

THE IMPACTS OF SOCIO-ECONOMIC FACTORS ON THE PERCEPTION OF RESIDENTS ABOUT URBAN VEGETATION: A COMPARATIVE STUDY OF PLANNED VERSUS SEMI-PLANNED CITIES OF ISLAMABAD AND RAWALPINDI, PAKISTAN

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Abstract. The present study deciphers the impacts of urban planning and role of socio-economic determinants on the perception about urban vegetation. The residents inhabiting the planned (Islamabad) and the semi-planned (Rawalpindi) urban centres were the study population. Both urban areas, lying in close proximity, face rapid transformations in LULC due to urbanization. Despite their closeness, such variants as discrepancies in the standards of urban-planning and socio-economic characteristics of inhabitants make them apt study-sites. The inhabitants' perception was tapped regarding the importance of urban vegetation, temporal and spatial changes and their impacts. The majority concurred to its efficacy, a substantial proportion observed transformations in it over time while a reasonable number perceived these changes as negative and unwelcome. Such socio-economic determinants as location, education, gender, ownership status of residence and income of respondents were studied, deploying Statistical analyses (KW). Responses varied, with location and income weighing-in more heavily. Pair-wise comparison (WRST) further vindicated the results. Urbanization is sure to tarnish the environmental sustainability of both cities. Synchronized efforts from all stake-holders are a must.

Keywords: *urbanization, socio-economic, perception, urban ecology, urban ecosystem services, urban planning*

Introduction

Life on the planet Earth is dependent on constant support and productivity of Ecosystems Services (ES) (De Groot et al., 2002). The biophysical processes and ecological systems have profound effects on the natural and social systems (Pickett et al., 2001; Alberti et al., 2003; Rockström et al., 2009; Collins et al., 2011). Since the early stages of social and societal organization, the human perception regarding the role of ecological products in their lives, witnessed many transformations in response to spatial-temporal changes.

The researchers acknowledge that human perception and interactions with the ecological resources are significantly influenced by the contextual settings (Ward Thompson et al., 2005; Nasar, 2008; Jim and Shan, 2013). The nature of these interactions significantly transform with the awareness about the benefits of these resources. In present times, these benefits are acknowledged as ES, the contributions of ecological resources towards human wellbeing (Costanza et al., 1997, 2014; De Groot et

al., 2002). The ES are grouped into four categories i.e. provisioning, regulating, supportive and cultural (Millennium Ecosystem Assessment, 2005a; Rodríguez et al., 2006; De Groot et al., 2010).

It has been opined that the paradigm of human wellbeing is dependent upon the cumulative contribution of four types of capitals in a given geographical setting. These capitals are recognized as; the natural capital (natural resources), the human capital (human resources), the built capital (physical infrastructure) and the social capital which includes the social norms and institutions (Chiesura and De Groot, 2003; Mulder et al., 2006; Vemuri and Costanza, 2006). The human, built and social capitals have reflective effects on the contributions of natural capital towards human prosperity. The previous studies observed a symbiotic relationship between vibrant ecosystems and the quality of human life (Millennium Ecosystem Assessment, 2005b; Elmqvist et al., 2013; Gómez-Baggethun and Barton, 2013; Luederitz et al., 2015).

Thus, the evaluation of ES, in a given spatial setting, demands inclusion of trans-disciplinary perspectives based upon contextual requirements. These assessments are also indispensable for postulating sustainable measures to enhance the performance of eco-capital i.e. ecological resources e.g. natural and manmade vegetative covers.

The previous studies have stressed on the evaluation of ecosystem services based upon holistic appraisal about the contextual demands (Millennium Ecosystem Assessment, 2003; Heal Geoffrey et al., 2005; Troy and Wilson, 2006). Thus, the identification of socio-economic factors are needed to ensure the sustainability of ecology and environment (Holling, 2001; Ostrom et al., 2001; Anton et al., 2010; Castro et al., 2011; Colding, 2013; Jim and Shan, 2013; Mcphearson et al., 2014; Kaczorowska et al., 2016; Sutton and Anderson, 2016). This realization is a precondition for sustainable development and warrants a coordinated research effort across the disciplinary divides. In response to these demands, the understanding of linkages between man and the natural environment have begun to gain momentum (Costanza and Folke, 1997; Egoh et al., 2007).

The socio-cultural transformations in a society have noteworthy impacts on the ecological resources and their performance. Agricultural activities have magnified the role of ecological resources in the wellbeing of human society (Goldblatt, 2013; Hannigan, 2014). Agricultural revolution also supported the phenomenon of permanent settlements. The urban centers are the culmination of these earlier settlements. These settlements are classified into three major types on the basis of their physical structure i.e. planned, unplanned and semi planned urban settlements. Planned cities are built and progress according to a 'Master Plan', thus, displaying a perfect equilibrium of infrastructure for urban social life and ecological sustainability. While, the unplanned cities reflect no formal structure and design to achieve these goals. As compared to these types of urban settlements, the semi-planned urban settlements, grow haphazardly i.e. without any specific design or form but in the subsequent stages, its expansion and development might be regulated with planning and management instruments.

The 21st century is being labeled as the 'urban century' due to the alarming concentration of human population in the urban areas (Benko and Strohmayer, 2014; Nersesian, 2014). The researchers supported the notions that the proportion of global population living in the urban areas is increasing (Elmqvist et al., 2013; Nations, 2014; Luederitz et al., 2015; Green et al., 2016; Larondelle and Lauf, 2016). The uncontrolled urbanization and socio-economic transformations in the urban-based activities are held responsible for unregulated land use/ land cover changes (LULC), loss of urban

biodiversity, weather and climatic abnormalities and compromises over urban ecological managements (Grimm et al., 2008; McDonald et al., 2008; Seto et al., 2012; Wamsler et al., 2013; Luederitz et al., 2015; Green et al., 2016; Kaczorowska et al., 2016; Schetke et al., 2016). Veeman and Politylo (2003) and Corburn (2017) opined that the ecological degradations in the urban areas are also accountable for rising vulnerabilities among the economically deprived and socially marginalized segments of society. The pressures on urban ecological resources will intensify in magnitude and complexity (Grimm et al., 2008; United-Nations, 2014; Schetke et al., 2016). Thus, the uncontrolled urbanization and ecological deteriorations in urban areas are the real challenges of the present times (Marten, 2001; Solecki et al., 2013; Sutton and Anderson, 2016) and synchronization of these two realities is incumbent for the social, economic, ecological and environmental sustainability of urban areas (Luederitz et al., 2015). The assessment of human perception about the ecological resources in a given urban milieu is, thus, a precondition for ensuring wellbeing of urban areas (Mcintyre et al., 2008; Jim and Shan, 2013; Rapoport, 2016). The developing nations are less equipped and hence less prepared to address these challenges (Schetke et al., 2016; Jim, 2013). This lack of preparedness in the developing regions is a potent threat for their urban ecological assets and social life (Morinière, 2012; Schetke et al., 2016).

The phenomena of permanent settlements in Pakistan emerged during the phase of Indus Valley Civilization (Kenoyer et al., 2013) and these settlements were urban in structure and character. The inhabitants were acquainted with the benefits of healthy environment. The subsequent socio-economic and structural transformations in this region such as canalization of the Indus Plain (Shiva, 2016) and more economic opportunities in the big cities stimulated the rural population to migrate towards these urban areas as they were already facing a paucity of basic facilities in their native rural areas. Thus, it triggered an uncontrolled urbanization of certain regions at the cost of their ecological environment. The resulting degradation in ecological resources has added stress for the urban social life in these settlements. The occurrences of erratic weather extremities such as urban heat waves and smog in winter have become a common phenomenon of big cities. These undesirable phenomena are thought to be associated with hyperactive urbanization and urban ecological degradation. Grimm et al. (2008), Wu (2008) and Qureshi et al. (2010b) anticipated that in future the process of urbanization will more accelerate in the developing countries.

The reorientation of policy to reverse the ensuing urban environmental/ecological degradation demands scientifically-based research initiatives (Kaplan and Kaplan, 1989; Jim and Shan, 2013). The inclusion of stakeholder's perception about the urban ecological resources in research and management initiatives is a prerequisite for ensuring ecological integrity and social wellbeing in the urban areas (Elkington, 1997; Sutton and Anderson, 2016).

Pakistan is among those countries where the research regarding urban environment is in its embryonic stages. Therefore, an increased focus on urban studies is required towards the assessments of urban environment and its ecological resources. In response to these demands, the research focusing on urban vegetative resources got impetus in Pakistan during the last decade. Most of the earlier research concerning urban vegetation was carried out in the contextual settings of the coastal city-Karachi. The studies such as Qureshi et al. (2010a, b, 2013) and Schetke et al. (2016) were designed to decipher the impacts and nature of relationship between urban social life and vegetative cover. However, the physical and human geography of Karachi is

diametrically different from the urban settlements of Pothwar Plateau such as Islamabad and Rawalpindi.

In the similar time period, the researchers also tried to investigate the potentials of ecological resources and impacts of urbanization on the environmental sustainability of Islamabad and Rawalpindi. However, these studies such as Malik and Husain (2006), Jabeen et al. (2009) and Ali and Malik (2010a, b) were either inclined towards plant sciences are the studies such as Adeel (2010), Ali et al. (2011), Butt et al. (2015) and Hassan et al. (2016) were designed to decipher the impacts of urbanization on LULC changes.

Whereas, the evaluation of human perception about ecological resources is a requirement for ensuring integrated management of urban environment (Breuste, 2008; Qureshi and Breuste, 2010; Qureshi et al., 2010b). In this respect, it is apt to note that human interaction and perception about urban environment is significantly determined by societal perception about ecological resources, economic status, technological advancements, standards of urban planning, and management of existing vegetative covers in the urban regions.

The current study was designed to evaluate the impacts of socio-economic factors on the perception of urban residents about urban greenery in the planned (Islamabad) and semi-planned (Rawalpindi) urban settlements. The study hypothesizes that urban planning and socio-economic status of the inhabitants significantly influence the awareness about urban greenery.

Method

Study area

The study context is located between 72°55"E to 73°10"E and from 33°30" N to 33°45" N and comprises urban and peri-urban areas of twin cities, Islamabad and Rawalpindi. Islamabad owes its development to an administrative decision in 1959 (Maria and Imran, 2006) and was designed to serve as the capital city of Pakistan (Doxiadis, 1965). The green landscape of Islamabad was mainly inhabited by government employees besides some rural population in the vicinity. The older city of Rawalpindi, on the other hand, is a sprawling urban settlement with no formal design and infrastructure. It has less developed green areas and which are typically less taken care of.

In the recent times, the structural and social transformations in this region are responsible for the phenomena of rural to urban migration. The educated and resourceful migrants prefer to shift in Islamabad for better opportunities and peaceful urban social life. While, the economic, environmental and social migrants with less financial support find an abode in urban centers such as Rawalpindi. Resultantly, the density of human population in both urban centers is rapidly increasing (*Fig. 1*).

The impacts of population growth in the study area have become more visible over the period of the last ten years in the form of unregulated urban expansion. *Figure 2* depicts the spatial-temporal transformations in the LULC of the study area.

The quantitative and qualitative changes in the LULC of the study area from 2005 to 2016 have been condensed in *Figure 3* for comparison and brevity.

These urban centers are located in close proximity but their contrasting socio-ecological contextual settings and level of urban planning make it a suitable context for conducting this study of human perception. *Figure 4* indicates that the respondents were

selected from across the study area with the intent of representing the socio-economic heterogeneities of the study population.

Data collection

The data about socio-economic characteristics of respondents and their views about urban vegetation was retrieved through questionnaire method. The questionnaire was designed for deciphering the effects of socio-economic factors on the perception of respondents about urban vegetation in planned and semi planned urban areas. For this purpose, a structured questionnaire based upon literature review and feedbacks of the pilot survey was prepared.

The questionnaire is composed of two sections. The first section was designed to collect information about the economic and demographic characteristics of the respondents. The second part of the questionnaire deals with the views of the respondents about the urban vegetative cover of the study area. The respondents were required to select an option from the given format for depicting their views (*Appendix 1*). The questionnaire with a brief introduction about the scope and significance of the study was translated in the Urdu language for clarity and convenience of the respondents.

The residents, who were living within the metropolitan limits of Islamabad and Rawalpindi for the last ten years, were the target population. In the contextual setting of Pakistan, the head of a household significantly influences the socio-economic status and orientations of the other family members. Thus, the designated head of the family by National Database and Registration Authority (NADRA) was requested to participate in the survey as a respondent.

The sub-division of the study area into neighborhoods is a reliable sampling technique for representing social, economic and ecological heterogeneities of urban areas (Dupont, 2004). The technique was relied upon and deployed. The initial respondent from each selected locality was contacted through convenience sampling method. The rest of the respondents from the same neighborhood were approached with the help of the initial respondent on the principle of the snowballing or chain-referral sampling (Etikan et al., 2016; Marcus et al., 2017).

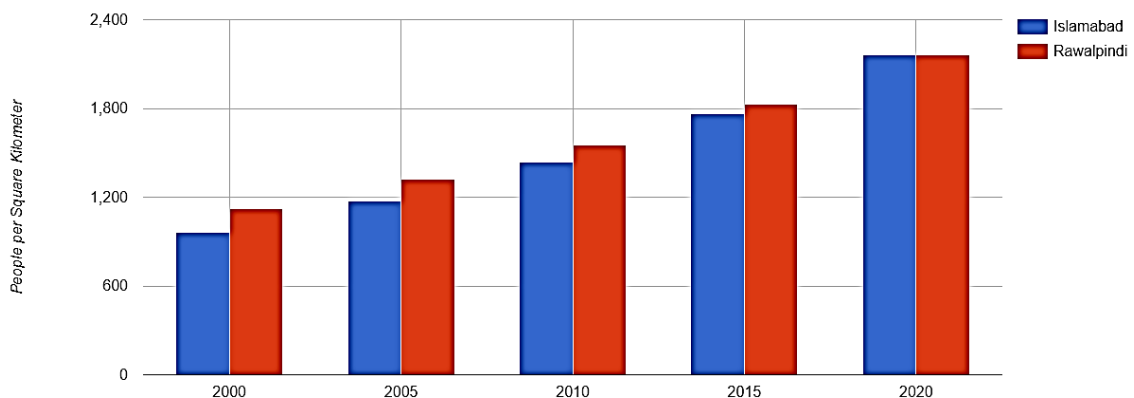


Figure 1. Estimated and Projected population density of Islamabad/ Rawalpindi. (Source: Gridded Population of the World, Version 4. <http://sedac.ciesin.columbia.edu/data/collection/gpw-v4>)

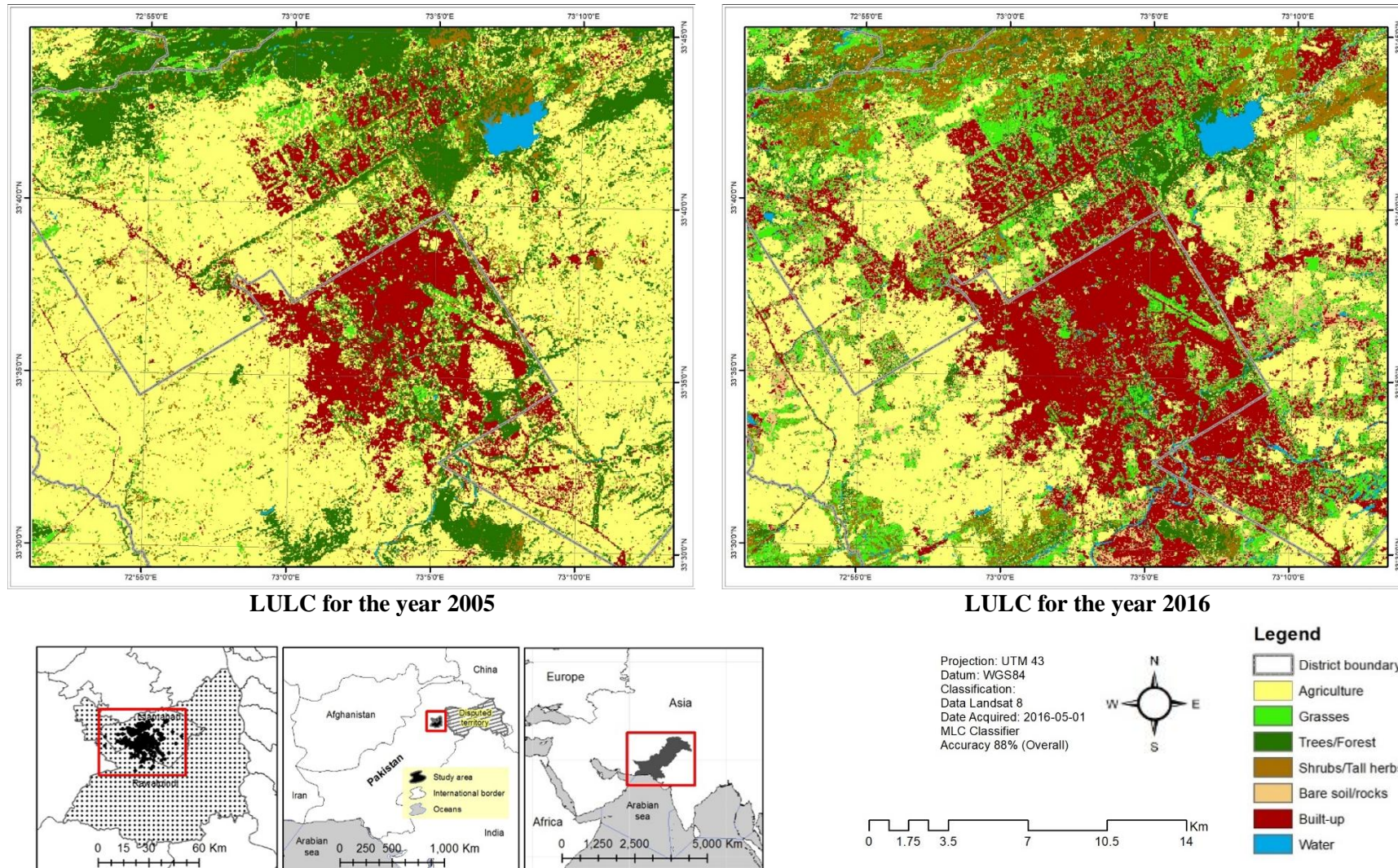


Figure 2. Portraying the LULC of the study area for the years 2005 and 2016

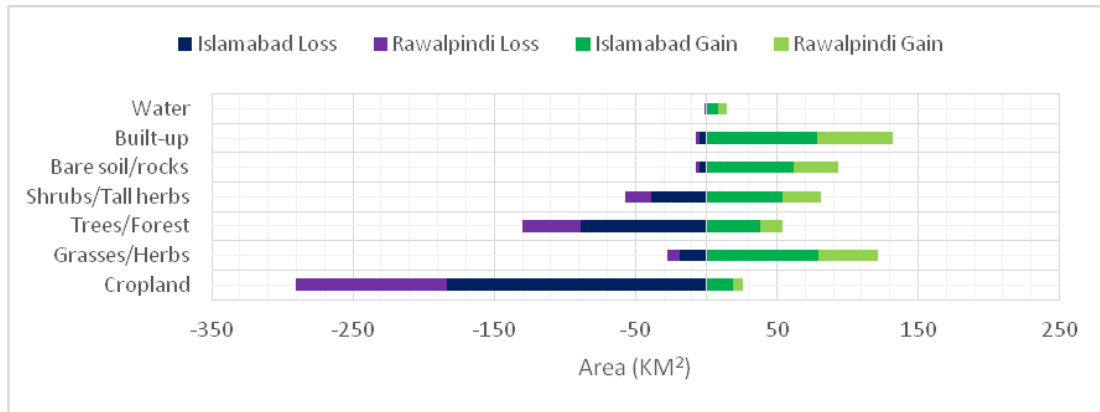


Figure 3. Comparing the changes in LULC of the study area from 2005 to 2016

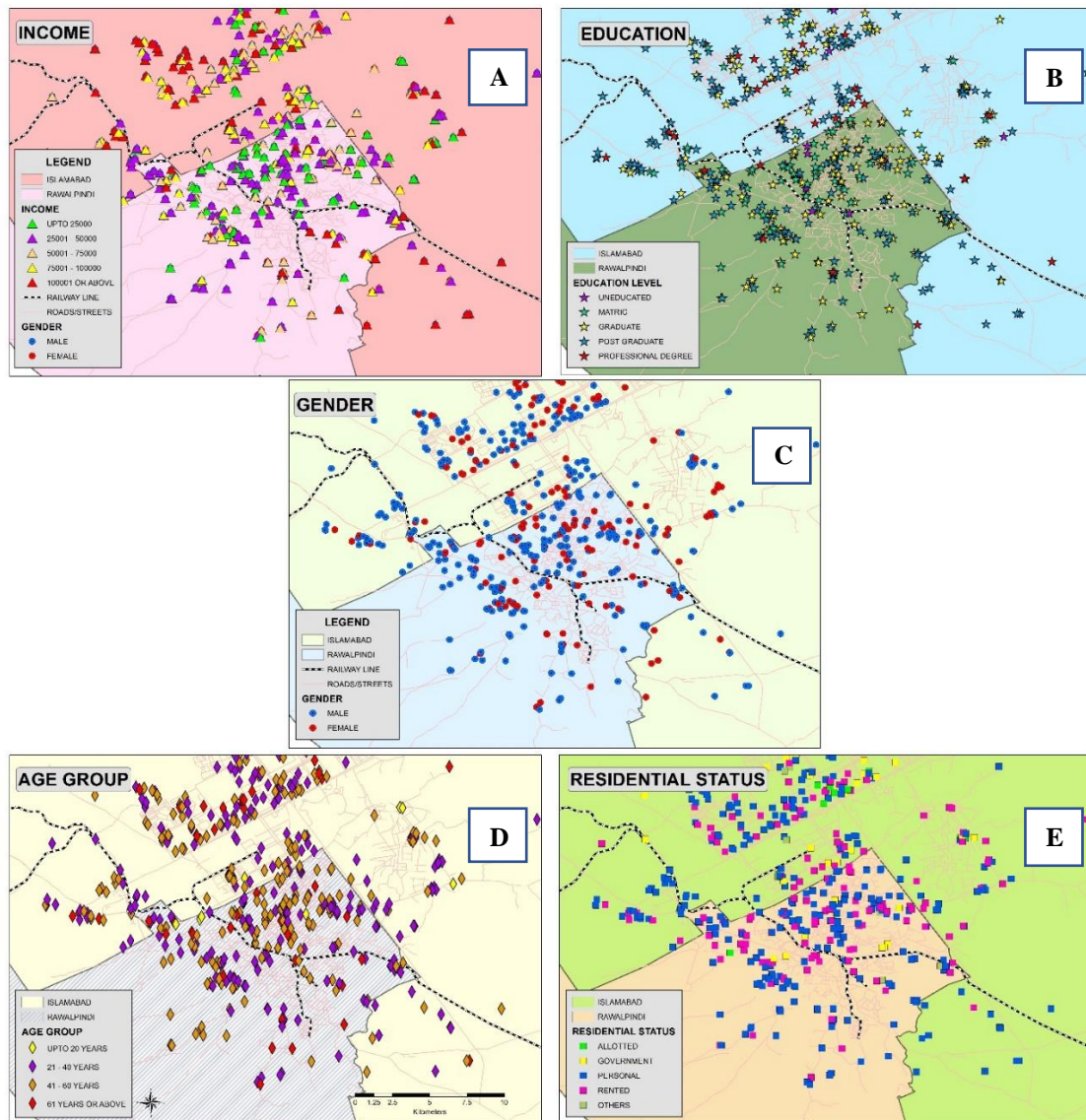


Figure 4. Maps (A-E) illustrating the spatial distribution of respondents in the study area on the basis of income, education, gender, age and residential status.

Vollmer et al. (2015) stressed on the recording of the geo-coordinates for each data point as these information are helpful in portraying the fine scale heterogeneities of a study area. The geographic coordinates were noted down on the questionnaire at the residence of each potential respondent (*Appendix 2*).

The questionnaires were retrieved from the respondents after one week of delivery. On the whole, 531 questionnaires out of the distributed 800 were collected, returning an average of (66.37%). The process was concluded during the months of July & August 2016.

The questionnaires with incomplete records were discarded during the scrutiny. On the whole, 250 questionnaires each, from both urban centers were selected. The initial data entries were made by the researchers in Microsoft Excel (Version 2016) for subsequent processing and analysis in R (R Version 3.4.2) program language and Geographic Information System (GIS). A portion of this data set is being used in this study.

Data analysis

Three questions about urban vegetation were asked from the respondents. The respondents were grouped on the basis of their residential location i.e. Islamabad and Rawalpindi for inter-city comparison. In the next stage, the respondents were classified and their responses were segregated on the basis of gender, education, residential status of dwellings, monthly income, and age for evaluating the role of these predictor variables in opinion building (*Table 1*).

Table 1. The socio-economic and demographic characteristics of respondents

Respondents	Islamabad (%)	Rawalpindi (%)
Gender		
Male	178 (71.2%)	174 (69.6%)
Female	72 (28.8%)	76 (30.4%)
Education		
Uneducated	3 (1.2%)	7 (2.8%)
Up to matric	24 (9.6%)	60 (24%)
Graduate	70 (28%)	89 (35.6%)
Postgraduate	33 (13.2%)	9 (3.6%)
Professional	120 (48%)	85 (34%)
Residential/ownership status of dwelling		
Allotted	9 (3.6%)	2 (0.8%)
Government/official	27 (10.8%)	8 (3.2%)
Personal	137 (54.8%)	151 (60.4%)
Rented	73 (29.2%)	85 (34%)
Others	4(1.6%)	4 (1.6%)
Monthly household income (Pak Rupees)*		
Up to 25000	31 (12.4%)	57 (22.8%)
25001 to 50000	57 (22.8%)	113 (45.5%)
50001 to 75000	35 (14%)	36 (14.4%)
75001 to 100000	53 (21.2%)	27 (10.8%)
100001 and above	74 (29.6%)	17 (6.8%)
Age		
Up to 20 years	31 (12.4%)	28 (11.2%)
21 to 40 years	103 (41.2%)	121 (48.4%)
41 to 60 years	110 (44%)	97 (38.8%)
61 and above		4 (1.6%)

*One hundred and thirty six Pak. Rupees are equal to 1€ (EURO) on June 7, 2018

The responses and attributes of the respondents were subsequently cross-tabulated for subsequent statistical analysis (*Appendix 3*).

Keeping in view the non-parametric nature of data the Kruskal-Wallis (KW) test was performed to discover the significant variations between the responses on the basis of predictor variables. In the next stage, pair-wise comparisons were carried out with the help of Wilcoxon Rank Sum Test (WRST) for those predictive variables in which the significant differences were observed in the initial KW test. The findings of WRST helped in deciphering the intra-group variations in responses. The findings were tabulated for assessments and comparisons.

Results

Perception about the usefulness of urban vegetation

The role and value of ecological contributions in a contextual setting is determined by human perception (Bixler and Floyd, 1997; Jim and Shan, 2013). The urban surroundings and socio-economic factors such as gender, education, residential status of dwellings, monthly income, and age, markedly influence the human perception about urban vegetation. The outcomes of the study (90% respondents agreed or strongly agreed; 4.8% responded “disagree or strongly disagree” while 5.20% stayed neutral) vindicate that the contributions of urban ecological resources stand acknowledged across the study area. However, the statistical findings (KW $\chi^2 = 5.90$; $df = 1$; $p < 0.02$) pointed out the significant differences between the responses of residents from both cities about the usefulness of urban vegetation.

The findings of KW based upon the predictor variables such as Education (KW $\chi^2 30$; $df 4$; $p < 0.01$), Income (KW $\chi^2 30$; $df 4$; $p < 0.01$), Age (KW $\chi^2 220$; $df 3$; $p < 0.01$) and Residential status (KW $\chi^2 10$; $df 4$; $p < 0.02$) indicated that these predictor variables also have a significant influence on the perception of respondents regarding the usefulness of urban vegetation (*Table 2*). However, the test statistics (KW $\chi^2 0.3$; $df 1$; $p > 0.05$) indicate that the Gender of respondent has a less significant role in this connection.

Table 2. The findings of Kruskal-Wallis (KW) test based upon of socio-economic variables

Kruskal-Wallis (KW) test and views of respondents									
Predictor variables	Chi square value			Degree of freedom (df)			P value		
	UVBR	VCC	ICUV	UVBR	VCC	ICUV	UVBR	VCC	ICUV
Gender	0.3	0.5	4	1	1	1	0.6	0.5	0.05
Education	30	10	4	4	4	4	0.0000006	0.05	0.4
Residential status	10	10	7	4	4	4	0.02	0.03	0.2
Income	30	20	20	4	4	4	0.000002	0.001	0.0001
Age	20	20	1	3	3	3	0.0007	0.001	0.8

Urban Vegetation is Beneficial for Residents (UVBR); Vegetation Cover Changes (VCC); Impacts of Changes in Urban Vegetation (ICUV)

The predictor variables identified in KW as responsible for significant differences were further tested for pair-wise comparison by WRST. The findings ($p < 0.05$) of

WRST based upon educational background revealed significant differences in the responses between the lesser or uneducated and educated respondents (*Appendix 4a*). This clearly implies that the level of education has significant bearings on the human perception about the benefits of natural capital. The ownership status of the dwelling is another important socio-economic indicator and meaningfully influences the opinions of people about the benefits of urban ecology. The marked variations ($p < 0.05$) among the views of respondents residing in different categories of accommodations were also observed in the findings of WRST (*Appendix 4b*).

The age-based comparison of WRST among different age groups (*Appendix 4c*) revealed significant differences ($p < 0.01$) between the responses of the most senior age group (61 years and above) with all other age groups (up to 20 years; 21-40 years; 41-60 years). The significant variations in views were not found between all the other categories of age groups. The income of respondents was also observed to be an influential factor in shaping the perception of respondents about the usefulness of urban vegetation. The pair wise comparison of income based categories in (*Appendix 4d*) indicated that the two lowest income groups (Up to Rs. 25000, Rs. 25001 to 50000) have a significantly different perception about the importance of urban greenery ($p < 0.01$) than the respondents from three higher income categories (Rs. 50001 to 75000, Rs. 75001 to 100000, and Rs. 100001 and above).

Perception of respondents about change in urban vegetation

The respondents were enquired about the vegetation cover changes in the study area. The majority of the respondents (69.20%) observed that the vegetative cover of Islamabad and Rawalpindi is changing and 12.80% reported that they do not perceive any visible change in it. Whereas, the remaining 18% of respondents have no considered opinion about the phenomenon.

However, the test statistics (KW χ^2 5.26; df 1; $p < 0.02$) identified the significant variations in the responses of inhabitants from both urban centers regarding the changes in vegetation cover. The significant variations in the responses were also found on the basis of socio-economic factors such as Education (KW χ^2 10; df 4; $p < 0.05$), Residential status (KW χ^2 10; df 4; $p < 0.03$), Income (KW χ^2 20; df 4; $p < 0.001$) and Age (KW χ^2 20; df 3; $p < 0.001$). However, the role of Gender was found negligible in this regard (KW χ^2 0.5; df 1; $p > 0.5$) (*Table 2*).

The subsequent findings of WRST ($p < 0.05$) revealed meaningful variations among the different categories of respondents on the basis of education (*Appendix 5a*). In this connection, significant differences ($p < 0.05$) were also observed in the opinions of respondents living in the rented dwellings with those who are living in government residences or in their personal abodes (*Appendix 5b*). These statistical findings infer that the ownership status of dwelling influences the opinions of people about changes in urban vegetation.

The significant differences in the opinions ($p < 0.01$) about the phenomenon were also observed in the findings of WRST between the responses of age group (61 years and above) with all other ages based categories (*Appendix 5c*). While, the Income based pair wise comparison based upon WRST indicated that the lowest income group (up to Rs. 25000) had a significantly different perception ($p < 0.01$) about the changes in vegetation cover of the study area than all the other income based categories of respondents (*Appendix 5d*).

Impacts of vegetative cover changes and respondents

The changes in the vegetative cover of the study area were negatively perceived by the majority (55.80%) of respondents. The significant differences in views regarding the impacts of these changes were also observed on the basis of residential location i.e. Islamabad or Rawalpindi (KW χ^2 7.37; df 1; $p < 0.01$) and socio-economic factors such as Gender (KW χ^2 4; df 1; $p < 0.05$) and Income (KW χ^2 20; df 4; $p < 0.01$). However, the test statistics based upon KW in (Table 2) depicted that the predictor variables such as Education, Residential status and Age of respondents have an ineffective influence on the views of residents in the study context.

The (KW) findings revealed that the gender of respondents had, yet, a different type of influence on perceptions regarding outcomes of change in the urban vegetative cover of the study area (Table 2).

The succeeding findings based upon WRST suggested that the economic status of urban residents has significant bearings on their views about the consequences of changes in vegetation cover (Appendix 6e). The pair wise findings of WRST based upon categories of education (Appendix 6b) pointed towards significant variations in perception about the impacts of changes ($p < 0.05$) between uneducated and higher educated respondents. However, such differences were found to be insignificant between uneducated and moderately educated respondents.

Discussion

The study evaluated socio-economic impacts and role of urban planning in shaping the perceptions of urban residents about ecological resources. The study was carried out in the contextual setting of Islamabad and Rawalpindi in Pakistan. The findings of the study establish that the process of urbanization is gaining momentum. The previous studies (Ali and Malik, 2010b; Ali et al., 2011; Ghafoor Chaudhry et al., 2014) returned similar conclusions. The critical findings of the study also formulate that urbanization through LULC changes is responsible for transformations in the ecology of the study area. These findings give credibility to the assertions of Ali and Malik (2010b) and Faeth et al. (2011) that urbanization causes and stimulates changes in the urban vegetation.

The majority (90%) of the respondents affirmed the positive contributions of urban ecological resources. The finding is in line with the opinions of Kaplan and Kaplan (1989) and Qureshi et al. (2010b) that urban residents acknowledge the importance of ecological contributions.

However, the findings divulge that the residential location and socio-economic characteristics of the study population are accountable for significant variations in views about the various aspects of urban vegetation. The outcomes of subsequent analysis vindicate the assertions that human perspectives about vegetative cover are significantly influenced by the level of education (Tidball and Krasny, 2011; Rupperecht and Byrne, 2014), ownership status of the inhabitant (Van Heezik et al., 2013; Shakeel and Conway, 2014), age (Lee and Maheswaran, 2011), income (Lee and Maheswaran, 2011; Majumdar et al., 2011) and gender (Gidlöf-Gunnarsson and Öhrström, 2010; Lee and Maheswaran, 2011).

The statistical findings based on empirical data validate the differences in the views of respondents from both urban centers about the transformation in vegetative cover. These variations in opinions are attributable to quantitative and qualitative differences

in socio-ecological settings of both cities. The urban vegetative cover, city structure, level of urban planning and management of urban ecological resources in Islamabad and Rawalpindi are inherently different. The former urban settlement is comparatively greener, broader in structure, more planned and administered by a well-structured and resourceful organization. As compared to it, Rawalpindi is a semi planned city, a victim of compromised environmental governance and unregulated and disorderly urban expansion.

However, this acknowledgement of change in urban vegetation is not homogenous among the different socio-economic segments of the study population. The summary statistics of data illustrate significant heterogeneities among the opinions of respondents on the basis of their awareness and sensitivity. The socio-economic trajectories of respondents were found influential in shaping their perception regarding changes in urban vegetation. These observations are in line with the previous assertions (Faeth et al., 2011; Kowarik, 2011) that socio-economic factors suggestively influence the human perception about changes in urban vegetative cover.

The variations in views about the impacts of changes on the basis of gender, support the previous findings (Gidlöf-Gunnarsson and Öhrström, 2010; Lee and Maheswaran, 2011) that the gender of respondents influences the human perception about human-environment relationships. In conservative social settings of the developing world, unequal exposures between male and female, is responsible for differences in normative knowledge about urban vegetation. Thus, it offers a plausible explanation for reported dissimilarities in views.

The study also substantiates the notions of reported findings (Jim and Shan, 2013; Mcguirk, 2013) that income, a proxy variable for economic status of individuals, not only determines socio-economic standings of the individuals but also significantly influences their propensities towards ecological resources. It is the considered opinion of the authors of this study that in the present age of consumerism and knowledge based economy the role of income and education is becoming more influential in shaping the perception of respondents regarding urban ecological resources.

Conclusions

The present study evaluated the role of urban planning and socio-economic factors i.e. gender, education, residential status of dwellings, monthly income, and age, in shaping the perception of respondents about ecological resources in the study area. The findings of the study indicate that the level of urban planning, exposure to ecological resources, socio-economic and demographic characteristics of the urban population have significant bearings on their orientations towards green infrastructure of urban areas. The study also points towards the growing urbanization and rapid transformations in LULC of the study area. The resultant impacts of these intrusions may adversely impact the performance and sustainability of the urban environment in both cities. The synchronized efforts of researchers, opinion builders, policy makers, concerned institutions and proactive participation of urban residents are required for integrated management and sustainability of the urban environment. In this connection further research is needed for evaluating the orientation of spatial and temporal changes in the LULC of the study area. The use of Remote Sensing (RS) data with the help of Geographic Information System (GIS) techniques seems to be a pragmatic option for measuring these trends. The findings of this study also signify the role and importance

of environmental management for the sustainability of urban green resources. Therefore, further investigations are also required for assessing the role and performance of institutions responsible for the environmental management of the study area. The holistic appraisal about such dimensions of environmental management are imperative for a healthy, green urban infrastructure.

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APPENDIX

Appendix I. Questionnaire

Date	GPS Coordinates	
	LAT.	LONG.

1	Location of respondent	(a) Islamabad (b) Rawalpindi
2	Year of birth	
3	Gender	(a) Male (b) Female
4	Highest education level	
5	Monthly household income	
6	Do you have any knowledge about ecosystem?	Yes No
7	What is the ownership status of your Dwelling?	(a) Personal (b) Official (c) Rented (d) Allotted (e) any other

8	Do you think that urban vegetative cover is beneficial for urban residents?	(a) Strongly disagree
		(b) Disagree
		(c) Agree
		(d) Strongly agree
		(e) Don't know
9	In your opinion, have the vegetative cover between your work place and home have changed in the past 10 years?	(a) Strongly disagree
		(b) Disagree
		(c) Agree
		(d) Strongly agree
		(e) Don't know
10	What is your opinion about the impacts of these changes in vegetative cover?	(a) Positive change
		(b) Negative change
		(c) Don't know

Appendix 2. Latitude/longitude coordinates of the respondents

Sr#	LOC	LAT	LOG	Sr#	LOC	LAT	LOG	Sr#	LOC	LAT	LOG
1	ISB	33.536923	73.174316	26	ISB	33.639852	73.15182	51	ISB	33.672661	73.076228
2	ISB	33.536846	73.172665	27	ISB	33.686116	72.99567	52	ISB	33.667629	73.066207
3	ISB	33.636117	72.978908	28	ISB	33.658383	73.156036	53	ISB	33.649446	73.029046
4	ISB	33.607847	72.850839	29	ISB	33.674268	73.064078	54	ISB	33.64249	73.033104
5	ISB	33.530552	73.153841	30	ISB	33.725245	73.043077	55	ISB	33.664002	73.073039
6	ISB	33.674121	73.140556	31	ISB	33.695646	73.059183	56	ISB	33.628747	72.970096
7	ISB	33.672931	73.141064	32	ISB	33.711004	73.047149	57	ISB	33.635737	72.973216
8	ISB	33.726474	73.141703	33	ISB	33.663343	72.997037	58	ISB	33.637068	72.973638
9	ISB	33.671609	73.14178	34	ISB	33.680973	73.034108	59	ISB	33.630741	72.972535
10	ISB	33.671251	73.14158	35	ISB	33.689797	73.025659	60	ISB	33.647733	73.031731
11	ISB	33.727595	73.056729	36	ISB	33.700229	73.05811	61	ISB	33.634999	73.016013
12	ISB	33.702391	72.973088	37	ISB	33.736223	73.18053	62	ISB	33.701716	72.977988
13	ISB	33.726474	73.056701	38	ISB	33.714305	73.022111	63	ISB	33.626205	72.943854
14	ISB	33.696425	73.002886	39	ISB	33.67777	73.006601	64	ISB	33.679226	73.006626
15	ISB	33.718631	73.03959	40	ISB	33.70351	73.052849	65	ISB	33.68595	73.042524
16	ISB	33.714255	73.030288	41	ISB	33.706771	73.057767	66	ISB	33.671719	73.138991
17	ISB	33.714187	73.035895	42	ISB	33.670639	73.011922	67	ISB	33.67251	72.993287
18	ISB	33.709318	73.047175	43	ISB	33.659214	73.046819	68	ISB	33.656493	73.059137
19	ISB	33.712017	73.032955	44	ISB	33.669774	72.989071	69	ISB	33.669039	72.992042
20	ISB	33.657152	73.156284	45	ISB	33.645494	73.112561	70	ISB	33.694461	73.045402
21	ISB	33.654241	73.153504	46	ISB	33.721724	73.035479	71	ISB	33.694822	73.032598
22	ISB	33.641731	73.153008	47	ISB	33.699268	73.069618	72	ISB	33.697278	72.948379
23	ISB	33.641161	73.151337	48	ISB	33.569066	73.146967	73	ISB	33.647354	73.038753
24	ISB	33.640303	73.154155	49	ISB	33.722568	73.039925	74	ISB	33.655301	72.852578
25	ISB	33.738727	73.184161	50	ISB	33.672295	73.032692	75	ISB	33.670407	73.033975
76	ISB	33.680982	72.979134	101	ISB	33.710882	73.045141	126	ISB	33.707578	73.085324
77	ISB	33.69022	72.978645	102	ISB	33.720249	73.061964	127	ISB	33.708621	73.088182
78	ISB	33.620439	72.996606	103	ISB	33.657195	73.157919	128	ISB	33.708703	73.083634
79	ISB	33.691769	72.999643	104	ISB	33.686878	73.004887	129	ISB	33.706632	73.082528
80	ISB	33.670827	72.948749	105	ISB	33.718432	73.080917	130	ISB	33.706717	73.043412
81	ISB	33.695233	72.976793	106	ISB	33.733158	73.174369	131	ISB	33.710411	73.080945
82	ISB	33.539643	73.095454	107	ISB	33.664736	73.002125	132	ISB	33.700287	73.072771
83	ISB	33.570388	73.117425	108	ISB	33.672513	73.015797	133	ISB	33.698098	73.067043
84	ISB	33.618189	73.141211	109	ISB	33.665239	73.001066	134	ISB	33.710545	73.083518
85	ISB	33.618473	73.140682	110	ISB	33.685229	73.027236	135	ISB	33.702063	73.06734
86	ISB	33.668057	73.076849	111	ISB	33.710437	73.071021	136	ISB	33.700811	73.07123
87	ISB	33.646749	73.102839	112	ISB	33.70951	73.048247	137	ISB	33.705475	73.035411
88	ISB	33.658427	73.106216	113	ISB	33.682738	73.215079	138	ISB	33.495701	73.108808
89	ISB	33.64129	72.95239	114	ISB	33.692377	73.056488	139	ISB	33.711154	73.049321
90	ISB	33.70373	73.066209	115	ISB	33.62327	72.943758	140	ISB	33.708969	73.062294
91	ISB	33.670355	73.138939	116	ISB	33.695217	72.986642	141	ISB	33.557094	73.162729
92	ISB	33.671886	73.071259	117	ISB	33.673274	73.009671	142	ISB	33.556691	73.16306
93	ISB	33.671893	73.139966	118	ISB	33.679621	72.980374	143	ISB	33.623932	73.012788
94	ISB	33.679005	73.024874	119	ISB	33.698752	73.062879	144	ISB	33.643816	73.164535
95	ISB	33.724127	73.03138	120	ISB	33.626269	72.938704	145	ISB	33.690077	73.132412
96	ISB	33.631234	72.924653	121	ISB	33.668952	73.064887	146	ISB	33.689706	73.134008
97	ISB	33.611977	73.132363	122	ISB	33.695896	73.049999	147	ISB	33.619684	73.232303

Sr#	LOC	LAT	LOG	Sr#	LOC	LAT	LOG	Sr#	LOC	LAT	LOG
316	RWP	33.566926	73.030336	341	RWP	33.621525	73.060629	366	RWP	33.631609	73.06565
317	RWP	33.544268	73.067471	342	RWP	33.621457	73.061821	367	RWP	33.597469	73.069398
318	RWP	33.486988	73.099908	343	RWP	33.607402	73.00942	368	RWP	33.597341	73.071352
319	RWP	33.58562	73.091711	344	RWP	33.584748	73.027598	369	RWP	33.600499	73.050567
320	RWP	33.608074	73.04495	345	RWP	33.585021	73.03487	370	RWP	33.62114	72.980886
321	RWP	33.591667	73.046588	346	RWP	33.614597	73.00681	371	RWP	33.582371	73.09762
322	RWP	33.616621	73.065852	347	RWP	33.550436	73.115782	372	RWP	33.583582	73.095847
323	RWP	33.616167	73.065788	348	RWP	33.530077	73.112428	373	RWP	33.641394	73.068788
324	RWP	33.596916	73.053857	349	RWP	33.596473	73.022209	374	RWP	33.638368	73.056437
325	RWP	33.616496	73.06608	350	RWP	33.596454	73.019341	375	RWP	33.635115	73.085288
376	RWP	33.544563	73.055324	401	RWP	33.624667	73.054338	426	RWP	33.557562	73.061322
377	RWP	33.625636	73.064122	402	RWP	33.652706	73.07189	427	RWP	33.589325	73.025251
378	RWP	33.642315	73.081253	403	RWP	33.607978	73.066514	428	RWP	33.628171	73.124221
379	RWP	33.551925	73.027701	404	RWP	33.625575	73.075722	429	RWP	33.596572	73.024144
380	RWP	33.552281	73.013677	405	RWP	33.628529	73.109527	430	RWP	33.596275	73.025553
381	RWP	33.634119	73.090047	406	RWP	33.582073	73.019416	431	RWP	33.594028	73.130073
382	RWP	33.594477	73.02448	407	RWP	33.603771	73.008261	432	RWP	33.621935	73.041589
383	RWP	33.5936	73.021246	408	RWP	33.626628	73.017598	433	RWP	33.586621	73.078158
384	RWP	33.651597	73.065626	409	RWP	33.62701	73.032636	434	RWP	33.605451	73.093072
385	RWP	33.627663	73.057469	410	RWP	33.622498	73.011807	435	RWP	33.598654	73.026315
386	RWP	33.652161	73.090715	411	RWP	33.626204	73.064411	436	RWP	33.605257	73.091759
387	RWP	33.65293	73.091171	412	RWP	33.594171	73.126695	437	RWP	33.58513	73.088427
388	RWP	33.496017	73.110314	413	RWP	33.59433	73.126932	438	RWP	33.614625	73.02527
389	RWP	33.49659	73.108891	414	RWP	33.637067	73.077261	439	RWP	33.596077	73.134311
390	RWP	33.63229	73.038046	415	RWP	33.593028	73.130417	440	RWP	33.626994	73.094579
391	RWP	33.633104	73.03795	416	RWP	33.637044	73.069514	441	RWP	33.616851	73.062575
392	RWP	33.633113	73.037213	417	RWP	33.590299	73.132788	442	RWP	33.522612	73.048165
393	RWP	33.568377	73.052454	418	RWP	33.629281	73.092291	443	RWP	33.474636	73.014316
394	RWP	33.567956	73.052714	419	RWP	33.628574	73.060012	444	RWP	33.583477	73.024615
395	RWP	33.633629	73.07574	420	RWP	33.598285	72.994212	445	RWP	33.62893	73.116726
396	RWP	33.616649	72.990835	421	RWP	33.552195	73.119747	446	RWP	33.651335	73.064304
397	RWP	33.617502	72.991409	422	RWP	33.607463	73.09511	447	RWP	33.635075	73.038575
398	RWP	33.618942	73.079751	423	RWP	33.599097	73.015775	448	RWP	33.634102	73.063326
399	RWP	33.58213	73.03863	424	RWP	33.629861	73.090781	449	RWP	33.620943	73.051603
400	RWP	33.581969	73.039268	425	RWP	33.654378	73.071851	450	RWP	33.634531	73.069006
451	RWP	33.622218	73.050947	476	RWP	33.615132	73.046074				
452	RWP	33.633956	73.069073	477	RWP	33.617942	73.039156				
453	RWP	33.63611	73.076866	478	RWP	33.652163	73.082399				
454	RWP	33.627316	72.941757	479	RWP	33.617326	73.030224				
455	RWP	33.61338	72.991244	480	RWP	33.605947	73.008537				
456	RWP	33.602171	73.000066	481	RWP	33.616002	73.043123				
457	RWP	33.619449	72.997178	482	RWP	33.647004	73.058734				
458	RWP	33.617075	72.987958	483	RWP	33.64691	73.061459				
459	RWP	33.623411	72.983935	484	RWP	33.598928	73.049117				
460	RWP	33.60239	73.018763	485	RWP	33.596737	73.044823				
461	RWP	33.619696	73.051036	486	RWP	33.631572	73.05052				
462	RWP	33.590859	73.074469	487	RWP	33.607581	73.006539				
463	RWP	33.628651	73.060912	488	RWP	33.611767	73.068567				
464	RWP	33.626496	73.035736	489	RWP	33.630137	73.062296				
465	RWP	33.604472	73.074591	490	RWP	33.631233	73.061962				
466	RWP	33.62491	73.03405	491	RWP	33.639587	73.049848				
467	RWP	33.596699	73.012665	492	RWP	33.621038	73.064693				
468	RWP	33.62567	73.031908	493	RWP	33.620015	73.077435				
469	RWP	33.604092	73.072392	494	RWP	33.364216	73.15347				
470	RWP	33.62645	73.03099	495	RWP	33.37426	73.222				
471	RWP	33.588147	73.025732	496	RWP	33.363432	73.25764				
472	RWP	33.627691	73.084004	497	RWP	33.3752	73.24996				
473	RWP	33.536371	73.079054	498	RWP	33.36576	73.4368				
474	RWP	33.6254	73.050937	499	RWP	33.364445	73.43563				
475	RWP	33.586415	73.023293	500	RWP	33.374917	73.43779				

Appendix 3. The socio-economic and demographic characteristics of respondents and their predilections

City ↓	City code ↓	Predictor Categories ↓	Natural capital beneficial for urban residents?					Did vegetation cover change?					Change type?		
			ST.AG	AG	NL	DA	ST.DA	ST.AG	AG	NL	DA	ST.DA	- ve	+ve	NA
City	I	Islamabad	99	131	9	7	4	38	143	40	15	14	126	82	42
	R	Rawalpindi	78	142	17	8	5	20	145	50	24	11	153	53	44
Gender	I	FEMALE	24	40	3	2	2	13	38	12	3	5	27	29	15
		MALE	75	91	6	5	2	25	105	28	12	9	99	53	27
	R	FEMALE	22	45	6	1	3	7	43	18	6	3	40	20	17
		MALE	56	97	11	7	2	13	102	32	18	8	113	33	27
Education	I	1.UE	1	1	1	0	0	1	1	1	0	0	2	1	0
		2.MT	4	16	3	0	1	3	14	4	1	2	11	6	7
		3.GR	24	39	2	3	2	9	34	13	8	6	24	33	13
		4.PG	58	61	3	2	1	22	72	17	5	4	70	33	17
		5.PD	17	14	0	2	0	3	22	5	1	2	19	9	5
	R	1.UE	0	5	1	0	1	0	3	3	1	0	3	1	3
		2.MT	8	40	5	5	2	1	35	14	8	2	35	12	13
		3.GR	32	47	7	1	2	6	56	18	5	4	55	18	16
		4.PG	35	45	4	1	0	13	44	14	9	5	54	21	10
		5.PD	3	5	0	1	0	0	7	1	1	0	6	1	2
Residential Status	I	1.ALT	6	3	0	0	0	2	3	3	1	0	5	2	2
		2.GOV	10	15	0	2	0	3	19	4	1	0	13	11	3
		3.PER	50	73	7	4	2	24	80	15	10	7	67	50	19
		4.REN	31	38	2	1	2	7	40	18	3	6	40	17	17
		5.OTH	2	2	0	0	0	2	1	0	0	1	1	2	1
	R	1.ALT	1	1	0	0	0	1	1	0	0	0	1	1	0
		2.GOV	2	4	2	0	0	0	6	2	0	0	4	1	3
		3.PER	50	91	5	3	2	9	96	27	16	3	95	32	24
		4.REN	21	46	10	5	3	9	39	21	8	8	52	16	17
		5.OTH	4	0	0	0	0	1	3	0	0	0	1	3	0
Age	I	1.A	3	2	0	1	0	1	4	1	0	0	4	2	0
		2.B	37	58	4	2	2	18	57	13	8	7	51	32	20
		3.C	53	62	5	3	2	19	71	22	6	7	67	41	17
		4.D	6	9	0	1	0	0	11	4	1	0	4	7	5
	R	1.A	1	1	3	0	0	1	1	2	0	1	3	0	2
		2.B	40	75	9	2	0	13	63	27	15	8	71	28	27
		3.C	29	53	4	4	5	5	64	16	8	2	63	20	12
		4.D	8	13	1	2	0	1	17	5	1	0	16	5	3
Monthly Income	I	C.1	6	21	3		1	4	12	11	1	3	13	9	9
		C.2	18	33	2	4		4	40	5	4	4	9	10	38
		C.3	15	17	1	1	1	6	19	6	4		12	5	18
		C.4	28	21	2	1	1	11	30	8	2	2	16	6	31
		C.5	32	39	1	1	1	13	42	10	4	5	32	12	30
	R	C.1	10	33	6	6	2	2	28	13	10	4	14	14	29
		C.2	33	70	8		2	6	70	25	8	4	20	20	73
		C.3	12	22	1		1	6	21	5	3	1	5	5	26
		C.4	15	9	2	1		3	15	6	2	1	7	3	17
		C.5	8	8		1		3	11	1	1	1	7	2	8

Appendix 4. Pair-wise findings of Wilcoxon Rank Sum Test (WRST) based upon predictor variables about Urban Vegetation is Beneficial for Residents (UVBR)

a: Education				
	Matric	Graduate	Postgraduate	Professional
Uneducated	0.449	0.039	0.006	0.014
	Matric	0.0005	0.000001	0.0001
		Graduate	0.055	0.144
			Postgraduate	0.712
b: Residential Status				
	Rented	Government	Allotted	Others
Personal	0.24	0.78	0.04	0.02
	Rented	0.73	0.03	0.02
		Government	0.07	0.04
			Allotted	0.64
c: Age				
	up to 20 years	21 to 40 years	41 to 60 years	
61years and above	0.001	0.0003	0.0002	
	up to 20 years	0.452	0.67	
		21 to 40 years	0.065	
d: Monthly Income				
	Up to Rs.25000	Rs.25001 to 50000	Rs.50001 to 75000	Rs.75001 to 100000
Rs.100001 and Above	0.00001	0.015	0.378	0.374
	Up to Rs.25000	0.005	0.001	0.000003
		Rs.25001 to 50000	0.221	0.002
			Rs.50001 to 75000	0.106

Appendix 5. Pair-wise findings of Wilcoxon Rank Sum Test (WRST) based upon predictor variables about Vegetation Cover Changes (VCC)

a: Education				
	Matric	Graduate	Postgraduate	Professional
Uneducated	0.795	0.573	0.207	0.279
	Matric	0.442	0.009	0.146
		Graduate	0.029	0.381
			Postgraduate	0.554
b: Residential Status				
	Rented	Government	Allotted	Others
Personal	0.01	0.5	0.72	0.11
	Rented	0.05	0.32	0.06
		Government	0.98	0.15
			Allotted	0.48
c: Age				
	up to 20 years	21 to 40 years	41 to 60 years	
61years and above	0.0002	0.00009	0.0002	
	up to 20 years	0.9	0.6	

		21 to 40 years	0.5
d: Monthly Income			
	Up to Rs.25000	Rs.25001 to 50000	Rs.50001 to 75000
Rs.100001 and Above	0.001	0.06	0.851
	Up to Rs.25000	0.012	0.003
		Rs.25001 to 50000	0.14
			Rs.50001 to 75000
			0.891

Appendix 6. Pair-wise findings of Wilcoxon Rank Sum Test (WRST) based upon predictor variables about Impacts of Changes in Urban Vegetation (ICUV)

a: Gender				
		FEMALE		
		MALE	0.05	
b: Education				
	Matric	Graduate	Postgraduate	Professional
Uneducated	0.87	0.039	0.006	0.014
	Matric	0.22	0.73	0.79
		Graduate	0.06	0.24
			Postgraduate	0.97
c: Residential Status				
	Rented	Government	Allotted	Others
Personal	0.31	0.4	0.97	0.05
	Rented	0.16	0.72	0.02
		Government	0.69	0.16
			Allotted	0.15
d: Age				
	up to 20 years	21 to 40 years	41 to 60 years	
61years and above	0.6	1	0.8	
	up to 20 years	0.4	0.7	
		21 to 40 years	0.5	
e: Monthly Income				
	Up to Rs.25000	Rs.25001 to 50000	Rs.50001 to 75000	Rs.75001 to 100000
Rs.100001 and Above	0.327	0.00002	0.007	0.021
	Up to Rs.25000	0.0006	0.046	0.119
		Rs.25001 to 50000	0.46	0.208
			Rs.50001 to 75000	0.686