Social equity & social exclusion in public transport networks: Case study of the physical coverage of Batna's public transport

Houssem MOUFFOUK [1], Farès BOUBAKOUR [2,] Salah KORICHI[3]

[1,3]Institute of Technology, Kasdi Merbah University, Ouargla
[2] Ecole des Hautes Etudes Commerciales

Received:01/10/2019 ; **Revised:** 06/10/2019 ; **Accepted:** 24/11/2019

Summary: The current paper represents a part of the obtained results of a wider project financed by "CREAD". It deals with the problematic of social equity/exclusion in public transport networks using the physical coverage as an indicator to measure it. The case study was conducted in the Wilaya of Batna where 476 questionnaires have been distributed in 31 provinces that have been selected randomly.
Researchers have tried to build a social equity/exclusion map of the Wilaya of Batna, by converting the digital outputs into graphical representations using a geographical information system (QGIS). The map has shown that many provinces are suffering from a weak physical coverage of the public transport network mainly in Ein Djasser, Boumia, Djerma, Tilatou and Tigherghar.

Keywords: social equity, social exclusion, physical coverage, public transport, Batna.
Jel Classification Codes:D63, R40. R41.

I- Introduction:

The importance that the transport sector plays in contemporary life makes it a vital sector for the development of nations, and it is obvious that the challenges of this sector increases with the expansion of the covered spaces.

Providing an efficient and equitable transport system is considered one of the most important requirements for the integration of all segments of society in the daily life, but this process is not easy due to the unique characteristics of the transport market in Algeria[1].

The responsible authorities of this sector are facing many problems that can be summarized in two main categories; the first one is the necessity to put a transport scheme that covers all areas within the Wilaya* and the second one regarding the management of artisanal actors.

The Wilaya of Batna is considered one of the largest population centers in Algeria, therefore the local authorities are facing challenges that are not easy to conquer in terms of providing an effective and equitable public transport systems to all segments of society[2].

This research paper is addressing the problematic of social equity in the mobility of individuals using public transport means, where it will measure the reality of spatial coverage of public transport network in the Wilaya of Batna.

The case study has been conducted by interrogating 476 individuals in 31 provinces. Researchers moved from one municipality to another making an observation while investigating the interviewees in order to answer the question of whether the Wilaya of Batna is being covered physically by public transport means or not?

The main hypothesis of this study is that the physical coverage of the public transport network of Batna is weak and it does not cover all the populated areas of the Wilaya.

I.1.A brief literature review on equity/exclusion in public transport networks.

This part consists of some studies that addressed the indicators used in this research paper. However, before delving into these indicators we must understand the essence of social equity in public transport networks, or in other words, what is social exclusion in transport networks?

* Corresponding author:mouffouk.houssem@univ-ouargla.dz

The reason of mentioning equity and exclusion together, from one side, is that some researchers consider the involuntarily social exclusion of an individual as the result of lack of justice in the community[3]. Hence, this paper deals only with the involuntarily social exclusion. On the other side, the Center for Economic and Social Exclusion in UK defined social inclusion -as a process that generates social justice- as follows:

"*Social inclusion is, therefore, generally recognised as the process by which social exclusion is ameliorated, as particular individuals, social groups or geographical areas are integrated into society and people have the opportunity to reach their potential*"[4]

Many researchers give credit of the appearance of the concept of social exclusion to the French secretary of state for social services René Lenoir[5], in 1974 where he pointed out that 10% of the French population are excluded, and he restricted the excluded individuals in the following categories:

"*mentally and physically handicapped, suicidal people, aged invalids, abused children, substance abusers, delinquents, single parents, multi-problem households, marginal, asocial persons, and other social 'misfits'.*"[6]

The concept of social exclusion does not lack definitions, contrary there are many definitions addressing the social exclusion each according to the dimension or the viewpoint chosen. Below are the two most used definitions in the literature of social exclusion in public transport:

"An individual is socially excluded if (a) he or she is geographically resident in a society, (b) he or she cannot participate in the normal activities of citizens in that society, and (c) he or she would like to so participate, but is prevented from doing so by factors beyond his or her control" [7]

"A situation in which certain members of a society are separated from much that comprises the normal 'round' of living and working within that society."[8]

From the above definitions, individuals have the will to participate in the daily activities but, because of some barriers beyond their control, they cannot do so. Their mobility is being restrained by the lack of accessibility to the public transport means.

1.2 The spatial coverage of the public transport networks.

The spatial (physical) coverage of the public transport systems is considered to be the most important problematic that can face public transport users, because all other criteria depend on this latter (like temporal coverage, safety and security inside transport means or any other criteria).

The problematic of spatial coverage in public transport networks is characterized to be perceived differently from one individual to another; some consider 400 meters very acceptable as a distance between their places of residence and the nearest bus station whereas others consider it very unacceptable.[9]

In 2003, Witten and her colleagues gave standards to set the distance between the individual and the various services starting from the bus stations down to hospitals:

- "Bus stop = 500 metres;
- Park = 750 metres;
- GP Surgery and Church = 1,000 metres;
- Bank = 1,500 metres;
- Fruit and vegetable shops and supermarkets = 2,000 metres;
- Community centres and social services = 3,000 metres;
- Hospitals and accident and emergency clinics = 5,000 metres."[10]

In the same context, Merseytravel made a set of indicators to measure social sustainability of the transport systems in the area of Merseyside in England:

- "Proportion of households within 400 m of a bus stop;
- Proportion of households within 800 m of a rail station;

- Proportion of major facilities/services within 400 m of a bus stop or 800 m of a rail station (Facilities include hospitals, retail parks, multiplex cinemas, city parks, recreation areas and major centres of employment.);
- Proportion of rail stations which are fully accessible to wheel chair users;
- Proportion of buses which are fully accessible to less able members of Society" [11]

The two above models indicate that there are attempts to set indicators for the spatial coverage of the public transport networks. Having said that, these standards remain relative because the physical abilities of individuals and the geographical features vary from one person/region to another, hence it has a significant impact on these indicators.

II– Methods and Materials:

Wilaya of Batna consists of 1.2 million individuals living in 61 municipalities12; therefore, it is very difficult to conduct the study on all individuals and regions inside the Wilaya.

The study was based on a random selection of individuals and regions; 31 regions out of 61 have been selected randomly to conduct the study on (see appendix 01). Considering the minimal accepted size of population, a formula was used as follows[13]:

$$n = \frac{x^2 \times N \times K(1-K)}{[\delta^2(N-1)+x^2 \times K(1-K)]}$$

n= the minimal accepted size of population
N= population size.
X2= the table value of chi-square for 1 degree of freedom at the desired confidence level 95%. Kai calculated this item to be (3.841)
δ= the degree of accuracy expressed as a proportion (0.50)
K= The population proportion (assumed to be 0.50 since this would provide the maximum sample size.)

By applying the previous formula, the minimal accepted size of the population is to be 384 individuals; however, to increase the degree of accuracy, the study was based on distributing 480 questionnaires where only 476 were eligible to be used in the analysis.

Regarding the number of questionnaires to be distributed in each region, researchers used the size of each region to deduce the exact number (fourth proportional rule).

The study used the questionnaire as a tool to collect data regarding the reality of spatial coverage of public transport network in the Wilaya of Batna. The questionnaire contained questions built using Likert scale, appendix 02 illustrates the ranges.

III- Results and discussion:

This part of the study will be dedicated, firstly, to demonstrate the obtained results then an analysis and discussion of these lasts will be developed.

A. Results:

This item will list the results obtained from the analysis of the 476 questionnaires. However, before doing so, a description of the main characteristics of the sample study has to be made:

- **Gender**: the biggest proportion of the sample study consists of males 76.5% (346 individuals), compared to 23.5% females (112 individuals);
- **Age:** 81.1% of the sample study are between 18 and 36 years old, 14.5% are between 37 and 54 years old, 2.3% individuals are less than 18 years old and 2.2% are more than 54 years old;
- **Educational level:** Almost half of the sample study (234 individuals which consists 49.2%) have university level, 26.1% have high school level or less, 22.1% have higher education level and only 2.7% have never been to school before;
- **Occupation:** students and employees are the main segment of the sample study (136 students and 198 employees, which consists 70.2% of the sample study), the rest are

divided into 11.6% unemployed, 8.4% are traders, 4.8% working on handicrafts, 4.4% are retired and 0.6% are farmers;

- **Income per month:** 47.5% of the sample study have less than 18000 DZD as income per month, 29.2% own between 18000 and 36000 DZD, 17.4% own between 36001 and 54000 DZD, 2.9% own between 54001 and 72000 DZD and 2.9% own more than 72000 DZD;
- **Family status:** 68.5% of the sample study are single, 31.1% are married and only 0.4% are divorced;
- **Car ownership:** 75% of the sample study do not own a car whereas 25% own a car.

After describing the main characteristics of the sample study, results of the survey will be presented according to each question.

1. Daily used means of transport: this question investigates how individuals are moving in the Wilaya of Batna. The results (see appendix 03), based on mean, show that the most used means of transport is walking (3.68) then bus (3.12) then private car (2.67) then taxi (2.39) and the less used means of transport is interurban taxis (2.09).

2. Distance between public transport stations and places of living: In this section, we measure how much people are forced to walk in order to get into the closest public transport station. Three types of questions have been asked; the first one is a direct question where we ask them to provide the actual exact distance linking them to the closest public transport stations in meters. The second one is by letting them judge this distance using *Likert scale* from (very close to very far) and the last question is about the distance that people are seeing it acceptable to walk.

Appendix 04illustrates a comparison between the actual distance & the accepted distance between places of living and the closest public transport stations. What can be noticed from it is that the "actual distance" and the "acceptable distance" are far from being equal. However, if we want to get a closer look on the impressions of individuals regarding the actual distance and link each impression with the relative distance expressed in meters, a further analysis needs to be established (seeappendix 05).

Basing on the results of the appendix 05, it is clear that the impression of individuals on the actual distance linking them to the closest public transport station is "close". We can notice as well that the mean of the actual distance for each impression increases as the impression gets more negative (from 121.67m in very close to 2004.17m in very far).

It has to be mentioned that some people expressed walking almost 10km from their homes to reach the closest public transport station (as for individuals living in villages of Oughanim and Ammatan in Tigharghar district.)

3. Distance between public transport stations and places of work/study: questions in this item are the same as the previous one but it deals with the distance between the closest public transport stations and places of work/study instead of places of living.

Appendix 06 shows a comparison between the actual distance & the accepted distance between places of work/study and the closest public transport stations, and it can be noticed that the two distances are far from being equal, and bigger than the distance between places of living and the closest public transport stations (people have to walk more when they get off public transport means than when they want to get in them).

As in the previous item, a further analysis is need in order to get a closer look on the impressions of individuals regarding the actual distance and link each impression with the relative distance expressed in meters (see appendix 07).

Basing on the results of appendix 07, it is clear that the impression of individuals on the actual distance linking them to the closest public transport station is "**acceptable**". We can notice as well that the mean of the actual distance for each impression increases as the impression gets more negative (from 209.10m in very close to 1843.08m in very far).

In order to get a wider image on the previous two items (B and C), a comparison between the mean of the relative distance/impression for the actual distance between home/work/place of study and the closest public transport station with the accepted distance has been made (see appendix 08).

Basing on appendix 08,it is clear that the distance is getting bigger when we move from a positive impression to a negative one.

Talking about the accepted distance individuals are willing to walk, we note 299.09m in the impression "**accepted**" but for the impression "**far**", the distance decreases to 255.31m; it is

supposed that the distance increases when the impression is more negative but in this example it does not. The only analysis that can explain this decrease is that the distance is a "relative item" that can be perceived differently from an individual to another.

4. Number of public transport means used in one trip: In this item, we will investigate how many public transport means are used in one trip (see appendix 08).

It can be noted that only 44.1% of the total trips are made by a direct line. For the other trips, individuals have to change the means they use (at least one time) to reach their destination. 20.2% use two different means of transport, 26.9% use three different means of transport, 6.1% use four different means of transport and 2.7% use more than 4 means of transport to reach their destination. The more an individual has to take different means of public transport stations, the more he consumes time while commuting.

5. Sufficiency of public transport means: This item investigates whether public transport means are sufficient in numbers to meet daily movements of individuals in Batna (see appendix 09).

Basing on the results of appendix 09, the sufficiency of public transport means is "acceptable" and the concentration of answers is in the range "not sufficient, acceptable and sufficient" with a higher score in "acceptable."

B. Analysis of the obtained results:

The previous part has been dedicated to only the results. Hence, this part is about analyzing the obtained results in order to understand the reality of physical coverage of the public transport network in the wilaya of Batna.

- The main used mode of transport by our study sample is walking, which is very adequate for our study because every trip starts and ends with walking. Moreover, it will be easy to measure the impressions people are giving about the distance to the closest public transport stations;
- Regarding the distance people have to walk every day in order to reach the closest public transport station, we notice that there is a big difference between the actual distance (for both home tostations and work/study tostations) and the accepted distance; Hence, individuals are not satisfied about the distance they have to walk every day;
- Furthermore, if we analyze the actual distance in each district, we can notice that only "Djerma, Boumia and Ein Djasser" are excluded, but if we use the model of "*Wittenet al"* the number of excluded districts will increase (see appendix 10). A geographical information system software (QGIS) has been used to convert the provided data regarding distances to the closest public transport stations into graphical interpretation.
- Almost half of the trips of our sample study are made by one means of public transport, whereas the rest have to make intermediate stops in order to get to their destinations. This criterion cannot be efficient to measure social equity regarding the physical coverage because Batna is very large in size and it is quite impossible to guarantee all trips with one public transport means;
- Regarding the sufficiency of public transport means, it was found that public transport means do not lack in numbers. However, with an in-depth analysis, some provinces are excluded (Tilatou, Ein Djasser, Djerma, Tigherghar) and for others they lack public transport means during weekends and during the first and the last day of the week (Sunday and Thursday).

To conclude this paper, an attempt to create a social exclusion map of public transport services in Batna using the following criteria:

- Impressions on the closest public transport stations from places of living;
- Impression on the closest public transport stations from places of work/study;
- Sufficiency of public transport means.

Basing on the answers of our sample study, we used QGIS to interpret the aforementioned criteria into a graphical output. (See appendix 11). a classification of the social equity/exclusion inside the municipalities has been made. The classification was based on the *Likert scale* analysis and the three levels (not excluded, acceptable situation, excluded) are as follows:

1. **Level one**: it includes all the provinces that are not excluded (Menaa, Ouled Fadhel, Batna, Fesdis, Seriana and Boumegar);

2. **Level two:** it includes all the provinces that are in an accepted status (Ein Yagout, Boulhilet, Chemora, Timgad, Oued Taga, Tazoult, Theniet El Abed, Chir, El Maader, Oued Chaaba, Ein Touta, Seganna, Barika, El Djezzar, N'gaous, Ras El Aioun, Guigba, Errahbat, Talkhempt and Merouana);
3. **Level three:** it includes all the provinces that have been catergorized to be excluded or very excluded (Ein Djasser, Boumia, Djerma, Tilato and Tigherghar).

IV-Conclusion:

The transport sector has its weight that forces governments to enhance its efficiency. This paper was an attempt to measure the efficiency of the public transport network inside the Wilaya of Batna regarding its physical coverage.

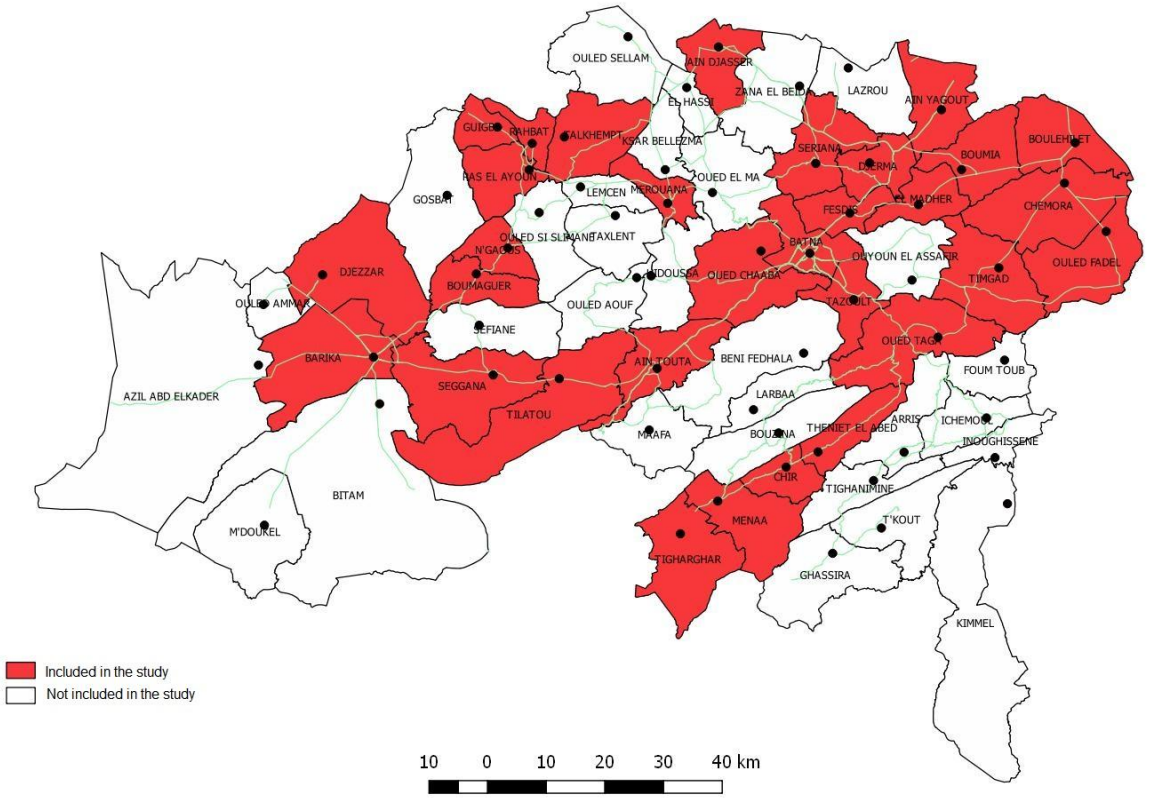
Fighting social exclusion in public transport networks is a tool to promote social inclusion that leads, ultimately, to more efficiency. Several criteria have been used to measure social equity in the public transport network in the wilaya of Batna, mainly, how far public transport stations are located from places of living, work or study, sufficiency of public transport means during days of the week and the number of trips that are made without the need to make intermediate stops.

The questionnaire was used as a tool to collect data, and direct interrogation with interviewees has helped to get responses that are more accurate for the analysis.

Finally, the researchers have tried to create a map of social exclusion in Batna's public transport network from the physical coverage viewpoint. A geographical Information System software (GIS) has been used to convert digital results to graphical interpretations. The map has showed that many provinces are suffering from a weak physical coverage of the public transport network mainly in Ein Djasser, Boumia, Djerma, Tilatou and Tigherghar. Hence, in order to enhance the efficiency of Batna's public transport, local authorities have to ameliorate the physical coverage starting from the previous mentioned provinces.

- Appendices:

Appendix (01): provinces that are included in the case study.



Source: Based on the results of the study using QGIS software.

Appendix (02): ranges of the used Likert scale

The length of the range	Significance
From 1 to 1.8	Never, very close, not sufficient at all, not excluded at all
From 1.81 to 2.6	Rarely, close, not sufficient, not excluded
From 2.61 to 3.4	Sometimes, acceptable
From 3.41 to 4.2	Usually, far, sufficient, excluded
From 4.21 to 5	Always, very far, very sufficient, very excluded

Source: made by the authors.

Appendix (03): daily used means of transport

	Never		Rarely		Sometimes		Usually		Always		Mean
	frequency	Percentage	frequency	Percentage	frequency	Percentage	frequency	Percentage	frequency	Percentage	
Private car	164	34.5	81	17	74	15.5	60	12.6	97	20.4	2.67
Bus	85	17.9	81	17	94	19.7	120	25.2	96	20.2	3.12
Taxis	89	18.7	193	40.5	132	27.7	41	8.6	21	4.4	2.39
Interurban taxis	224	47.1	93	19.5	81	17	44	9.2	34	7.1	2.09
Walking	34	7.1	45	9.5	128	26.9	99	20.8	170	35.7	3.68

Source: based on the results of the questionnaire using SPSS.

Appendix (04): comparison between the actual & the accepted distance between places of living and the closest public transport stations.

	Actual distance	**Accepted distance**
Distance	638.66 m	256.21 m

Source: based on questionnaire's results of analysis using SPSS.

Appendix (05): Impressions of individuals about the actual distance linking them to the closest public transport station from their places of living.

Impression	**Mean of the impressions**	**Mean of the actual distance for each impression (in meters)**
Very close	2.49	121.67
Close		354.12
Accepted		660.33
Far		1549.91
Very far		2004.17

Source: based on the results of the questionnaire using SPSS.

Appendix (06): comparison between the actual & the accepted distance between places of work/study and the closest public transport stations.

	Actual distance	**Accepted distance**
Distance	782.16 m	256.21 m

Source: based on the results of the questionnaire using SPSS.

Appendix (07): Impressions of individuals about the actual distance linking them to the closest public transport stations from places of work/study

Impression	**Mean of the impressions**	**Mean of the actual distance for each impression (in meters)**
Very close	2.80	209.10
Close		398.27
Accepted		593.97
Far		1629.07
Very far		1843.08

Source: based on the results of the questionnaire using SPSS.

Appendix (08): Number of public transport means used in one trip.

Number of used public transport means	Frequency	Percentage
1	210	44.1
2	96	20.2
3	128	26.9
4	29	6.1
More than 4	13	2.7
Total	**476**	**100**

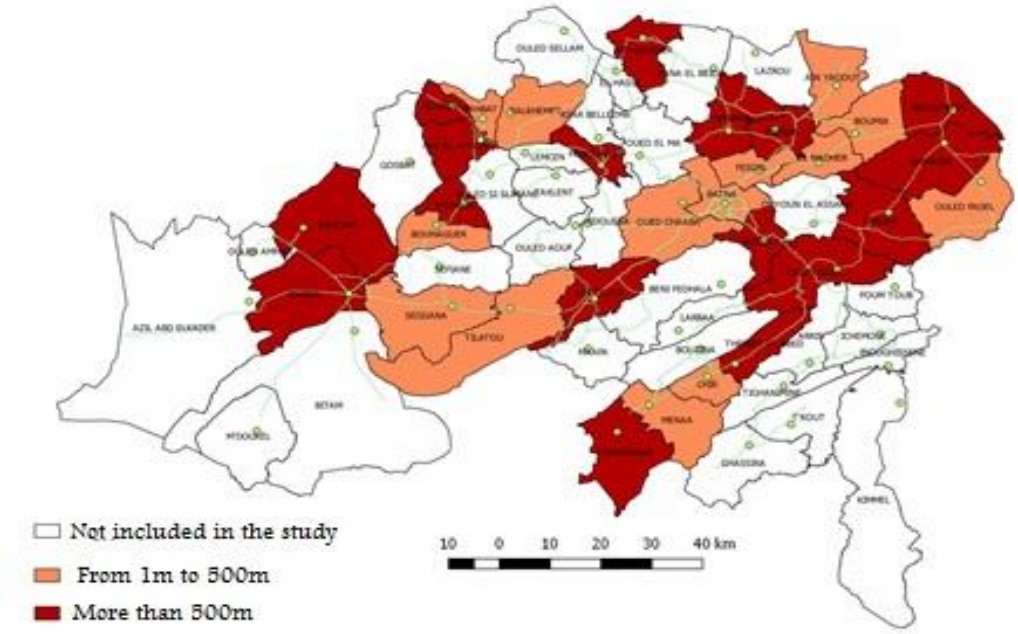
Source: based on the results of the questionnaire using SPSS.

Appendix (09): sufficiency of public transport means.

Sufficiency of public transport means	Frequency	Percentage	Mean
Not sufficient at all	61	12.8	
Not sufficient	110	23.1	
Acceptable	182	38.2	2.83
Sufficient	90	18.9	
Very sufficient	33	6.9	
Total	**476**	**100**	**/**

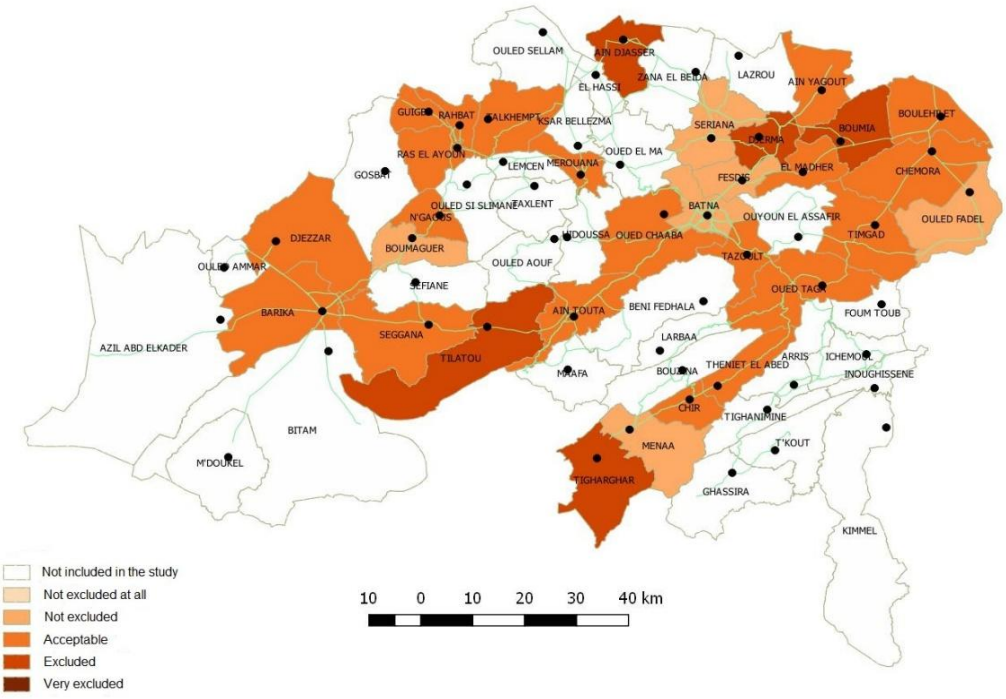
Source: based on the results of the questionnaire using SPSS.

Appendix (10): physical exclusion of areas based on *Witten et al* model.



Source: Based on the results of the study using QGIS software.

Appendix (11): Map of social exclusion in Batna's public transport network from the physical coverage viewpoint.



Source: Based on the results of the study using QGIS software.

References:

1 Houssem MOUFFOUK. (2016). Equity and the struggle against social exclusion in urban transport: on certain aspects in the city of batna (Algeria). Algeria: El-Tawassol. 22 (2), p :317.

* Wilaya is a name given to a district (also called a state) that contains smaller sub-regions called « Dairas » and these lasts are, as well, divided into smaller districts called « provinces».

2 Houssem MOUFFOUK &Farès BOUBAKOU. (2017). Algeria: The Social Dimension of Sustainable Transport: Investigating the Accessibility of Batna's Residents to Public Transport Systems.Strategy and Development Review 7 (13), p :20.

3B. Barry. Social exclusion, social isolation and the distribution of income. Center for analysis of social exclusion. London school of economics. 1998. p: 06.

4 Center for economic and social exclusion. London. UK. Quoted in: Wixey et al.Measuring accessibility as experienced by different socially disadvantaged groups. Working paper 1: User needs Literature review. Transport studies group. University of Westminster. 2005. p: 16.

5 J. Preston & F. Rajé. Accessibility, mobility and transport-related social exclusion. Journal of transport geography 15. 2007, p: 151-160; Dirk-Jan Omtzigt. Survey on social inclusion: theory and policy. Oxford institute for global economic development. 2009, p: 01; A. Sen. Social exclusion: concept, application and scrutiny. Office of environment and social development, Asian development Bank.2000, p: 01.

6R. Lenoir. Les exclus : un français sur dix. Paris: Editions du Seuil. 1989. Quoted in: A. Sen, Op cit. p: 01.

7Julian Le Grand. Individual choice and social exclusion. Center of analysis of social exclusion, London school of economics. 2003, p: 02.

8 C. Philo. 'Social Exclusion' in R. Johnston et al The Dictionary of Human Geography. Blackwell, Oxford. 2000. p: 691.

9 Hernández, D. (2017). Public transport, well-being and inequality: coverage and affordability in the city of Montevideo. CEPAL Review, 122, p: 153.

10 K. Witten. D. Exeter and A. Field. The Quality of Urban Environments: Mapping Variation in Access to Community Resources. Urban Studies, Vol.40, No.1, pp. 161-178. In Wixey et al, Op cit. p: 57.

11 Merseytravel, Community Links Strategy, Merseytravel, Liverpool. 1998. in A. Church, M. Frost and K. Sullivan. Transport and social exclusion in London. Transport Policy 7. 2000. p: 201.

12DPSB. Monorgaphie Batna année 2014. p: 36.

13V. R. Krejcie& D.W. Morgan. Determining sample size for research activities, Educational &PsychologicalMeasurement, 30 [3], 1970, p: 608.

How to cite this article by the APA method:

Houssem MOUFFOUK, Farès BOUBAKOUR ,Salah KORICHI, (2019), **Social equity & social exclusion in public transport networks, Algerian review of economic development**, Volume 06 (Number 02), Algeria: KasdiMarbah University Ouargla, pp. 355-365.