.

Table 2. Survey questionnaire attributes for growth scenarios evaluation categorized by sustainability goals

Sustainability Goals	Survey Part C: *Based on the information presented about scenarios, to what degree do you think each scenario fits the statement about the future of the Boston Metro Area?*	Survey Part D: *In comparing the different scenarios, please indicate how much each scenario appears to address the following issues?*
Environment	• Enhance ecosystem services needed to support quality of life • Build a stronger connection between people and our environment	• Improve Air Quality • Improve Water Resources • Protect Wildlife Habitats • Adapt to Climate Change • Enhance Urban Resilience • Preserve Agriculture • Conserve Energy
Economy	• Achieve economic growth and prosperity	• Promote Economic Growth
Equity	• Address social needs for diverse groups	• Provide for Healthy Living • Access to Healthy Food • Promote Social Equity

3.3. Landscape preference survey

In the *Survey Part B*, Landscape Preference Survey, participants were asked to rate 16 color scenes of urban development according to how much they considered them to be acceptable for the future of the Boston metro area (Figure 5). The scenes were selected and rated using the landscape preference research methodology developed by Kaplan and Kaplan (1989). Photos were chosen to represent relative low and high levels of tree canopy for each building density group applied in the Boston Metro Area growth scenarios (e.g., low-rise, mid-rise, high-rise), and were selected from images in Boston and other cities including four scenes used in a previous study (West, 2008) without simulation or manipulation. A panel of researchers reviewed the preliminary and final photo sets for how well they represented for each building density types. Very high density was illustrated as high rise buildings with more than 6 floors or gross density of more than 60 dwelling units per acre; high density represented midrise buildings with 4 to 6 floors or gross density between 32 to 60 units per acre; moderate density referred to low rise buildings with 2 to 4 floors or gross density between 8 to 32 units per acre; low density included single or multi-family with 1 to 2 floors or gross density lower than 8 units per acre. The urban tree canopy density was selected to vary in the same building density group. Very high, high, moderate, and low tree canopy density was estimated in proportion to building mass and in comparison within each building type for each photo. Four photographs (Scenes 1, 10, 12,

14) were used in a previous study (West 2008) that examined suburbanites' perceptions of compatibility for transit-oriented developments in Boston suburbs. These photographs were from a large-scale mail-out survey of 253 suburban residents, which allowed for a baseline comparison along the rural-urban gradient. We chose one scene with trees on a rooftop of a high-rise building to spur strategic thinking of urban tree canopy on green roofs (Scene 6). The arrangement of scenes in Figure 5 was done on an a priori basis by the research team based on the selection criteria of urban tree canopy and building density, not by stakeholders who were shown the scenes in random order to avoid order bias (Kaplan and Kaplan, 1989). The scenes were randomly ordered in a PowerPoint presentation and shown unlabeled except for an identification number for approximately 20 seconds each.

- Likert scale (Kaplan & Kaplan, 1989): 1) not at all, 2) a little, 3) somewhat, 4) quite a bit, 5) very much
- # score ranking order: score mean/standard deviation
- ★ Top three ranked scenes; ⊘ Bottom three ranked scenes

Figure 5. Landscape preference photo scenes and survey results based on relative urban tree canopy and building density

3.4. Survey sample

Over 80 stakeholders were invited through electronic mail from institutions that are involved in the decision-making of the Boston Metro Area in the fields of environmental conservation, parks

and recreation, economic development, transportation and social services. About 30 stakeholders were present; 20 participants completed the landscape preference survey and 14 completed all four parts of the survey. The 20 stakeholders were primarily from governmental (68%) and not-for-profit organizations (26%); 90% were in managerial positions, of which 20% were executives with decision-making power. When asked about one's organization's area of interests, some people indicated multiple interests. Among a total of 26 answers, 58% represented from environmental related organizations, 12% represented economic development and 12% represented human services and cultural heritage. Participants were primarily white (80%), male (65%), and highly educated with graduate or post graduate degree (60%).

Out of 14 stakeholders who participated in the small group discussions, 10 were from governmental organizations (three from the transportation and planning sector and one from the public health sector), three were from not-for-profit organizations (including one also identified as a professional consultant), and one was not disclosed. Their interest areas were 50% environmental focused, 11% economic focused, 6% social focused, and 22% were either broad or not specified (e.g., planning, sustainability). Three or four stakeholders were at each table during the small group discussions. We intentionally invited selected people at senior level in their organizations to participate in the scenario development rather than the general public in the region since our primary aim was for the scenario analysis to inform city and region level decision-making.

3.5. Data analyses

In order to synthesize the benefits of the three 'E's in sustainable development, each attribute in the questionnaires of survey *Part C* and *Part D* related to ranking each scenario was analyzed respectively. To test whether these results changed after the small group discussions, only the 14 stakeholders who completed both questionnaires were included in further analyses. The rating of each questionnaire was analyzed in two ways. First, we evaluated the overall ratings for each sustainability goal in each scenario by their composite mean scores and ANOVA Tukey's t-test. Second, we used a t-test to examine whether the mean scores of the overall rating of each scenario, which were derived from composite sustainability goals, differed significantly before and after the small group discussions. Finally, we conducted qualitative content analysis of the transcribed conversations from each table during the small group discussions.

4. RESULTS

4.1. Landscape preference results

The landscape preference survey results revealed a positive trend with increasing amount of tree canopy in the ratings; however, the relationship between preferred building density types was less linear in nature (Figure 5). It appeared that stakeholders considered higher amount of tree canopy with low to moderate density building types more acceptable for the Boston Metro Area. The highest rated Scene 9 (mean=4.40, SD=0.7) showed a very mature street tree canopy with mid-rise buildings; as did the second highest rated Scene 16 (mean=4.35, SD=0.7). The other highly rated scenes (e.g., Scene 2, mean=4.00, SD=0.6; Scene 10, mean=4.10, SD=0.9) also showed moderate building density with a dominance of tree canopy, although less flourishing than Scenes 9 and 16. The lowest rated scenes (Scenes 15, 3, and 12, mean ranges between 2.55

and 3.00) had little to no tree canopy, yet showed a range of building types from low-rise (Scene 3), mid-rise (Scene 15) to high-rise (Scene 12). In general, very high building density scenes were rated lower than low building density scenes.

As part of this study, there was a clear connection between the landscape preference survey and scenario evaluation. The landscape preference survey was conducted prior to presenting the scenarios to stakeholders so that their ratings would not be influenced by the information presented by the research team. The visual scenes were then used to help illustrate the type of density categories that were projected in the urban growth scenarios presented in the next session of the workshop.

4.2. Scenarios evaluation

Table 3 compares the synthesized results before and after the small group discussions for each of the sustainability goals. Of the four scenarios, *Current Trends* was perceived to achieve the lowest ratings for every dimension of sustainability; *Green Equity* had the highest rating in achieving the environmental goal (mean=4.11) and social equity goal (mean=4.00). *Compact Core* was perceived to provide the most potential economic benefits (mean=3.86). However, *Compact Core* was rated significantly lower than the other two alternative scenarios, *MetroFuture* and *Green Equity*, in both environmental and equity benefits. After small group discussions, the three alternative scenarios were rated more closely and distinctly from *Current Trends*. Specifically, *Green Equity* maintained the highest environmental and social equity scores while *MetroFuture* had the highest perceived economic benefits (mean=3.86). For *Compact Core*, the environmental (increased mean from 2.46 to 3.38) and equity (increased mean from 2.57 to 3.07) benefits were rated significantly higher after the small group discussions.

Table 3. Evaluation of scenarios based on sustainability goals before and after small group discussions

Growth Scenarios	**Current Trends**		**MetroFuture**		**Green Equity**		**Compact Core**	
Small Group Discussions	Before	After	Before	After	Before	After	Before	After
Sustainability Goals[1]	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Environment	1.79 (0.69)	1.93 (0.63)	3.64 (0.56)	3.54 (0.62)	**4.11** (0.69)	**3.78** (0.83)	2.46 (1.00)	3.38 (1.11)
Economy	2.57 (0.51)	2.46 (0.66)	3.79 (0.43)	**3.86** (0.36)	3.50 (0.76)	3.50 (0.76)	**3.86** (1.03)	3.79 (0.80)
Equity	2.07 (0.73)	1.85 (0.66)	3.64 (0.50)	3.50 (0.60)	**4.00** (0.71)	**3.86** (0.95)	2.57 (0.76)	3.07 (0.91)
Overall Rating	2.05 (0.72)	1.93 (0.63)	3.68 (0.51)	3.54 (0.62)	**3.93** (0.74)	**3.78** (0.91)	2.84 (1.11)	3.32 (1.03)
T-test p value[2]	**		**		**		*	

[1]bolded numbers are the highest ranking among scenarios for each sustainability goal

[2]significance indicator: * <0.05, ** <0.01

In *Survey Part D*, stakeholders rated the degree to which each scenario would "provide multiple benefits to address the complex future of the Boston Metro Area." The result was consistent with the previous question. *Green Equity* received the highest average rating score for providing multiple benefits (mean=4.15, SD=0.69) compared to *MetroFuture* (mean=3.77, SD=0.60), *Compact Core* (mean=3.69, SD=0.85) and the lowest one of *Current Trends* (mean=2.23, SD=0.60).

4.3. Perceived change during the planning process

From the overall ratings of each scenario, we found that the 14 stakeholders who participated in both sessions did perceive each scenario differently after the small group discussions (Table 3). We saw a significantly higher overall appreciation for *Compact Core* (increased 0.48 in mean, p value <0.05) and interestingly, a slight decrease between 0.12 and 0.15 in mean score (p value <0.01) for the other three scenarios. Overall, these changes brought *Compact Core's* closer to the originally higher rated *MetroFuture* and *Green Equity* scenarios.

Finally, in order to understand whether each scenario was rated significantly different from the other scenarios, a t-test was performed to compare the questionnaire ratings before and after the small group discussions (Table 4). The results showed that before the small group discussions, *Compact Core* was rated significantly different (p value <0.01) from all the other three scenarios. After the small group discussions, however, *Compact Core* was not significantly different from the other two alternatives and was rated even more significantly different (p value <0.001) from *Current Trends*. This result suggests that incorporating the small group discussions in the process did make an impact on the stakeholders' perceptions of the benefits provided by the scenarios.

Table 4. T-test results of scenarios evaluation between *Compact Core* and other scenarios before and after small group discussions

Growth Scenario	**Compact Core**	
Small group discussion	Before	After
Current Trends	**	***
Metro Future	**	—
Green Equity	**	—

Significance indicator: —No significance; ** < 0.01; *** < 0.001

4.4. Supporting qualitative evidence

The qualitative data analyses provide additional support for the conclusion that stakeholders were open to the idea of achieving multiple benefits rather than trading one benefit for the other. At the beginning of the small group discussions, stakeholders talked about the conflicting goals in sustainable development. When asked whether the four scenarios were achievable, stakeholders appeared to have most concerns about *Compact Core* in which quality of life and equity would be compromised:

> "Can you really put more growth into the cities and have it be livable?"
> "…*Compact Core* makes me a little bit nervous as far as investment in areas that really need investment in order to have equal economic growth as it is defined."
> "…it's not going to be additional cheap housing anytime you look at a built-up area in Boston at the moment. This is the reason why I don't move there: it's too expensive. I see myself drifting towards the suburbs or someplace further out because you're being priced out."
> "…the tradeoff between impervious surface and lot size impervious surface on a watershed scale: as the lot size decreases that you increase the impervious on site and decrease overall impervious on a watershed scale. And we're using this to talk about some of the broader tradeoffs that are impeded in *Compact Core*."

Toward the end of the small group discussions we heard a convergence of multiple benefits in sustainability goals. Stakeholders began to seek common ground for diverse interests:

> "…from the standpoint on impacts of climate change we're looking for greater tree cover as part of those puzzle pieces. And then particularly the *Green Equity* fits in with the commission's overall mission, which is to address racial inequities on health and access on a number of levels."
>
> "…there's integrating trees into other initiatives and priorities. Trees are important to stormwater management and pedestrian environments, walkable city streets…"
>
> "We can create linkages to policy that might have similar goals. Public health could be achieved through urban greening forestry that also might achieve a climate control goal."

In particular, we observed evidence of stakeholders' changing attitudes toward the *Compact Core* scenario:

> "…in some ways *Compact Core* aligns well from a purely, transportation, moving people, goods and services…so we don't spend all our resources and money on working on trains out to Worcester, down to TF Green [Providence, RI]. We're also spending a fair amount of money using the MBTA and other sources within Boston and that immediate area to improve transportation there for all communities. So there is a social equity even to transportation."
>
> "And you've got clarification of *Compact Core*—it's not just putting more people where the dense growth already. It's saying this is where the transport networks are and we want to do things like reducing carbon emissions, improving air quality, and putting people closer to schools and parks, improving access to green space, bikeways…"

5. DISCUSSION

5.1. Expanding the discussion about multiple benefits through visualization

Using landscape preference surveys as a tool for visualizing planning policies related to urban housing density and greening can expand discussions that may advance sustainability goals. In this study we revealed some modifying effects of tree canopy on perceptions of building density—higher density developments were perceived as more acceptable when more tree canopy was present. For example, Scene 2 was highly rated, yet is a densely developed urban center with high-rise buildings with two lines of trees planted neatly along the streets, which appears to have softened the impact of these high-rise concrete buildings. In contrast, Scenes 6 and 12 received some of the lowest ratings, in spite of their similar high building density to Scene 2; the difference in perception was apparently the result of less tree canopy in Scenes 6 and 12. In the final part of the survey, participants indicated that they "understand that increasing tree canopy and population density are not mutually exclusive" (mean=3.43, SD=0.94). Our results are consistent with those in more suburban settings showing the benefits of trees and green space as a tradeoff for residents accepting higher density when choosing a residential location (Kaplan and Austin 2004; Kearney 2006; West 2008).

The stakeholders considered higher density development to be much more acceptable than did the suburbanite samples from the previous study (West 2008), suggesting that incorporating stakeholders and local residents' responses for locating new development according to appropriate density along the urban-suburban-rural gradient is crucial for planning infill projects (Forman 2008). Currently, regional plans call for adding density to existing regional centers and existing and proposed transit centers (MAPC 2009). The challenge for planners is that high density infill may face local opposition, based on a variety of fronts including increased traffic, compatibility issues, and economic costs. The study results suggest that trees and vegetation are a necessary part of gaining public acceptance for new developments as Hosey (2012) discusses the aesthetics of sustainability matter to the public. However, they need to be considered as part of an overall sustainability strategy where planners present the benefits of increased infill on a variety of planning metrics. Planners also need to be aware that all trees are not perceived equally by the public (Kaplan et al. 1998). People tend to accept higher density developments planting with more mature and higher tree canopy. This suggests that protecting existing mature trees within a development should take priority over clearing sites in order to maintain larger amounts of tree canopy. Moreover, increasing urban greening manifests itself differently than increasing urban density. For example, adding a high-rise building can exponentially increase density in a neighborhood, but urban greening, especially tree planting, may not be increased in the same exponential fashion, being limited by biophysical constraints of available planting areas in a developed urban fabric (Danford et al., 2014).

5.2. Achieving multiple benefits through the scenario planning process

Even within a limited time frame—six hours in a one-day workshop—we saw a shift in stakeholders' perception of each scenario's ability to achieve multiple sustainability goals. The participatory process provides a space to allow Boston stakeholders representing diverse interests and sectors to frame common issues in the region and exchange knowledge and concerns through their discussions about the region's future beyond one's boundary organization (Polk 2014). In

addition, visualization tools integrating quantitative information of each scenario (e.g., density estimates, a measure of social equity, impacts on biodiversity) can help to illustrate actionable landscape and urban planning practices in multiple plausible scenarios (e.g., various priorities in urban greening investment), which helps to narrow the gaps between science and policy-making under the common goals toward sustainability (Wang et al. 2014). We envision the participatory scenario planning process as part of an ongoing feedback loop, a loop that includes empirical evaluation of scenarios, plan development, implementation, and monitoring of the outcomes and success of plans, and the development of subsequent scenarios. Each time stakeholders 'travel' around this loop, new or redefined issues can be identified, and the process therefore leads to greater achievement of multiple benefits in sustainability goals over time (Figure 6).

Our findings support the literature that the participatory process allows stakeholders to frame problems by discussing their viewpoints and sharing their understanding of the issues (Bardwell 1991), thus facilitating knowledge exchange and building consensus among stakeholders (e.g. Innes 1996; Oels 2003; Takayanagi et al. 2011). Additionally, combining public participation with a scenario-based planning process, as the literature suggests, can enhance social learning and facilitate decision-making for future plans (Albert et al. 2012; Sheppard 2005; Tompkins et al. 2008). For example, the fact that *Compact Core* was rated significantly higher in environmental and equity goals after small group discussions implies that stakeholders modified their initial opinion of the degree to which multiple benefits of urban greening and social equity could be obtained under higher housing density development.

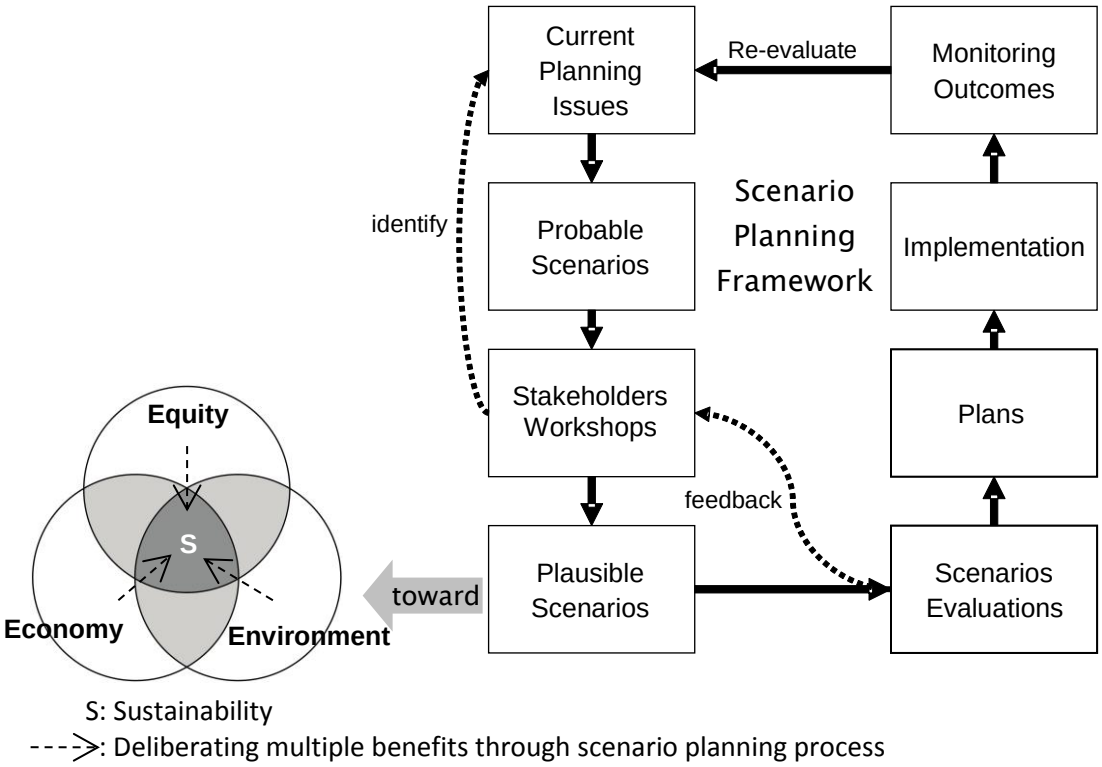

Figure 6. Summary of workshop process engaging stakeholders in a scenario planning framework in deliberating mutual benefits of multiple sustainability goals

We also observed a participant whose advocacy for equity helped other stakeholders to incorporate social equity benefits in their own interests. This finding supports the contention that including stakeholders who represent specific sustainability goals may increase the quality of sustainability plans as well as helping to achieve multiple benefits (Brody 2003; Takayanagi et al. 2011). It also supports the notion that participants were able to ascertain and discuss the less visible aspects of sustainability, such as social and economic equity that were not "shown" in the urban density and greening scenes. Furthermore, participants rated the small group discussions as the most effective tool in helping both to encourage their participation (mean=4.5, SD=0.65) and to understand the scenarios more fully (mean=4.07, SD=0.83). This supports findings of other studies (e.g., Bardwell 1991) that small group discussion is a particularly effective technique for allowing stakeholders to discuss, compare, and even argue about outcomes, and that the small group setting assisted with shifting their framing of sustainability issues. Such a framing-shift allows common understanding of issues and therefore encourages problem-solving that could help to facilitate building toward common goals. Eventually, stakeholders may be open to changing initially strongly-held attitudes based upon the information provided by and interaction with other stakeholders.

5.3. Planning applications

Currently, several planning tools exist to encourage density, urban greening, and open space preservation. In Washington D.C., for example, the Green Area Ratio (green.dc.gov/GAR) in zoning regulations requires certain amounts of landscape elements (e.g., tree canopy, vegetated roof, vegetated swales, or bio-retention) to be incorporated into site design for building permits. Several states adopt 'bonus density' (wcel.org/density-bonus) in regulations as incentives to allow developers to increase density development while providing affordable housing units, preserving open space or critical habitat preservation. Instead of using regulation associated enforcement or incentives for achieving urban density development and urban greening, our study has revealed community members' acceptance and supports for such development and the notion of context as a critical aspect of public acceptance for new buildings (Wohlwill and Harris 1980). Moderate density is prevalent in Boston neighborhoods and nearby cities (e.g., Cambridge). The participants' familiarity with this housing type may partially account for their perceived compatibility of such development types for the metro area, as well as the suburbanites' significantly lower ratings for compatibility of the same scenes (Scenes 1, 10, 12, and14) for suburban communities (West 2008).

While our particular study focused on urban greening and densification, the insights described above are relevant for a wider range of green infrastructure planning. Using scenarios and stakeholder workshops is an essential element in developing consensus and support for implementing urban greening and greenways projects (Fitzsimons et al. 2012; Luz 2000). Framing green infrastructure discussion within a larger discussion about landscape and urban planning for sustainability is one strategy to broaden the dialogue among stakeholders. The scenario approach is relevant to a broad range of other planning issues such as land use planning, transportation planning, and urban redevelopment (Shearer 2005; Zegras et al. 2004).

5.4. Future research opportunities

Our work suggests several promising avenues for future research that explores how visualization approaches can be used in the planning process to reach common goals in sustainability. First, our sample size was intentionally small because of the workshop setting with invited leaders, and participants from environmental and planning agencies ended up being more highly represented numerically than stakeholders representing economic development and social justice interests. This study was not designed to generalize the findings to general population but rather to understand the workshop process with the particular stakeholders associated with the specific study area. Future research could broaden sample sizes and could apply random sampling techniques to improve generalization of the research findings. In addition, engaging diverse groups such as business leaders and those from the realms of social justice and equity planning will help to increase representation of multiple sustainable development goals. The social inequality that can result from redevelopment efforts may need additional tools beyond urban greening, such as social programs, rent controls, or job programs to deal with economic inequities.

Alternative visualization techniques such as computer simulations could be used in further research to control for the variability in photos of existing places (Nassauer 1993). Factors such as architectural styles, building materials, site amenities (e.g. sidewalks, lightings, benches), and view angles could be streamlined in order to better understand stakeholders' acceptance for different housing density development (Groat 1984). Likewise, additional measures can be used to control for the density of tree canopy and other vegetation (Kaplan and Kaplan 1989).

Our study intentionally limited the amount of information provided at our workshop in order to control for prior knowledge about the environmental implications of a particular planning strategy (Kearney 2001; Ryan 2005; Ryan 2012). Nassauer (1993) noted that environmental knowledge influences aesthetic judgments about ecological health and acceptable landscape management. Future research could also use pre-/post-ratings of scenes after a scenario exercise that helps to illustrate multiple benefits of each scenario. For example, our study focused on increasing population density and tree canopy with environmental and social equity evaluations; future research could collaborate with experts in developing additional measures for the economic goals of each scenario.

Finally, we acknowledge that the research team may have a role in influencing stakeholders' perceptions and attitudes toward each scenario in various ways. The scenarios were named by the research team during the scenario development process. Calling a scenario "*Green Equity*," for example, may have biased participants' views by implying that both environmental and equity goals would be achieved together in this scenario. In addition, *Compact Core* may at first have been perceived as negative high-density development. However, during the discussion, the research team had the opportunity to explain in more detail the other benefits and assumptions built into this scenario (e.g., achieving regional environmental protection by concentrating development in existing urban centers) and eventually changed participants' perceptions of the scenario. Finally, each table facilitator had one's own style in facilitating the discussions.

In future research, more in-depth qualitative analyses of each participant's attitudes and perceptions during the workshop would help to inform the degree to which the stakeholders' viewpoints may have changed during the planning process. In addition, more longitudinal studies would allow researchers to understand how stakeholders' perceptions about sustainability change over time and what are the long-term implications for sustainability planning when stakeholders' participate in iterative scenario planning over an extended time period.

6. CONCLUSIONS

This study illustrated how visualization tools such as a landscape preference survey and scenarios can be used to engage stakeholders in the participatory planning process for building a common vision for a sustainable future, in our case that of the Boston Metro Area. It revealed the potential for a policy decision shift among stakeholders in the Boston region, namely that higher density urban development would likely be more acceptable to them when combined with a simultaneous increase in tree canopy cover. This implication is a win-win scenario for many: it encourages more infill development with higher density while in the same time encouraging innovations in policies and design practices that provide more urban greening. In addition, the stakeholder workshop itself, particularly with small group discussions, was shown to provide an effective platform for engaging in an analytic-deliberative planning process (Innes 1996). Stakeholders are more likely to consider policies and designs that embrace a variety of goals for their community's future in lieu of placing one goal in opposition to another. This study supports planning practices to integrate visualization of alternative futures into participatory scenario planning process, which can articulate and expand stakeholders' views about the multiple benefits of sustainable development about the value of green infrastructure and its role in creating more sustainable urban environments.

LITERATURE CITED

Albert, C., T. Zimmermann, J. Knieling, and C. von Haaren. 2012. Social learning can benefit decision-making in landscape planning: Gartow case study on climate change adaptation, Elbe valley biosphere reserve. *Landscape and Urban Planning*, 105(4), 347-360. doi - 10.1016/j.landurbplan.2011.12.024

Bardwell, L. 1991. Problem-framing: A perspective on environmental problem-solving. *Environmental Management*, 15(5), 603-612. doi - 10.1007/bf02589620

Boone, C.G., G.L. Buckley, J.M. Grove, and C. Sister. 2009. Parks and people: An environmental justice inquiry in Baltimore, Maryland. *Annals of the Association of American Geographers*, *99*(4), 767-787.

Brinkerhoff, D.W. and A.A. Goldsmith. 1992. Promoting the sustainability of development institutions: A framework for strategy. *World Development*, 20(3), 369-383. doi - 10.1016/0305-750X(92)90030-Y

Brody, S. D. 2003. Measuring the effects of stakeholder participation on the quality of local plans based on the principles of collaborative ecosystem management. *Journal of Planning Education and Research*, 22(4), 407-419. doi - 10.1177/0739456x03022004007

Campbell, S. 1996. Green cities, growing cities, just cities? Urban planning and the contradictions of sustainable development. *Journal of the American Planning Association,* 62(3). doi - 10.1080/01944369608975696

Campoli, J. and A.S. MacLean. 2007. *Visualizing density.* Cambridge, MA: Lincoln Institute of Land Policy.

Cheng, C. 2013. *Social vulnerability, green infrastructure, urbanization and climate change-induced flooding: A risk assessment for the Charles River watershed, Massachusetts, USA*. Dissertation. Amherst: University of Massachusetts. Open access - scholarworks.umass.edu/dissertations/AAI3603065

Churchman, A. 1999. Disentangling the concept of density. *Journal of Planning Literature,* 13(May), 389-411. doi - 10.1177/08854129922092478

Cook, T.D. and D.T. Campbell. 1979. *Quasi-experimentation: design and analysis issues for field settings*. Chicago: Rand McNally College Pub. Co.

Danford, R., C. Cheng, M. Strohbach, R.L. Ryan, C. Nicolson, and P.S. Warren. 2014. What does it take to achieve equitable urban tree canopy distribution? A Boston case study. *Cities and the Environment*, 7(1).

Douglas, H.E. 2009. *Science, policy, and the value-free ideal*. Pittsburgh, PA: University of Pittsburgh Press. 210 pp.

Elkington, J.B. 1997. *Cannibals with forks: The triple bottom line of 21st century business*. Oxford: Capstone Publishing.

Fitzsimons, J., C.J. Pearson, C. Lawson, and M.J. Hill. 2012. Evaluation of land-use planning in greenbelts based on intrinsic characteristics and stakeholder values. *Landscape and Urban Planning,* 106(1), 23-34. doi - 10.1016/j.landurbplan.2012.01.012

Forman, R.T.T. 2008. *Urban regions: Ecology and planning beyond the city*. New York: Cambridge University Press.

Freeman, R. E. 1994. The politics of stakeholder theory: Some future directions. Business Ethics Quarterly, 4 (4) pp. 409–421.

Groat, L. 1984. Public opinions of contextual fit. *Architect.* November, 72–72.

Gunder, M. 2008. Ideologies of certainty in a risky reality: Beyond the hauntology of planning. *Planning Theory,* 7(2), 186-206. doi - 10.1177/1473095208090434

Hanson, W.E., J.W. Creswell, V.L.P. Clark, K.S. Petska, and J.D. Creswell. 2005. Mixed methods research designs in counseling psychology. *Journal of Counseling Psychology,* 52(2), 224-235. doi - 10.1037/0022-0167.52.2.224

Hawkes, J. 2001. *The fourth pillar of sustainability: Culture's essential role in public planning*. Melbourne: Common Ground and the Cultural Development Network.

Herzog, T.R. and T.A.Gale. 1996. Preference for urban buildings as a function of age and nature context. *Environmental Behavior,* (28), 44–72.

Herzog, T. R. and J. A. Flynn-Smith. 2001. Preference and perceived danger as a function of the perceived curvature, length, and width of urban alleys. *Environmental Behavior*, 33 (5), 653-666.

Hosey, L. 2012. *The shape of green: Aesthetics, ecology and design*. Washington, DC: Island Press.

Innes, J. E. 1996. Planning through consensus building: A new view of the comprehensive planning ideal. *Journal of American Planning Association*, 62(4), 460-472. doi - 10.1080/01944369608975712

Ivankova, N. V., J. W. Creswell, and S.L. Stick. 2006. Using Mixed-Methods Sequential Explanatory Design: From Theory to Practice. *Field Methods*, 18(1), 3-20. doi - 10.1177/1525822x05282260

Kaplan, R. and M. E. Austin. 2004. Out in the country: Sprawl and the quest for nature nearby. *Landscape and Urban Planning*, 69 (2-3), 235-243. doi - 10.1016/j.landurbplan.2003.09.006

Kaplan, R. and S. Kaplan. 1989. *The experience of nature.* New York: Cambridge Press.

Kaplan, R., S. Kaplan, and R.L. Ryan. 1998. *With people in mind: Design and management of everyday nature.* Washington, DC: Island Press.

Kearney, A.R. 2001. Effects of an informational intervention on public reactions to clear-cutting. *Society and Natural Resources*, 14 (9): doi - 10.1080/089419201753210594

Kearney, A. R. 2006. Residential development patterns and neighborhood satisfaction: Impacts of density and nearby nature. *Environmental Behavior*, 38 (1), 112-139. doi - 10.1177/0013916505277607

Klosterman, R. E. 2007. Deliberating about the future. In *Engaging the Future: Forecasts, Scenarios, Plans, and Projects*. Eds. Hopkins, L. D. and M. A. Zapata. Cambridge, Mass., Lincoln Institute of Land Policy (pp. 199-219).

Lindsey, G., M. Maraj, and S. Kuan. 2001. Access, equity, and urban greenways: An exploratory study. *Professional Geographer*, 53 (3): 332-346. doi - 10.1111/0033-0124.00288

Lowe, I. 1994. Performance Measurement. *Proceedings of the Fenner Conference on the Environment*, Canberra, Australia, November 1994.

Luz, F. 2000. Participatory landscape ecology - A basis for acceptance and implementation. *Landscape and Urban Planning*, 50(1), 157-166. doi - 10.1016/S0169-2046(00)00087-6

MAPC 2009. *MetroFuture: Making a Greater Boston Region*. Metropolitan Area Planning Council. Retrieved from – http – //www.mapc.org/sites/default/files/MetroFuture_Goals_and_Objectives_1_Dec_2008.pdf

Myers, D. and A. Kitsuse, A. 2000. Constructing the future in planning: A survey of theories and tools. *Journal of Planning Education and Research*, 19(3), 221-231. doi - 10.1177/0739456X0001900301

Nassauer, J. I. 1993. Ecological function and the perception of suburban residential landscapes. In P.H. Gobster, ed. *Managing urban and high use recreation settings.* St. Paul, MN: General Technical Report, USDA Forest Service, North Central Forest Experiment Station (pp.55-60).

NRC. 1996. *Understanding risk: Informing decisions in a democratic society*. National Research Council. Committee on Risk Characterization. National Academy Press. Washington, DC.

Oels, A. 2003. *Evaluating stakeholder participation in the transition to sustainable development: methodology, case studies, policy implications*. Münster; Piscataway, NJ: Lit Verlag; Distributed in North America by Transaction Publishers.

Peterson, G.D., G.S. Cumming, and S.R. Carpenter. 2003. Scenario planning: A tool for conservation in an uncertain world. *Conservation Biology*, 17(2), 358. doi - 10.1046/j.1523-1739.2003.01491.x

Polk, M. 2014. Achieving the promise of transdisciplinarity: a critical exploration of the relationship between transdisciplinary research and societal problem solving. *Sustainability Science*, 9(4), 439-451. doi: 10.1007/s11625-014-0247-7

Renn, O. 1999. A model for an analytic−deliberative process in risk management. *Environmental Science and Technology, 33*(18), 3049-3055. doi - 10.1021/es981283m

Ryan, R.L. 2002. Preserving rural character in New England: Local residents' perceptions of alternative residential development. *Landscape and Urban Planning*, (61), 19-35. doi - 10.1016/S0169-2046(02)00066-X

Ryan, R.L. 2005. Exploring the effects of environmental experience on attachment to urban natural areas. *Environmental Behavior*, (37), 3-42. doi - 10.1177/0013916504264147

Ryan, R.L. 2006. Comparing the attitudes of local residents, planners, and developers about preserving rural character in New England. *Landscape and Urban Planning*, 75(1–2), 5-22. doi - 10.1016/j.landurbplan.2004.10.005

Ryan, R.L. 2012. The influence of landscape preference and environmental education on attitudes toward wildfire management in the Northeast pine barrens (USA). *Landscape and Urban Planning*, 107 (1), 55-68. doi - 10.1016/j.landurbplan.2012.04.010

Shearer, A.W. 2005. Approaching scenario-based studies: three perceptions about the future and considerations for landscape planning. *Environment and Planning B: Planning and Design*, (32), 67-87. doi - 10.1068/b3116

Sheppard, S. 2005. Participatory decision support for sustainable forest management: a framework for planning with local communities at the landscape level in Canada. *Canadian Journal of Forest Research*, (35), 1515-1526. doi - 10.1139/x05-084

Steinitz, C., M. Flaxman, D. Mouat, H. Arias, T. Goode, R. Peiser, S. Bassett, T. Maddock III, and A. Shearer. 2003. *Alternative futures for changing landscapes: the Upper San Pedro River Basin in Arizona and Sonora*. Washington, DC: Island Press.

Takayanagi, N., Y. Mizutani, and D. Loucks. 2011. Stakeholder consensus building in multiobjective environments. *Journal of Water Resources Planning and Management*, 137(3), 293-303. doi - 10.1061/(ASCE)WR.1943-5452.0000115

Tashakkori, A. and C. Teddlie. 2003. *Handbook of mixed methods in social and behavioral research*. Thousand Oaks, CA: Sage.

Tompkins, E. L., R. Few, and K. Brown. 2008. Scenario-based stakeholder engagement: Incorporating stakeholders preferences into coastal planning for climate change. *Journal of Environmental Management*, 88(4), 1580-1592. doi - 10.1016/j.jenvman.2007.07.025

UNCED. 1992. *Agenda 21: United Nations Conference on Environment and Development*, Earth Summit.

U.S. Census Bureau. 2010. *Census of Population and Housing*. Washington, DC: U.S. Dept. of Commerce, Economics and Statistics Administration, U.S. Census Bureau.

Wang, Z., P.Y. Tan, T. Zhang, and J.I. Nassauer. 2014. Perspectives on narrowing the action gap between landscape science and metropolitan governance: Practice in the US and China. *Landscape and Urban Planning*, 125, 329-334. doi: http://dx.doi.org/10.1016/j.landurbplan.2014.01.024

Webler, T., S. Tuler, K. Dow, J. Whitehead, and N. Kettle. 2014. Design and evaluation of a local analytic-deliberative process for climate adaptation planning. *Local Environment*, 1-23. doi - 10.1080/13549839.2014.930425

West, N. 2008. *Testing the new suburbanism: Exploring attitudes of local residents in metropolitan Boston toward residential neighborhoods and sustainable development*. Masters of landscape architecture thesis. Amherst: University of Massachusetts.

White, E.V., and B. Gatersleben. 2011. Greenery on residential buildings: Does it affect preferences and perceptions of beauty? *Journal of Environmental Psychology*, 31 (1), 89-98. doi - 10.1016/j.jenvp.2010.11.002

Wohlwill, J.F. and G. Harris. 1980. Response to congruity or contrast for man-made features in natural-recreation settings. *Leisure Science*, 3 (4), 349–365. doi - 10.1080/01490408009512943

Xiang, W.N. and K.C. Clarke. 2003. The use of scenarios in land-use planning. *Environment and Planning B: Planning and Design*, 30(6), 885-909. Doi -10.1068/b2945

Zaccai, E. 2012. Over two decades in pursuit of sustainable development: Influence, transformations, limits. *Environmental Development, 1*(1), 79-90. doi - 10.1016/j.envdev.2011.11.002

Zegras, C., J. Sussman, and C. Conklin. 2004. Scenario planning for strategic regional transportation planning. *Journal of Urban Planning and Development*, 130(1), 2-13. doi - 10.1061/(ASCE)0733-9488(2004)130:1(2)