Discrimination of Inhabitant Satisfaction with the Public Infrastructure Between Region and Various Income Groups in Punjab, Pakistan

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Abstract. In the prevailing circumstances, an analysis of residents’ satisfaction with the quality of public infrastructure is essential in determining the degree of contentment of society. The aim of this study is to determine the degree of serenity of the inhabitant with the different public infrastructure provided for their use. This assessment is based on different regional and income classes in the province of Punjab, Pakistan. The stratified random sampling technique is used to explain such regional economic segregation by selecting 14 out of 36 districts in Punjab, Pakistan. A total of 1500 people from large, medium and small districts are interviewed. Multinomial logistic regression and study of the Chi-square tests were adopted. We see that the satisfaction of the population with the facilities (education, health, electricity, transport, water and sanitation) varies considerably within the region and the income classes. The government must therefore adopt a realistic strategy for balanced growth between the various regions and implement a labor-intensive project in small districts.

Keywords: Region · Income · Discrimination · Satisfaction · Infrastructure

1 Introduction

Infrastructure is a necessary prerequisite for economic growth of any country. To measure the overall happiness of society, it is important for the prevailing circumstances to satisfy...
the inhabitant with the quality of public services. Public Infrastructure expresses the actual state of economic growth for each region. The Government of the developing countries occurs in urban growth rather than rural development [1]. It is important for a country’s economic growth and life satisfaction for both urban and permanent rural users [2–9]. It is also reported that well-planned urban infrastructure would bring stability to society and development quality of life inequalities [4, 10]. Despite this, the inequalities in regional development triggered a postponement of the economic growth of the country (Rauf and Jahan, 2007), cited in [1]. Anomalous expertise often deliberately threatens sustainability, balanced economic growth and resource management [11]. Therefore economist valued the socio-economic justice and well-being of the people as a whole [12].

Public service [13] provided by a country’s government are called public infrastructure for the functioning of the economy. Infrastructure is similarly the services offered by the government to promote domestic consumers and private investors in the country [14]. A main component of public services is social infrastructure, which is related to the quality of life of the inhabitant or Inhabitant’s Satisfaction [9], such as schooling, health care, leisure facilities, and sanitation. whereas, economic infrastructures such as electricity, roads, water, ports, public transportation, water supply, drainage, flood control, sewerage, power supply, street lighting and telecommunications are used to manage commercial consumer goods [14, 15] also directly or indirectly related to inhabitants satisfaction. Inhabitant’s assessment of the quality of the infrastructure provided by the government is directly linked to the happiness or satisfaction of the population [4].

Public infrastructure investment left an ineradicable effect on the spatial distribution of economic activities and geographical shapes [10], [16–18]. Regional query describes the degree of serenity developed by variant development levels [19]. Pakistan is decorated with the various levels of infrastructure across the country [7, 20, 21]. Unfortunately, the public infrastructure situation in Pakistan is not satisfactory, and the state of the standing infrastructure is not meeting global standards. According to the World Economic Forum (2017), in Global competitive index Pakistan ranked 115th/137, while infrastructure ranked at 110th/137 [22]. Until many comparable Asian countries have better infrastructure than Pakistan [15]. Over the past three decades, the government has invested a lot of money on the mega-projects tendered for paramour, because the aim was to gain benefit regardless of the welfare of the people. In Pakistan, the state of the regional network between provinces and cities have skewed distribution [7]. In Pakistan there is a lack of data about the annual funds allocated at infrastructure for regional development. According to Economic Survey of Pakistan 2019–20 But Education, Health, Transportation, electricity and sanitation sectors accounts for about 2.4%, 2.9%, 2.1%, 4% and 1% of the country’s GDP respectively.

Many research has been done on the subject of satisfaction, such as customer [23], patient [24], Travel [3], Manager’s satisfaction with worker [25], resident [26], Household [27], Community [28], and dwellers [29] satisfaction with the prevailing circumstances. Even though existing literature comprise minimal research concerning inhabitant satisfaction with public infrastructure among the different countries [8, 15, 30, 31, 32], or between the counties [7, 17, 18, 33, 34]. Although research relating to the satisfaction of communities at a single city level are focused on affluence. The infrastructure’s
excellence can be assessed from the residents because they had developed the standard in their minds and their attitude towards infrastructural services [6, 9, 35]. For this reason, the present study opens the effort to segregate the satisfaction of the citizens with the permanent infrastructure between different levels of the region. Study also concern to describe inhabitant’s satisfaction with infrastructure between different income groups. In this paper, the aim is to investigate the regional level of resident satisfaction with the state of public infrastructure and how different income groups [4] assess it, because human perception is necessary in order to procure and manage knowledge about the nature of the spatial environment [35 36].

2 Review of Literature

Basic infrastructure attributes such as Transportation, Sanitation, Electricity, Health, and Education [7] are used to distinguish the satisfaction of the residents within and between the region. All of these are required and essential public infrastructure which has a direct or indirect effect on the inhabitants’ social and economic life. Regional inequality of residents’ satisfaction with public infrastructure excellence will also be assessed among income groups [31, 37, 38]. Significant inequalities in the quality of public infrastructure have been reported across the region and across the globe [3, 4, 5, 7, 30]. The level of satisfaction with the infrastructure available also varies amongst the masses [30, 39, 35]. Inhabitant’s satisfaction is also examine in connection with urban settings by taking into account different attributes [4, 7, 40]. Researchers assess regional variability by taking into consideration employment, safety, water and sanitation [20, 29], Road and Transportation [3, 4, 6], Sewerage, waste dispose of, water supply and power supply [39], social and physical Infrastructure [41] and Sewerage, Electricity, law & order [42].

The researcher studies the relationship between infrastructural facilities and the degree of social welfare [2, 39, 27]. Inhabitants of various income levels often have varying degrees of satisfaction of hard and soft public services [3, 33, 16]. In Punjab, Pakistan, regional disparities are also compared for different periods of time by taking different socio-economic factors [1]. [4] distinguish socioeconomic satisfaction within the city and equate land cover/use of towns with recorded resident life satisfaction. Provincial level income inequalities, consumption, allocation of funds at federal level and indicator of socio-economic development. Disparities in regional growth and life satisfaction of different socio-economic factors are contrasted by [19], The result showed that life satisfaction except for the economic factor was found to be identical between the social life indicator. Likewise, [3] recognize regional and social inequality in overall transportable satisfaction including rail transport among Beijing residents, then discuss how the response to satisfaction discords in expected and actual travel. [43, 44] derive Satisfaction with the provided infrastructure for customer of the tourism destination. Researcher also assess residential satisfaction with public housing [26, 45]. Household Satisfaction with the Excellence of Urban Infrastructure assessed by low income resident [40]. Infrastructure quality also assessed by dwellers in rural area about rural development [29, 46]. [8] also evaluate public infrastructure considering citizen outlooks.
3 Materials and Methods

3.1 Regional and Income Groups Classification

Punjab is a populous province in Pakistan, second by region, and the largest share of GDP in the economy. Punjab has 36 districts and 145 Tehsils with various features. Figure 1 shows the location of all Punjab districts which are classified by population size as large, medium, and small. Districts with a population of over four million are classified as large, 2 to 4 million people medium, and less than two million people in small districts [47, 48]. In Punjab, there are 10 large districts, 11 medium districts and 15 small districts. Big Districts have the best quality infrastructure, while medium Districts or small Districts have an average or low-quality public infrastructure. While classification of income groups like (Low income < 35000, 35000 < Low Middle income < 80000, 80000 < Upper Middle income < 170000 and Upper income > 170000 in Pakistani Rupees) followed by [49].

3.2 Sample Selection

For the sample collection 14 districts comprising 6, 4 and 4 from large, medium and small districts respectively were selected in this study. Sampled districts are marked in map give in Fig. 1. A total of 1500 respondents from Big, Medium and Small Districts were interviewed using stratified random sampling technique [10] in which 600, 500, 400 samples were from large, medium, and small districts respectively. In part due to the necessary information, the respondent must answer the number of members of the household, the number of employed persons, the level of education of an employed person, the respective sector of employment, the approximate monthly income and the degree of satisfaction with the infrastructure available for use. The respondent expressed their general views on how well they were satisfied with the infrastructures available such as education, health, transport electricity and sanitation.

Fig. 1. Regional classification of district of Punjab
3.3 Statistical Analysis

Exploring Association and Discrimination Between Level of Satisfaction, Income, and Region

Inhabitant’s Satisfaction with the said infrastructure have been described between the region and income groups in terms of contingency table. 3-D Bar chart is also used to describe the inhabitant’s satisfaction of infrastructure in different regions and income groups. Fuzzy forecasting molding is very useful technique for weighted association and least forecasting error [50] but due to Covid-19 data have some limitation. Therefore, Chi-square test is used to test the significance association between HH. Income group and region first, then infrastructural attribute satisfaction level separately with region and income group. Five-point Likert scale reduces to a Likert scale of three points (Satisfied, Neutral and Unsatisfied) by combining the Likert-point very satisfied and satisfied while very unsatisfied and unsatisfied with unsatisfied, the intention is to design attributes of infrastructural satisfaction [29, 51, 44]. Chi-square test is often used to test the association between income group and satisfaction [6, 29, 42, 51] but we also include regional attributes to test association with the satisfaction of described Infrastructure.

Exploring the Impact of Regional and Income Group on Inhabitant’s Satisfaction of Infrastructure

Multinomial logistic regression techniques [4] were used to analyze inhabitant’s satisfaction [4, 27, 29, 33] (Categorical variable) with the Infrastructure in relation with independent variable; No of Household (Discreet variable) regional (ordinal variable) and income group (ordinal variable). Dependent variable satisfaction on a five-point Likert scale (Very unsatisfied, Unsatisfied, Neutral, Satisfied and Very satisfied) assessed by the responded but to make our analysis comprehensive response of outcome variable reduce five-point Likert into three-point Likert scale (Unsatisfied, Neutral and Satisfied) by combining Very unsatisfied & Unsatisfied into Unsatisfied while very satisfied & Satisfied into Satisfied. Regional [4] variable are categories as (Large, Medium and Small) Districts. Income [33] groups are categories as High, Medium-High, Low-Medium and Low Income. Multinomial Logistic regression model are used to estimate relative probability of categories of given outcome with respect to baseline category. In our case inhabitant’s satisfaction have three categories in relation with income and regional categories, so our model will be defined as below:

\[
\ln \left( \frac{P(\text{Satisfied})}{P(\text{Neutral})} \right) = \beta_0 + \beta_1(\text{Large}) + \beta_2(\text{Medium}) + \beta_3(\text{NoHH}) \tag{1}
\]

\[
\ln \left( \frac{P(\text{Unsatisfied})}{P(\text{Neutral})} \right) = \beta_0 + \beta_1(\text{Large}) + \beta_2(\text{Medium}) + \beta_3(\text{NoHH}) \tag{2}
\]

\[
\ln \left( \frac{P(\text{Satisfied})}{P(\text{Neutral})} \right) = \beta_0 + \beta_1(\text{High}) + \beta_2(\text{lowMedium}) + \beta_3(\text{Low}) + \beta_4(\text{NoHH}) \tag{3}
\]
\[ \ln \left( \frac{P(\text{Unsatified})}{P(\text{Neutral})} \right) = \beta_0 + \beta_1(\text{High}) + \beta_2(\text{lowMedium}) + \beta_3(\text{Low}) + \beta_4(\text{NoHH}) \] (4)

The output variable satisfaction of the inhabitant is given in two parts of the above equations. Output category neutral to be used as a reference in both parts. In Eqs. 1 and 2 independent variables of the region, the category Small district is a redundant category, while in Eqs. 3 and 4 independent variables of the income group, the category Medium-high income group is a redundant category.

4 Results

4.1 Describing Inhabitant’s Satisfaction with Infrastructural Association and Discrimination Between Region and Income Group

Inhabitant’s satisfaction with infrastructure excellence has five characteristics. 3-D The chat bar is designed separately for all five attributes in Fig. 2. First, in all parts of Fig. 2, the distribution of the satisfaction of the inhabitant as satisfied, unsatisfied and neutral depicts that the satisfied inhabitant has a skewed distribution with the dissatisfied and neutral inhabitant of the region. Specifically, the largest bar in the category of satisfied is in the category of a large district. This means that a large number of inhabitants are satisfied who belong to large districts, while the rest of the district’s residents are less satisfied and more dissatisfied.

Secondly, as far as income groups are concerned, the distribution of satisfaction is also skewed in the opposite direction compared to unsatisfied and neutral. Here inhabitants who possess low income are not satisfied with the infrastructure, except for sanitation, because the number of unsatisfied inhabitants is small in number in part to the satisfaction of the sanitation infrastructure. Here is the highest bar in the category of high middle income in front of the satisfied category, which describes that inhabitant with a high middle income is more satisfied than other income groups.

Third, in all parts of Fig. 2, residents who have a neutral opinion on infrastructure excellence are fewer in the regional group and income groups, except for the attribute of Health Infrastructure. Here are the inhabitants who have a neutral opinion that is greater than the satisfied population in the low-income category. Similarly, the category of a small district within the regional group of inhabitants who have a neutral view of satisfaction is greater than the unmet population. Finally, the disparities in satisfaction exist not only between regions, but also within each category of the region, for all the characteristics of the infrastructure. In the same way, inequalities in the satisfaction of the inhabitant can be observed with regard to the given characteristics of infrastructure between income groups as well as within income groups. Same trend can be observed between region and within region.

4.2 Assessment of Discrimination of Inhabitant’s Satisfaction of Infrastructure

Assessment of Association and Discrimination by Region

Characteristics of Infrastructural Satisfaction such as Education, Health, Transportation
Discrimination of Inhabitant Satisfaction with the Public Infrastructure

Electricity and Health Analysis in Table 1. The Category Variable Region Lage, the Medium and Small Districts are column categories and the level of satisfaction are row categories in Table 1. The next part concerns the Pearson Chi-square and Likelihood Ratio Test for the significance of level satisfaction and the region. First of all, the level of satisfaction of the educational infrastructure shows that there is a significant association between the Region and the level of satisfaction at a 5% level of significance. Satisfaction of the Infrastructural attributes Health, Transportation, Electricity and Sanitation also has a significant association between the regional categories at a 5% level of significance. The probability ratio test also found to be significant at the 5% level between the satisfaction level of the infrastructural attributes and the regional level Table 1.

In terms of regional satisfaction discrimination, the equality of regional groups is tested for each level of satisfaction of infrastructural attributes. The result of the educational infrastructure shows that there is a significant difference between the regions in terms of the level of satisfaction of the inhabitants. Only those who perceive the level of satisfaction as neutral and belong to medium and small districts are not found to be
significant in their assessment Table 1. With regard to health infrastructure, regional and unsatisfied residents also found significant satisfaction levels, but residents of large and medium size have statistically the same level of satisfaction as neutral but different with residents of small districts Table 1. Satisfied and dissatisfied with the transport facilities are also significant for the region, while the inhabitants belong to Lage and the mall districts, and having a neutral opinion is not significant for the residents of the medium district, but significant for each. The results for the regional satisfaction of the inhabitants with the electricity and sanitation infrastructure are identical to those for educational infrastructure.

**Assessment of Association and Discrimination by Income Group**

Previous Described Infrastructural Attributed and Income Group Categories are assessed in Table 4. The Chi-Square test reveals a significant association between satisfaction levels and income groups. Results of the probability ratio also confirm the significance of the satisfaction of the inhabitant with the infrastructure and the income groups.

### Table 1. Discrimination analysis of inhabitant’s satisfaction with infrastructure by region

| Education | Level of Satisfaction | Level of District | Pearson Chi-Square | Likelihood Ratio |
|-----------|-----------------------|-------------------|--------------------|------------------|
|           |                       | Large | Medium | Small | Value | DF | Asymptotic Significance |
| Neutral   | Observed              | 70,   | 97,    | 58,   |       |    |                      |
|           | Expected              | 90.0  | 75.0   | 60.0  |       |    |                      |
| Satisfied | Observed              | 517,  | 281,   | 97,   | 497.648* | 4 | 0.000                 |
|           | Expected              | 358.0 | 298.3  | 238.7 | 541.983 | 4 | 0.000                 |
| Unsatisfied| Observed             | 13,   | 122,   | 245,  |       |    |                      |
|           | Expected              | 152.0 | 126.7  | 101.3 |       |    |                      |

*0 cells (0.0%) have expected count less than 5. The minimum expected count is 40.00.

**Health**

| Neutral   | Observed              | 161,  | 126,   | 141,  |       |    |                      |
|           | Expected              | 171.2 | 142.7  | 114,  |       |    |                      |
| Satisfied | Observed              | 353,  | 214,   | 44,   | 266.195* | 4 | 0.000                 |
|           | Expected              | 244.4 | 203.7  | 162.9 | 296.171 | 4 | 0.000                 |
| Unsatisfied| Observed             | 86,   | 160,   | 215,  |       |    |                      |
|           | Expected              | 184.4 | 153.7  | 122.9 |       |    |                      |

*0 cells (0.0%) have expected count less than 5. The minimum expected count is 114.13.

**Transportation**

| Neutral   | Observed              | 100,  | 107,   | 99,   |       |    |                      |
|           | Expected              | 122.4 | 102.0  | 81.6  |       |    |                      |
| Satisfied | Observed              | 448,  | 215,   | 47,   | 437.964* | 4 | 0.000                 |
|           | Expected              | 284.0 | 236.7  | 189.3 | 486.444 | 4 | 0.000                 |
| Unsatisfied| Observed             | 52,   | 178,   | 254,  |       |    |                      |
|           | Expected              | 193.6 | 161.3  | 129.1 |       |    |                      |

*0 cells (0.0%) have expected count less than 5. The minimum expected count is 81.60.

**Electricity**

| Neutral   | Observed              | 130,  | 174,   | 119,  |       |    |                      |
|           | Expected              | 169.2 | 141.0  | 112.8 |       |    |                      |
| Satisfied | Observed              | 394,  | 194,   | 98,   | 214.769* | 4 | 0.000                 |
|           | Expected              | 274.4 | 228.7  | 182.9 | 215.887 | 4 | 0.000                 |
| Unsatisfied| Observed             | 76,   | 132,   | 183,  |       |    |                      |
|           | Expected              | 156.4 | 161.3  | 129.1 |       |    |                      |

*0 cells (0.0%) have expected count less than 5. The minimum expected count is 104.27.

**Sanitation**

| Neutral   | Observed              | 95,   | 124,   | 101,  |       |    |                      |
|           | Expected              | 128.0 | 106.7  | 85.3  |       |    |                      |
| Satisfied | Observed              | 442,  | 277,   | 154,  | 144.125* | 4 | 0.000                 |
|           | Expected              | 349.2 | 291.0  | 232.8 | 143.604 | 4 | 0.000                 |
| Unsatisfied| Observed             | 63,   | 99,    | 145,  |       |    |                      |
|           | Expected              | 122.8 | 102.3  | 81.9  |       |    |                      |

*0 cells (0.0%) have expected count less than 5. The minimum expected count is 81.87.

Each subscript letter denotes a subset of District Level categories whose column proportions do not differ significantly from each other at the .05 level.
The Discrimination Analysis explores the existence of substantial variances between satisfaction-based income groups derived from different infrastructure attributes. The level of satisfaction of educational infrastructure is also distinguished from the income group (Table 2). The result shows that high-income groups and low-income groups are significantly different in terms of level of satisfaction. The level of satisfaction of the health facility is differentiated between income groups (Table 2). Here, high income and low-income groups are again found to be significantly different. Infrastructure satisfaction levels of transport, electricity and sanitation are discriminated against with income groups (Table 2). Here, too, high-income groups and low-income groups differ significantly in terms of level of satisfaction. Moreover, it can be determined that the high-income inhabitants are relatively satisfied, but the low-income inhabitants are not for all types of infrastructure. Similarly, the Medium-High Income Group is also significant and relatively satisfied with the low-income group. The low-medium income group is also significant for other income groups, almost all of the characteristics of the infrastructure in terms of all levels of satisfaction. However, for almost all the levels of satisfaction of all attributes, the High and High Medium Income groups are insignificant. These results indicate that poor or low-income groups are dissatisfied with infrastructural facilities because low-income people are unable to incur all basic costs. After all, education, health, transport and electricity are very expensive for them. Until low-income residents, as described above, are associated with a small district where there is inadequate sanitation and public work facilities.

4.3 Estimation of Impact on Inhabitant’s Satisfaction with Infrastructure

Estimation of Regional Impact on Inhabitant’s Satisfaction

Table 3 includes the coefficient ($\beta$) of multinomial nominal logistic regression for satisfaction level along with $\text{Exp}(\beta)$. Estimates are given for each outcome variable (Infrastructure attributes such as Education, Health, Transportation, Energy and Sanitation) and for each outcome variable category. Coefficient ($\beta$) tells us the expected amount of change in the outcome due to change in one unit of the predictor variable while $\text{Exp}(\beta)$ represents an odd ratio which is an opportunity to move from the reference category to the category of consequence.

In our case, the result shows that almost all the coefficients for all the output variables are significant at 10%, 5% and 1%. This means that all indicators have a significant impact on the satisfaction of the inhabitant with all the characteristics of the infrastructure. Specifically, if the size of the household increases one unit and keeps other predictors constant, the probability of switching from neutral to satisfied decreases, while the probability of switching from neutral to unsatisfied increases. Similarly, keeping household size constant when switching from a small district regional category to a large district will increase the chance of a satisfied category over a neutral one. While the regional predictor shifts from the small district to the Medium district, it also increases the chance of being satisfied relative to Neutral. The result in Table 3 indicated that the probability that a large district would be satisfied is greater than the probability that a medium district would be satisfied. On the other hand, if other predictors remain constant, then moving from a small district to a medium district has a low chance of catching satisfaction in an
Table 2. Discrimination result of inhabitant’s satisfaction with infrastructure by Income group

| Level of Satisfaction | Education | Poor | Low Low | Low Med | Med High | Pearson Chi-Square Likelihood Ratio |
|-----------------------|-----------|------|---------|---------|---------|-----------------------------------|
| Neutral               | Observed  | 20a  | 62a     | 91a     | 52a     | Value | DF | Asymptotic Significance |
| Expected              |           | 34.4 | 69.3    | 64.1    | 57.3    | 6 | 0.00 |
| Satisfied             | Observed  | 192a | 92a     | 298a    | 313a    | 654.320a | 6 | 0.00 |
| Expected              |           | 136.6| 275.7   | 254.8   | 227.9   | 654.704 | 6 | 0.00 |
| Unsatisfied           | Observed  | 174a | 308a    | 38a     | 17a     | x 0 cells (0.0%) have expected count less than 5. The minimum expected count is 34.35. |
| Expected              |           | 58.0 | 117.0   | 108.2   | 96.8    | x 0 cells (0.0%) have expected count less than 5. The minimum expected count is 65.34. |

Table 3 also shows that the multinomial logistic coefficient for all levels of infrastructural satisfaction among income groups is significant at 1%, 5% and 10%. The size of the household yields the same results as shown in Table 3. High medium income group income is automatically defined as a redundant category in the SPSS. As a result, the results for the satisfied outcome category showed that, if the predictor moves from the unsatisfied category of inhabitant while moving from a small district to a large district has less chance of catching in an unsatisfied category.

Estimation of Income Groups Impact on Inhabitant’s Satisfaction

Table 4 also shows that the multinomial logistic coefficient for all levels of infrastructural satisfaction among income groups is significant at 1%, 5% and 10%. The size of the household yields the same results as shown in Table 3. High medium income group income is automatically defined as a redundant category in the SPSS. As a result, the results for the satisfied outcome category showed that, if the predictor moves from the
Table 3. Multinomial logistic estimate for inhabitant’s satisfaction by Region

| Predictor Variable | Attributes of infrastructure | Education | Health | Transportation | Electricity |
|--------------------|-----------------------------|----------|--------|----------------|-------------|
|                    | Sanitation \( ^a \)         |          |        |                |             |
|                    | \( \beta \)                 | \( \exp(\beta) \) | \( \beta \) | \( \exp(\beta) \) | \( \beta \) | \( \exp(\beta) \) |
| Satisfied          | Intercept                    | 0.834*** | 1.094*** | 0.264          | 0.859***    | 0.373*       |
|                    | No. of HH                    | -0.057*  | 0.945   | -0.078**       | 0.925       | -0.199***    | 0.819        | -0.230***    | 0.794       | -0.080**    | 0.923       |
|                    | Large District               | 1.050*** | 2.857   | 1.382***       | 3.984       | 1.737***     | 5.680        | 2.064***     | 7.881       | 1.218***    | 3.381       |
|                    | Medium District              | 0.346**  | 1.414   | 0.494***       | 1.639       | 1.592***     | 4.916        | 1.347***     | 3.845       | 0.255*      | 1.291       |
|                    | Small District \( ^b \)     |          |         |                |             |             |             |             |             |             |             |
| Unsatisfied        | Intercept                    | -0.415*  | 1.684*** | 0.737***       | 0.812***    | -0.306       |
|                    | No. of HH                    | 0.102*** | 1.107   | -0.032         | 0.968       | 0.042*       | 0.959        | 0.017        | 1.017       | 0.097***    | 1.102       |
|                    | Large District               | -0.634***| 0.531   | -3.169***      | 0.642       | -1.101***    | 0.332        | -1.578***    | 0.206       | -0.843***   | 0.430       |
|                    | Medium District              | -0.521***| 0.594   | -1.235***      | 0.291       | -0.205       | 0.814        | -0.426***    | 0.653       | -0.645***   | 0.525       |
|                    | Small District \( ^b \)     |          |         |                |             |             |             |             |             |             |             |
|                    | Pseudo R\(^2\)              | 0.106    | 0.306   | 0.199          | 0.304       | 0.151        |
|                    | Cox and Snell                | 0.124    | 0.360   | 0.224          | 0.347       | 0.171        |
|                    | Nagelkerke                   |          |         |                |             |             |             |             |             |             |

The reference category is: Neutral.

* P < 0.1  ** P < 0.05  *** P < 0.01
This parameter is set to zero because it is redundant.
high-medium-income group to the high-income group, the likelihood of being satisfied with the neutral category increases. While this probability decreases if the predictor category moves from the high-medium-income group to the low middle or low-income group. This means that the high and high middle-income group produces a satisfactory result for the variable outcome. Likewise, the estimate of the unsatisfied holding of other variables constant from the high medium-income group to the low or low medium-income group produces an unsatisfied result for the neutral category of the outcome. The estimated probability of unsatisfied relative to neutral outcomes also increases when medium-high income steps into the high-income group for all attributes except transport attributes.

5 Discussion

Based on estimates, It has been founded that there are significant disparities between the regions [1, 3, 20] and between income groups [3, 33] as regards the satisfaction of the inhabitant [30, 43, 52]. In addition, the level of satisfaction of the population responds inversely as well as the number of household members increases [8]. The Multinomial Logit Regression analysis maintains a specific level of satisfaction for the inhabitants at different regions and income levels [26]. We can simply say that a higher level of infrastructure, as in large districts, than there will be a higher level of satisfaction for the inhabitants [36, 45]. Regional disparities, espacially infrastructural development conformed by [1]. Chi-square analysis also confirms variation in the Inhabitant’s Satisfaction regarding attributes of Infrastructure [35]. Chi-square results disclose that small Districts are associated with higher dissatisfaction of Infrastructure [5]. Similarly, findings reveal that there are significant relationships exist among the perceived level of infrastructure and regional & income groups [29]. Due to a lack of public Infrastructure in Small District, inhabitants found dissatisfied relative to other districts. The inhabitant who belongs to big districts is more satisfied because in big districts distribution of Infrastructure is more even than other districts. In context with the developing country, lower inequality in life satisfaction is closely associated with the even distribution of land cover/use [4]. Inhabitants belong to high-Income groups are more satisfied relative to the lower-income group; the finding is consistent with the study [37].

6 Conclusion and Recommendations

The present study is a sound addition to the literature, since the proposed issue was never sought before. Paper clearly describe discrimination between the region regarding social wellbeing by considering household satisfaction with the excellence of infrastructure. Additionally, paper pointed regions where investment potential is present therefor, government and private investment can be planned for these regions, where the citizens have low level satisfaction. Because low public infrastructure investments justify low quality of life [10]. Therefore, the study provides reason for public expenditure to the government for the welfare of the resident to preserve their quality of life. The paper invites government to describe its spending in the described areas where people are dissatisfied with the current situation of infrastructure.
Table 4. Multinomial logistic estimate for inhabitant’s satisfaction by Income group

| Predictor variable | Attributes of infrastructure |  |  |  |  |  |  |  |  |
|--------------------|-----------------------------|---|---|---|---|---|---|---|---|
|                   | Education                   | Health a | Sanitation a | Transportation a | Electricity a |
|                   | $\beta$                     | Exp($\beta$) | $\beta$               | Exp($\beta$) | $\beta$           | Exp($\beta$) | $\beta$   | Exp($\beta$) |
| Satisfied          | Intercept                   | 2.769*** | 2.709*** | 1.778*** | 3.176*** | 1.643*** |
|                    | No. of HH                   | -.147*** | .863     | -.264*** | .768     | -.099*** | .906     | -.297*** | .743     | -.132*** | .876     |
|                    | High- Income                | .476**   | 1.609    | .682*** | 1.977    | .694*** | 2.002    | .331*    | 1.392    | 1.267*** | 3.551    |
|                    | Low-Income                  | -1.438***| .237     | -1.716***| .180     | -.810*** | .445     | -1.567***| .209     | -1.153***| .316     |
|                    | Low-Mid-Income              | -.591*** | .554     | -1.176***| .308     | .077*    | 1.080    | -.277*   | .758     | -.571*** | .565     |
|                    | Mid-High- Income b          |         |          |          |          |          |          |          |          |          |          |
| Unsatisfied        | Intercept                   | -1.841***| -.552**  | -1.571***|          | -1.411*  |          | -1.525***|          |          |          |
|                    | No. of HH                   | .098*    | 1.103    | .005     | 1.005    | .120***  | 1.137    | .066**   | 1.068    | .131***  | 1.140    |
|                    | High- Income                | .959*    | 2.609    | .388*    | 1.474    | .282     | 1.326    | -.206    | .814     | .779**   | 2.179    |
|                    | Low-Income                  | 2.768*** | 15.921   | .929***  | 2.531    | .725***  | 2.065    | .661***  | 1.937    | .701***  | 2.015    |
|                    | Low-Mid-Income              | .257     | 1.293    | .486**   | 1.626    | .968***  | 2.632    | .411**   | 1.509    | .556***  | 1.743    |
|                    | Mid-High- Income b          |         |          |          |          |          |          |          |          |          |          |
| Pseudo R²          | Cox and Snell               | .374     | .246     | .119     | .230     |          |          |          |          |          |          |
|                    | Nagelkerke                  | .441     | .278     | .139     | .262     |          |          |          |          |          |          |

The reference category is: Neutral. 

$P < 0.1$ * $P < 0.05$ ** $P < 0.01$ *** 

This parameter is set to zero because it is redundant.
The satisfaction of the residents of both the regional and income groups regarding the excellence of this infrastructure is found to be significant. Chi-square analysis significantly discriminates against Upper-income groups associated with the big district, while low-income groups belong to the small district. Previous results show that there is a significant association between the attributes (Income and Region) and the level of satisfaction of the selected infrastructure Education, Health, Transport, Electricity and Water & Sanitation [37]. The conclusion is however that the big districts have the best quality of that infrastructure; that’s why most of the high-income inhabitants in this region belongs and is happy with the facilities available. In contrast, low-income people are associated significantly with the small district, where these infrastructures are not so developed therefore, the respondents are not happy. Likewise, medium-level districts have a connection with upper-middle and lower-middle income, since majority in the medium-sized districts are satisfied with the infrastructure.

In order to reduce domestic discrimination and increase competitiveness globally, governments should significantly increase investments in physical infrastructure. The policy of public works should be reviewed and the uniform infrastructure of the districts [7] should be develop to overcome such discrimination. Paper provide road map for the government may also introduce a proportional income-level tax strategy which is beneficial to the low-income community. The government is responsible for the establishment of all basic health, education, electricity, transport, communication, water and sanitation infrastructures, etc. The satisfaction of the people is linked momentarily to the Infrastructure. In order to overcome the deviation between districts and income groups, the employment and income raising project should start in the small District.

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**References**

1. Rana, I.A., Routray, J.K., Younas, Z.I.: Spatiotemporal dynamics of development inequalities in Lahore City Region, Pakistan. Cities 96, 2020 (2017). https://doi.org/10.1016/j.cities.2019.102418
2. Ersoy, A., Alberto, K.C.: Understanding urban infrastructure via big data: the case of Belo Horizonte case of Belo Horizonte. Reg. Stud. Reg. Sci. 6(1), 374–379 (2019). https://doi.org/10.1080/21681376.2019.1623068
3. Zhao, P., Li, P.: Travel satisfaction inequality and the role of the urban metro system. Transp. Policy (2019). https://doi.org/10.1016/j.tranpol.2019.04.014
4. Olsen, J.R., Nicholls, N., Mitchell, R.: Are urban landscapes associated with reported life satisfaction and inequalities in life satisfaction at the city level? A cross-sectional study of 66 European cities. Soc. Sci. Med. 226(7), 263–274 (2019). https://doi.org/10.1016/j.socscimed.2019.03.009
5. Chen, C., Id, Y.A., Wang, Y., Li, J.: Performance appraisal method for rural infrastructure construction based on public satisfaction. PLoS ONE 13(10), 1–18 (2018). https://doi.org/10.1371/journal.pone.0204563

6. Ali, L., Mi, J., Shah, M., Bli, K.: Local residents’ attitude towards road and transport infrastructure (a case of Pakistan economic corridor). J. Chinese Econ. Foreign Trade Stud. 11(1), 104–120 (2018). https://doi.org/10.1108/JCEFTS-08-2017-0024

7. Fareed, F., Mohey-ud-din, G., Paras, I.: Infrastructure development in Punjab, Pakistan: from assessment to spatiotemporal analysis at district level. J. Quant. Methods, vol. 2, no. 2, pp. 75–103 (2018). https://doi.org/10.29145/2018/jqm/020206

8. Clifton, J., Díaz-fuentes, D., Gutiérrez, M.F.: Evaluating public infrastructure services from the citizen perspective: are disadvantaged citizens being left behind? In: Dialnet (2017)

9. Christ, O., Czarnecki, M., Kressig, C., Scherer, L.: Satisfaction benchmark for smart cities. In: Brdulak, A., Brdulak, H. (eds.) Happy City - How to Plan and Create the Best Livable Area for the People. E, pp. 71–102. Springer, Cham (2017). https://doi.org/10.1007/978-3-319-49899-7_5

10. Pazhuhan, M., Shahraki, S.Z., Kaveerad, N., Cividino, S., Clemente, M., Salvati, L.: Factors underlying life quality in urban contexts : evidence from an industrial city (Arak, Iran). In: Sustainability, vol. 12, no. 2274, pp. 1–16 (2020). https://doi.org/10.3390/su12062274

11. Goletsis, Y., Chletos, M.: Measurement of development and regional disparities in Greek periphery: a multivariate approach. Soc. Econ. Plann. Sci. 45(4), 174–183 (2011). https://doi.org/10.1016/j.seps.2011.06.002

12. Ali, H., Abbas, M.H., Gill, U.: Doctrine values and economic advancement: a review of recent studies. J. Account. Appl. Bus. Res. 1(2), 1–9 (2018)

13. Public Service| Definition of Public Service by Merriam-Webster. https://www.merriam-webster.com/dictionary/publicservice

14. Fox, W.F.: Strategic Options for Urban Infrastructure Management. Urban Manage Program. Pap. 17, World Bank. (1994). https://doi.org/10.1596/0-8213-2826-3

15. Loyaza, N., Wada, T.: Public Infrastructure Trends and Gaps in Pakistan, World Bank Policy Series Pakistan, PK 10/12, p. 46 (2012)

16. Zhang, F., Zhang, C., Hudson, J.: Housing conditions and life satisfaction in urban China, Cities, pp. 1–10 (2018). https://doi.org/10.1016/j.cities.2018.03.012

17. Modarres, A., Dierwecchter, Y.: Infrastructure and the shaping of American urban geography. Cities 47, 81–94 (2015). https://doi.org/10.1016/j.cities.2015.04.003

18. Chandra, A., Thompson, E.: Does public infrastructure affect economic activity? Evidence from the rural interstate highway system. Reg. Sci. Urban Econ. 30, 457–490 (2000)

19. Amos, J.M., Hitt, M.A., Warner, L.: Life satisfaction and regional development: a case study of Oklahoma. Soc. Indic. Res. 11, 319–331 (1982). https://doi.org/10.1007/BF00351840

20. Ghaus, A.F.A., Pasha, H.A., Ghaus, R.: Social development ranking of districts of Pakistan. Pak. Dev. Rev., vol. 35, no. 4 PART 2, pp. 593–614 (1996). https://doi.org/10.30541/v35i4ipp.593-614

21. Attari, M., Pervaiz, D., Jan, D.: Temporal and spatial variations in human development across the districts of Punjab, Pakistan. FWU J. Soc. Sci. 11(2), 1–13 (2017)

22. Kamil, M.: The global competitiveness index, The Global Competitiveness Index (2017). http://www3.weforum.org/docs/GCR2017-2018/03CountryProfiles/Standalone2-pagerprof iles/WEF_GCI_2017_2018_Profile_Pakistan.pdf

23. Ozat, N., Saner, T., Sen, Z.S.: Customer satisfaction in the banking sector: the case of North Cyprus. Procedia Econ. Financ. 39, 870–878 (2016). https://doi.org/10.1016/s2212-5671(16)30247-7

24. Besciu, C.D.: Patient Satisfaction in the Hospital’s Emergency Units in Bucharest. Procedia Econ. Financ. 32, 870–877 (2015). https://doi.org/10.1016/s2212-5671(15)01534-8
25. Aljamal, S.S.: The practice of transformational management and its role in achieving institutional excellence from the point of view of workers in the directorates of education in Hebron. Int. J. Bus. Ethics Gov. 1(1), 64–90 (2018)

26. Huang, Z., Du, X.: Assessment and determinants of residential satisfaction with public housing in Hangzhou, China. Habitat Int. 47, 218–230 (2015). https://doi.org/10.1016/j.habitatint.2015.01.025

27. Badacho, A.S., Tushune, K., Ejigu, Y., Berheto, T.M.: Household satisfaction with a community-based health insurance scheme in Ethiopia. BMC Res. Notes 9(1), 1–10 (2016). https://doi.org/10.1186/s13104-016-2226-9

28. Vogt, R.J., Allen, J.C., Cordes, S.: Relationship between community satisfaction and migration intentions of rural nebraskans. Cent. Appl. Rural Innov. 3(1), 1–18 (2003)

29. Adedayo, A., Sulyman, A.O.: Assessment of rural dwellers satisfaction with quality of infrastructure in rural settlements of niger state, Nigeria. Res. Humant. Soc. Sci. 5(13), 78–86 (2015)

30. Clifton, J., Díaz-fuentes, D., Fernández-gutiérrez, M.: Public Infrastructure Services in the European Union : Challenges for Territorial Cohesion, Reg. Stud. Assoc. (2015). http://dx.doi.org/10.1080/03434304.2015.1044958

31. Pittau, M.G., Zelli, R., Gelman, A.: Economic disparities and life satisfaction in european regions. Soc. Indic. Res. 96, 339–361 (2010). https://doi.org/10.1007/s11205-009-9481-2

32. Jacobson, C.D., Tarr, J.A.: Ownership and financing of Infrastructure: Historical Perspectives, Policy Research on Washington DC, 1466 (1995)

33. Bomhoff, E.J., Siah, A.K.L.: The relationship between income, religiosity and health: their effects on life satisfaction. Pers. Individ. Dif. 144(11), 168–173 (2019). https://doi.org/10.1016/j.paid.2019.03.008

34. Khan, M.A., Rehman, H.U.: Regional disparities in human capital: the case of Pakistan. Pak. Econ. Soc. Rev. 50(1), 57–69 (2012)

35. Olayiwola, L.M.: Spatial dimensions of quality attributes of rural housing infrastructures in the ife region of nigeria. An Int. J. 6(1), 132–145 (1998). https://doi.org/10.4314/ifep.v6i1.23523

36. Ranjan Rout, N., Babu Bhagat, R.: City dwellers’ perception of urban environment in Bhubaneswar, India and its correlates, Built - Environ. - Sri Lanka, vol. 11, no. 01, pp. 7–13 (2012)

37. Moller, V.: Household satisfaction: past, present and future perspectives. Dev. South. Afr. 13(2), 237–254 (1996). https://doi.org/10.1080/03768359608439891

38. Molnar, J.J., Purohit, S., Clonts, H.A., Lee, V.W.: A longitudinal analysis of satisfaction with selected community services in a nonmetropolitan area. Rural Soc. 44(2), 401–419 (1979)

39. Ogunbajo, R.A., Bello, M.O., Adebayo, M.A.: Assessment of Urban Infrastructure Quality and User Satisfaction in Low Income Residential Neighbourhoods (2016)

40. Ogunbajo, R.A., Bello, M. O., Adebayo, M.A.: Assessment of urban infrastructure quality and user satisfaction in low assessment of urban infrastructure quality and user satisfaction in low income residential neighbourhoods in. J. Environ. Technol., vol. 9, no. 1, pp. 98–115 (2016)

41. Nadeem, N., Mushtaq, K., Javed, M.I.: Impact of social and physical infrastructure on agricultural productivity in Punjab, Pakistan-A Production Function Approach. Pakistan J. Life Sci. Soc. Sci. 9(2), 1–6 (2011)

42. Muhammad Iqbal Sarwar, M.M., Chodhrury, M.A.T.: Quality of urban neighborhood environment: a case study of resident’s perception in Chittagong City, Bangladesh. Academic Journals Inc. pp. 248–258 (2006)

43. Bogoro, P., Maimako, S.S., Kurfi, A.K.: Assessing the role of infrastructure on customer satisfaction. Int. J. Sci. Eng. Res. 4(10), 826–843 (2013)
44. Chi, C.G., Qu, H.: Examining the structural relationships of destination image, tourist satisfaction and destination loyalty: an integrated approach. Tour. Manag. 29, 624–636 (2008). https://doi.org/10.1016/j.tourman.2007.06.007
45. Mohit, M.A., Azim, M.: Assessment of residential satisfaction with public housing in hulhumale’, Maldives. Procedia - Soc. Behav. Sci. 50, 756–770 (2012). https://doi.org/10.1016/j.sbspro.2012.08.078
46. Barrios, S., Strobl, E.: The dynamics of regional inequalities. Reg. Sci. Urban Econ. 39(5), 575–591 (2009). https://doi.org/10.1016/j.regsciurbeco.2009.03.008
47. Kanwal zahra, A.: Poverty and income inequality in urban punjab : a case study of five large cities of punjab (pakistan). Int. J. Econ. Issues, 4(2), 267–277 (2011)
48. Hassan, M., Long, L.W.: Household income and income inequality analysis: a comparative study among cities of Punjab Pakistan. Int. J. Innov. Res. Educ. Sci. 4(2), 174–184 (2017)
49. Subohi, A.: Defining income group (2006). https://www.dawn.com/news/219652
50. Iqbal, S., Zhang, C., Arif, M., Hassan, M., Ahmad, S.: A new fuzzy time series forecasting method based on clustering and weighted average approach. J. Intell. Fuzzy Syst. 38(5), 6089–6098 (2020). https://doi.org/10.3233/jifs-179693
51. Djebarni, R., Al-abed, A.: Satisfaction level with neighbourhoods in low-income public housing in Yemen. Prop. Manag. 18(4), 230–242 (2005). https://doi.org/10.1108/02637470010348744
52. Veenhoven, R.: How satisfying is rural life? Fact and value. Chang. values attitudes Fam. households, Implic. institutional Transit. East West, no. 296, pp. 41–51 (1994)