

Title

Public transportation performance in Al-Kourah District

العنوان

أداء وسائل النقل العام في منطقة لواء الكورة

This scientific research is attributed to:

Engineer SUHIB ALI ABUMASRAH

<https://jasps.com>**Abstract**

The performance of public transportation in the Koura District municipalities assesses the efficiency and quality of services provided to citizens, in terms of route coverage, schedule consistency, and the adequacy of supporting infrastructure, as well as the level of comfort and safety for users. This includes an analysis of challenges facing public transportation, such as poor maintenance, a small number of buses, and insufficient connectivity between villages and major centres, and the impact of these challenges on the economic and social mobility of the region's residents. It also highlights the role of municipalities in improving performance through integrated planning, strengthening partnerships with the private sector, and adopting smart transportation solutions that increase service efficiency and meet the needs of residents in a sustainable manner.

<https://jasps.com>

I. INTRODUCTION

Jordan is located in the Middle East. According to the 2022 population survey, the country has a population of 11 million, of which approximately 3 million are Syrian and Iraqi refugees, among others. Due to its geographical location, Jordan is considered as a major transport hub in the region. The contribution of the transport sector in the gross national product is about 10%. Thus, an efficient and effective transport system, including both passenger and goods transport, is crucial for sustainable and balanced socio-economic and environmental developments

Currently, Land Transport Regulatory Commission (LTRC), Ministry of Transport, is responsible for passengers and goods transport at the kingdom level. While the Directorate of Transport in Amman, the capital of Jordan, is only responsible for passenger transport within the city. The responsibility includes planning, development, implementation, and supervision of public transport strategies, policies and actions to improve the sector.

During the last few years, Jordanian cities experienced intolerable congestion levels. This congestion may cause by the lack of an acceptable passenger transit services, consequently, many private vehicle owners used their cars instead of public transit. This situation creates large pressure on the existing infrastructure, which required huge investment to ease this problem. In Jordan, passenger transport means include buses, min-buses and shared service taxis, which are working on fixed routes. Definitely, the use of more efficient modes such as rapid bus transit and light rail systems is necessary especially for large cities such as Amman, which has a population of 4 million. In fact, the use of an efficient transit system will attract more users and encourage private vehicle users to convert to the new system, and ultimately reduce congestion levels on street network. The objective of this study was to evaluate performance of the existing public transit services in Al-Kourah District. It is the largest district in Jordan in terms of population. In fact, performance indicators such as accessibility, mobility, productivity, punctuality, passenger waiting time, and comfort were investigated in the study.

<https://jaspps.com>

II. LITERATURE REVIEW

Raed al-tal et.al, 2023 in a pioneer study analyses the causes of traffic congestion in urban corridors. It specifically studies the intersected relationship between land-use and transportation planning by examining Al-Madina Al Monawara street in Amman, the capital of Jordan, as a case study. Techniques implemented in data collection are personal observations, traffic counts, land use maps and questionnaires. The methods applied in analysing the collected traffic counts are: Level of Service (LOS), Automatic Traffic Counters (ATC) and Trip Attraction Analysis (TAA). The outcome of the research verified the relationship between the high level of traffic, where the traffic exceeds the actual capacity of the street by 43%, and the unregulated land use planning where 85% of the existing buildings along the street are commercial. The findings of this research will help to establish an assessment tool for testing the impacts of transportation and land use in congested developing cities. This study is important since transportation solutions receive little attention by planner's development agendas in Jordan and the neighbouring countries.

In the context of developing multi-modal transit systems in major cities, transit station distribution is a crucial indication for implementing public transportation services. Maram alharbi and mohammad hassan, 2023 presented an optimization method for bus stop locations to improve the accessibility level and reduce the transportation cost and distance. The research assesses the existing geographic distribution of bus stop locations in Amman city the capital of Jordan, to evaluate transport accessibility, and to determine the optimal locations of bus stops from a set of candidate locations. The minimized impedance location-allocation model for transportation problems is used as a network analysis method to design a new distribution of bus stops; the current accessibility ratio of 34 stopping points covering 135 out of 300 facilities increased from 45% to 69% of the total facilities within the study area, covering 208 services of available facilities. Optimizing bus stop locations will lead to an increase in the use of public transportation systems versus private vehicles, which will improve the levels of service, reduce traffic congestion and lower air pollution.

In the absence of previous studies regarding individuals' everyday life, the significance of the study lies in the fact that it is the first of its kind in the whole region. More specifically, the transport sector, which is considered very vital due to the high population growth in the region, and the region's distance from Irbid governorate city center. Moreover, the citizens of

<https://jasps.com>

the region are in need to go back and forth the downtown for different purposes, such as shopping centres, universities, hospitals, and government departments. Since the researcher himself is a resident of the region, the citizens' suffering, in terms of moving through public transport routes, is real and continued.

III. METHODOLOGY AND DATA COLLECTION

In this study, data were collected from related sources and through field This research analyses the causes of traffic congestion in urban corridors. It specifically studies the intersected relationship between land-use and transportation planning by examining Al-Madina Al Monawara street in Amman, the capital of Jordan, as a case study. Techniques implemented in data collection are personal observations, traffic counts, land use maps and questionnaires. The methods applied in analysing the collected traffic counts are: Level of Service (LOS), Automatic Traffic Counters (ATC) and Trip Attraction Analysis (TAA). surveys. For each city, data on transit routes, fleet size on each route, fare level, route length, and maps were obtained from LTRC and municipalities. For each region, data on resident population densities in Al-Kourah District were also obtained. Table 1 illustrates the number of public transit vehicles Length of the Road Estimated Time Fare of the Rider Population and The population of each municipality.

Table 1. Number of transit vehicles the Road Estimated Time Fare of the Rider Population and The population of each municipality in the included villages

Road Name	Buses Number	Estimated Time	Length of the Road	Fare of the Rider	Population	passengers/Bus
Judita-irbed	9	45 minute	32 KM	0.65 jd	22484	22
Kofer Abel-irbed	5	45 minute	34 KM	0.65 jd	13726	22
Kufr 'Awan-irbed	6	45 minute	33 KM	0.65 jd	15457	22
Bit Ides-irbed	4	42 minute	30 KM	0.60 jd	9334	22

<https://jaspss.com>

Kufr Rakeb-irbed	5	39 minute	29 KM	0.60 jd	8515	22
Ashrafieh-irbed	5	37 minute	25 KM	0.57 jd	17365	22
Kafr Al-Maa-irbed	5	33 minute	24 KM	0.55 jd	21215	22
Abu al-agayn-irbed	1	41 minute	28 KM	0.57 jd	1309	22
Der Abi Said-irbed	11	30 minute	22 KM	0.50 jd	35033	22
Jufain-irbed	2	36 minute	26 KM	0.55 jd	6853	22
Tobneh-irbed	4	30 minute	24 KM	0.55 jd	11240	22
Jenin Safa-irbed	2	31 minute	24 KM	0.40 jd	7771	22
Zmal-irbed	2	25 minute	18 KM	0.37 jd	4727	22
Smmao-irbed	4	20 minute	16 KM	0.35 jd	13174	22
Kafr Kifia-irbed	1	23 minute	17 KM	0.40 jd	1193	22

Accessibility was measured using spatial analysis through Geographic Information System (GIS). Many studies used the GIS in transportation fields (Murray, Xiaolan 2003). Accessibility is defined as the percentage of population served by public transit. For each route, access was measured depending on time or distance to public transit route, terminals or stops (El-Geneidy et al. 2013). Several buffers; including 160, 240, 400, 600, and 1000 meters from the transit routes in each side; were identified, and these distances are correspondence to levels of service of A, B, C, D, and E, respectively (Jason 1982). Using population density in each region, accessibility was computed based on the percentage of resident population within a given selected buffer area to the total village population.

<https://jaspss.com>

Mobility was measured using the average travel speed of public transit for each route. In fact, average speeds of public transit may be affected by vehicle type, traffic level, type and length of route, and the number of stops during the trip. As such, travel speed was measured during peak and offpeak hours.

The operating ratio of public transit and daily passengers carried by each transit vehicle were used for estimating productivity of public transit. In reality, the productivity is considered as a combined measure of the efficiency and effectiveness of transit performance. The operating ratio was computed for each route as the ratio of yearly revenue to the yearly operating cost. Fuel, oil, maintenance, salaries and overhead, licensing, tires, depreciation, taxes, and insurance costs were included in estimating the yearly operating costs. These cost elements were obtained from transit operators, drivers, among other sources. The LTRC regulations stipulated that operation life of buses, mini-buses and taxis are 20, 15, and 12 years, respectively. Thus, these values were considered in estimating depreciation rates. Furthermore, number of passengers carried by each transit vehicle and number of daily trips were also observed.

Field surveys were carried out to collect data on waiting time of passengers at terminals or stations. The average waiting time for public transit were used to measure the delay time of passengers in waiting for transit vehicle inside the terminals. In computing waiting time, it was assumed that arrival of passengers to the terminal is uniform (Govender 2014). The waiting time was measured during peak and off-peak hours.

The departure and arrival times of public transit were used to determine the punctuality. Punctuality is measured depending on the actual arrival time and the scheduled arrival time (Patel, Gor 2014). However, field observations indicated that both departure and arrival were not scheduled. Thus, to enhance transit operation in Jordan and attract more users, the transit operation should be scheduled

Also, questionnaires were distributed to obtain data on users' response about comfort of transit. Comfort included cleanliness of seats, windows, and floors, as well as availability of air condition (Eboli, Mazzulla 2011). The field surveys were conducted for each transit route on Saturday, as a holyday in Jordan, and two other working days. It is worth mentioning that data were obtained for 10 vehicles on each route served by more than 10 vehicles. In contrast,

<https://jasps.com>

the data were collected on all vehicles for a route served by less than 10 vehicles. This field study was performed from February.,2023 to May., 2023.

IV. DATA ANALYSIS AND RESULTS

3.1 Accessibility

Figure 1 shows accessibility of public service to users' in Al-Kourah District. In this figure, the Yellow buffer represents the 100 meters. The Red buffer represents 200 meters. The Highway Capacity Manual (HCM 2010) reported that the 400 meters' distance is the limit of the served areas by public transit. Thus, which corresponding to the 400 meters' limit, as shown in the figure

Using resident population density and service area for each region in the village, the percentage of population within the 400 m limit was found to be 37 %. Therefore, the aggregate or overall accessibility of public transit service in Study area is only 37%. Investigation of Fig. 4 revealed that the outskirts of the village is not well served, thus extension of radial routes and addition of circumferential routes are required to improve accessibility.

In this study, accessibility was measured using spatial analysis through Geographic Information System GIS for public transit routes in each village. Many studies were used the GIS in transportation fields (Hull and Karou, 2012; Abley and Williams, 2002) Accessibility was measured depending on time or distance to access to public transit stops (Victoria Transport Policy Institute, 2011). Jason C. Yu (1982) indicated that the accessibility is a tool used to measure the effectiveness of public transit performance. Also, he found that the percentage of population served is an indicator for the effectiveness of public transit system.

Using GIS, three buffer areas were identified in each side of public transit routes (100, 200 and 400 meters). Transit Cooperative Research Program (TCRP) indicated that 80% of passengers walk 400 meters or less to the bus stations. Also, Highway Capacity Manual (HCM, 2000) reported that the 400 meters' distance was the limit of the served areas by public transit.

The buffer at 400 meters is equivalent to 5 minutes walking distance (HCM 2000) Also, the second buffer at 200 meter is equivalent to 3 minutes. And the last buffer at 100 meters is equivalent to 2 minutes.

<https://jaspss.com>

Assuming the average speed of passengers is 133 mas' and to describe the quality of service provided by public transit, Table 3.1 presents six levels of service.

Table 3.1: Level of Service Provided by Public Transit depending on Time and Distance

Level of service	Time (min)	Walking (m)	All automobile (Km)	Park and ride (Km)
A	<2.0	0-100	<0.8	-
B	2.0-4.0	100-200	0.8-1.6	0.4-1.2
C	4.0-7.5	201-400	1.6-3.2	1.2-3.2
D	7.5-12.0	401-600	3.2-4.8	3.2-8.0
E	12.0-20.0	601-1,000	4.8-8.0	4.8-8.0
F	20.0	>1,000	>0.8	>0.8

Table 3.1 indicates that level of service "A" is the best level in which passengers are required to walk a distance less than 100 meters or a time not more than two minutes to access to the public transit route. In contrast, level of service "F" indicates that the time or distance to access a public transit route is more than 20 minutes or 1 kilometer, respectively.

<https://jasps.com>



Figure 1: A basic map of Jordan to show the accuracy of the map's Georeferencing

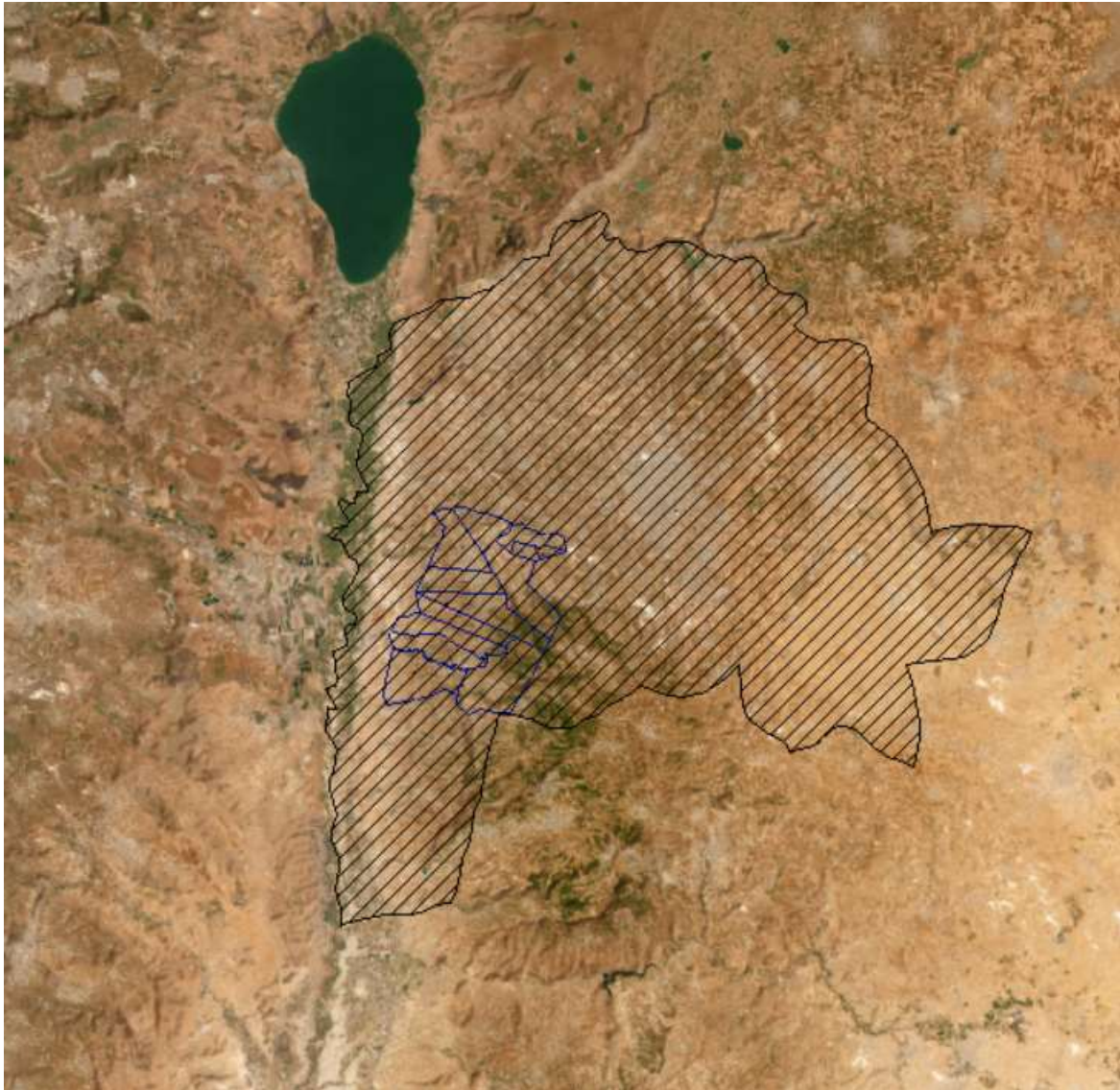


Figure 2: Indication of the location of the Al-Kourah District compared to the city of Irbid

<https://jasps.com>

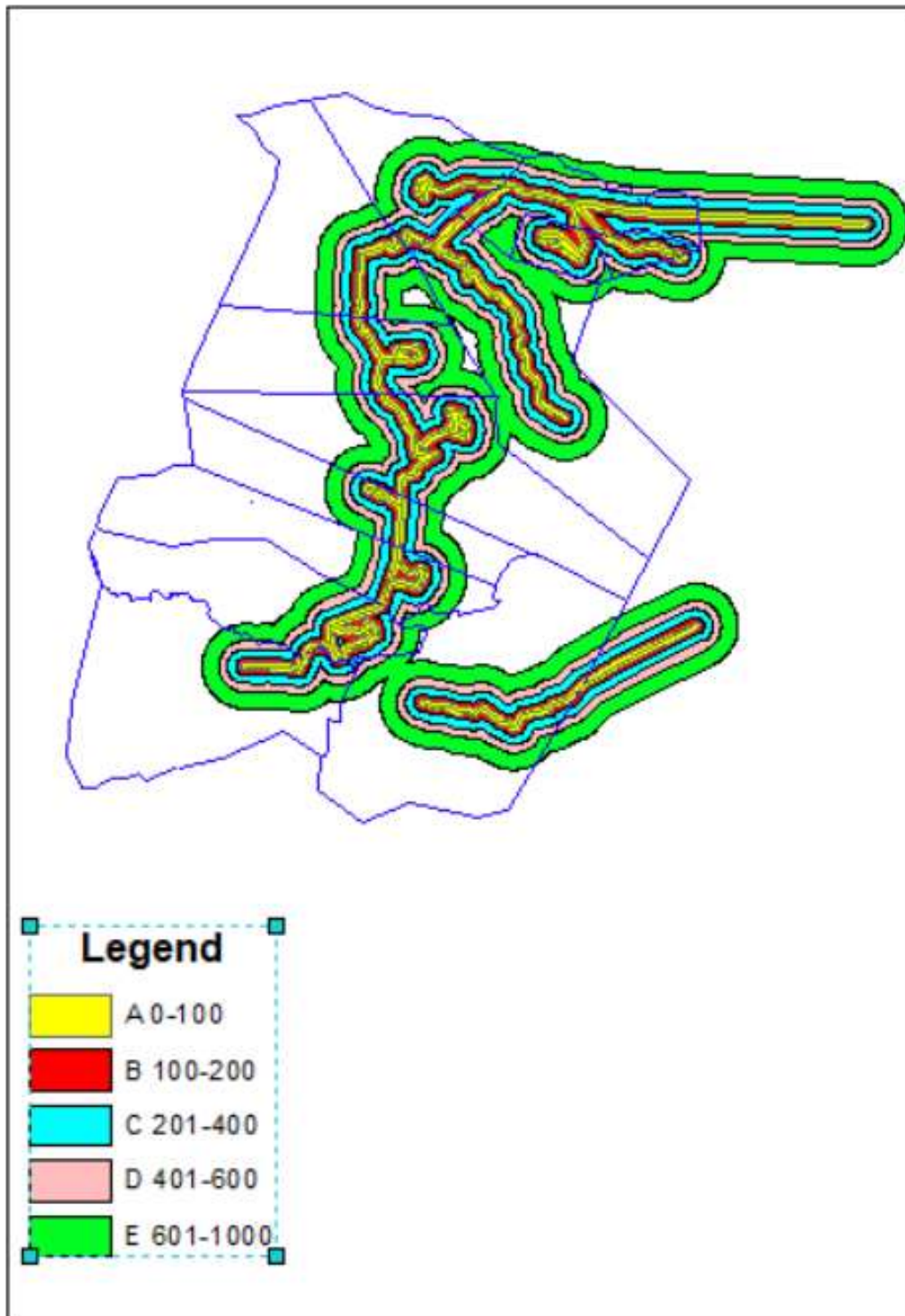


Figure 4: Coverage areas for public transit routes in Al-Kourah District.

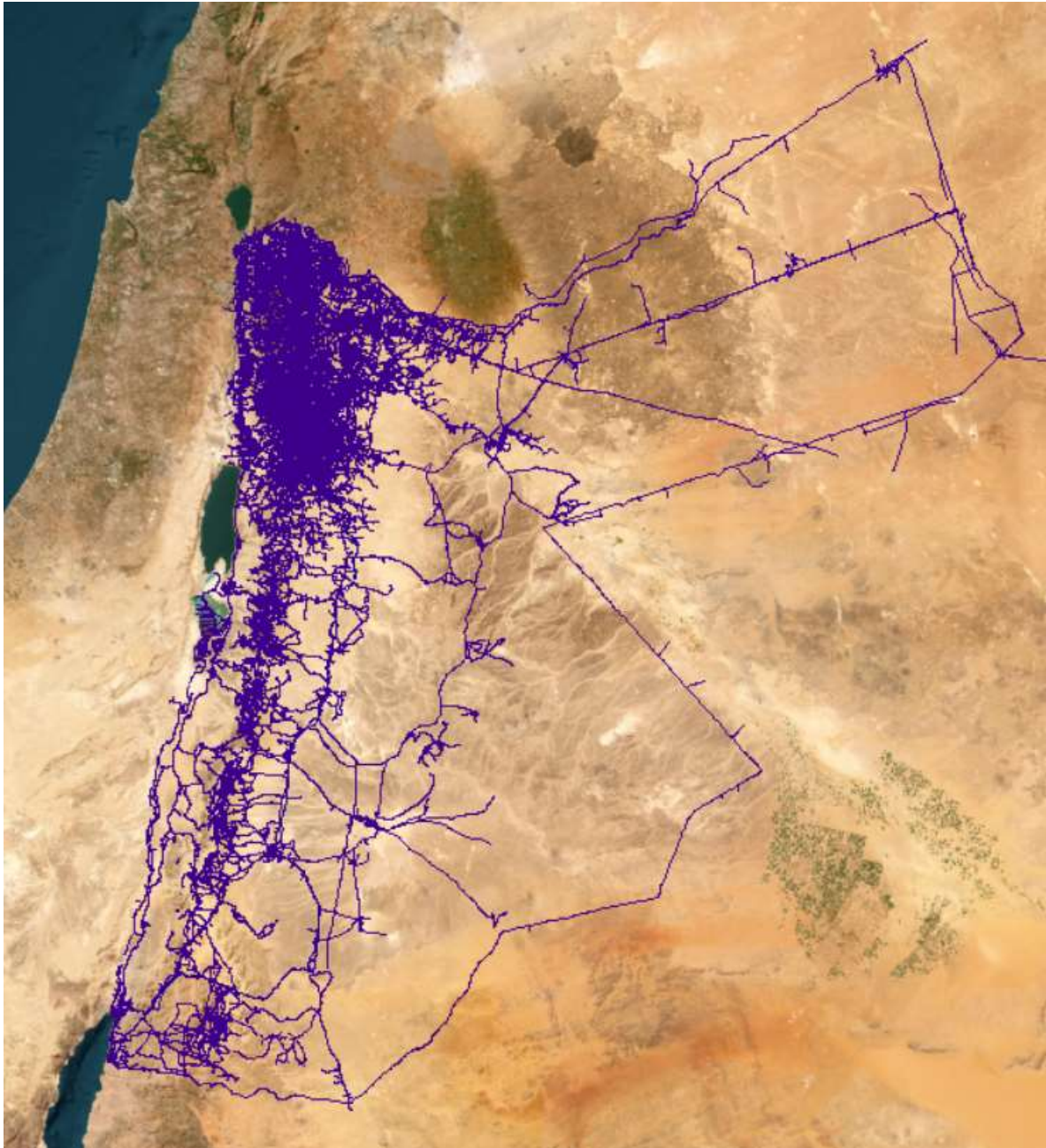


Figure 5: The Hashemite Kingdom of Jordan's road network

<https://iaspss.com>

	Coverage ratio for level %:				
The village	A	B	C	D	E
Judita	3.2	6.5	7.8	11.3	21.2
Kofer Abel	1.7	3.7	8.5	13.5	24.8
Kufr 'Awan	5.9	8.2	10	13.4	26
Bit Ides	5.2	7.6	9.1	12.3	23.3
Kufr Rakeb	4.4	6.1	7.6	10.2	18.9
Ashrafieh	5.3	7.5	9.3	12.5	21.4
Kafr Al-Maa	5.02	7.1	9.2	12.3	22.7
Samoa	21.7	27.5	37	49.2	67.4
Der Abi Said	1.3	3.7	6.2	11.3	20.4
Kufer kefea	21.7	26	36.4	47.8	65.3
Tobneh	1	3.4	7.4	10.2	19
Jenin Safa	4.5	7.3	8.9	12.7	24
Zmal	25.9	30.1	38.6	51.1	71.3

Table 3.2 shows the coverage ratios of each level to the area of each village.

According to the above table, the results showed that the first three levels were very small compared to the area, and this indicates that most of the residential areas were not served, where the individual needs to walk large distances, often up to kilometers meters to reach the bus route, due to the poor distribution of the road network, and it could be observed that some villages there were more than 70% and their area was not covered by Level f, and this is a clear evidence of poor service, so it became clear that the first solution to this problem is to find new and better distributed road lines, and through a review to municipalities in that area, it is to be found that there were a lot of residential areas located outside the municipality's organization ", in other words, outside the scope of the service provided by Municipalities",. Therefore, these areas cannot be reached by public bus, and its residents need to walk long distances to reach the scope of bus service. So, it is necessary that municipalities have to introduce these areas into the organization in order to open roads for buses to reach residents and to facilitate the organization itself.

<https://jaspss.com>

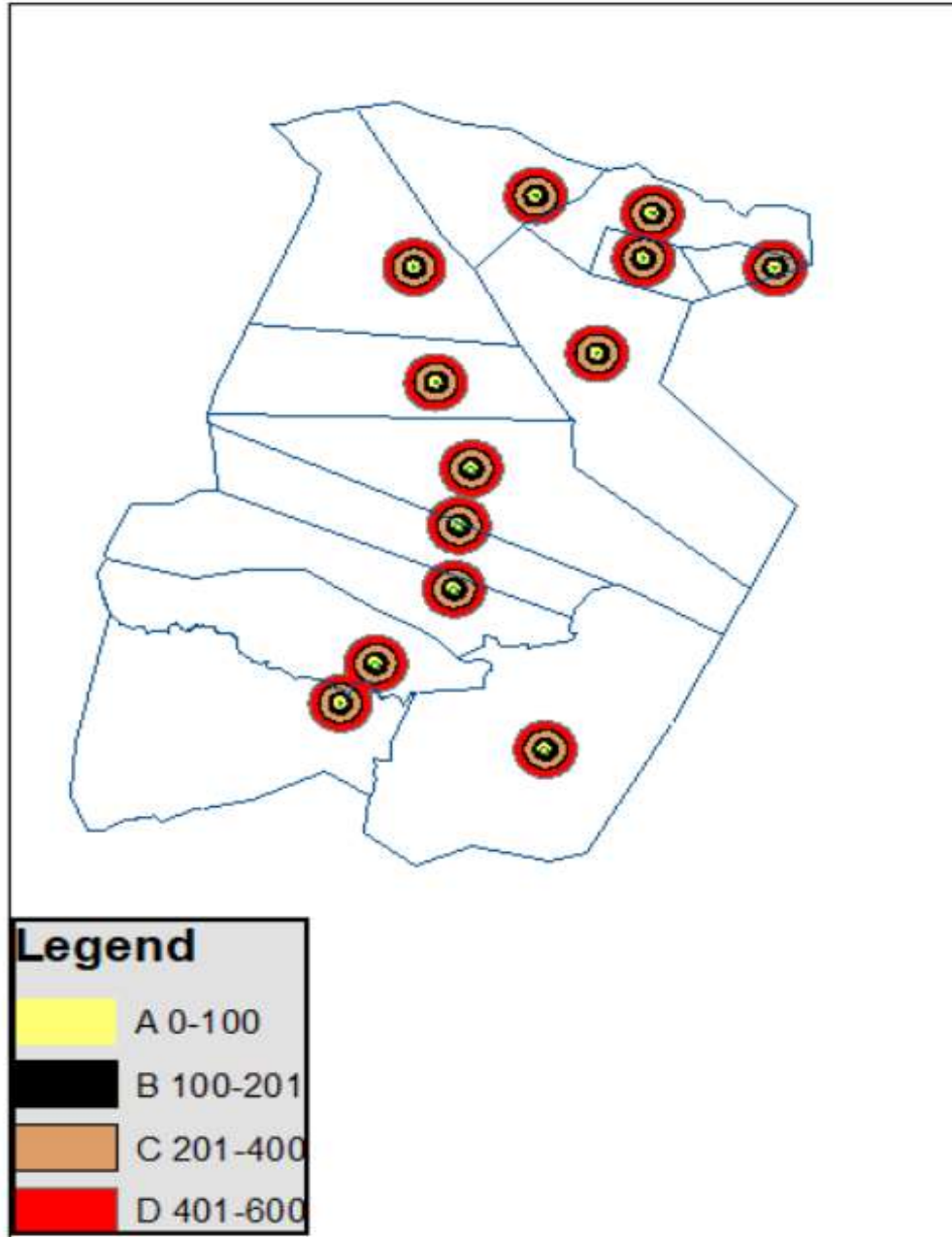


Figure 6: The coverage of Bus Stations in Al-Kourah District

In the figure 6 the waiting umbrellas for passengers scattered in the study area were considered as bus stops .Due to the geographical distribution of these umbrellas, we find that the umbrellas are lined up along the bus route, and their longitudinal concentration reduces the area served by waiting stations compared to the expanding geographical area of the study area.

<https://jaspss.com>

3.2 Mobility

The results indicated that average speeds of buses in peak and off-peak periods were 20 and 30 km/hr., respectively. Thus, the average speed of buses was considered low compared with cited values in the United States or Canada (Nakanishi 1997). Also, the results revealed that average speeds of mini-buses and taxis were nearly comparable, with values ranged from 24 to 38 km/hr. in peak and off-peak periods, respectively. Some of results indicated that longer routes showed higher speeds compared with the shorter ones, especially for mini-buses. In general, the number of stops during the trips was very high in the selected villages. In fact, traffic congestion, topographic, lack of traffic management may have a great influence on public transit speed. Clearly, introduction of bus rapid transit service is necessary to improve mobility.

In Table 3.3 we show the distance that the bus travels daily round trip to the city centre by knowing the time the bus travels on each trip, we can find out the average speed of each bus.

The Village	Distance to the governorate center	Buses Number	Estimated time of departure and return (Minites)	Speed Average (Km/hr)
Judita	32 KM	9	100	38.4
Kofer Abel	34 KM	5	110	37.1
Kufr 'Awan	33 KM	6	105	37.7
Bit Ides	30 KM	4	90	40
Kufr Rakeb	29 KM	5	80	43.5
Ashrafieh	25 KM	5	75	40
Kafr Al-Maa	24 KM	5	70	41.1
Abu al-agayn	28 KM	1	80	42
Der Abi Said	22 KM	11	60	44
Jufain	26 KM	2	70	44.6
Tobneh	24 KM	4	60	48
Jenin Safa	24 KM	2	60	48
Zmal	18 KM	2	50	43.2

<https://jaspss.com>

Smmo	16 KM	4	40	48
Kafr Kifia	17 KM	1	45	45.3

3.3 Productivity

Analyses indicated that the operating ratio of mini-buses in Al-Kourah was 3.8, while operating ratio of buses, for all included villages, was zero. In contrast, the operating ratio of taxis was zero. Compared with world statistics, values obtained in this study are very high. For example, the operating ratio for buses in the Amman and Irbid was found in the range of 2.3 to 3.7, while in European countries the range was 0.5 to 1 (National Transit 2013). However, higher values in the range of 1.6 to 2 were recorded in Canada, Jakarta and Bangkok.

Large values of operating ratios in the included cities may be explained by the fact that most of public transit vehicles leave terminals only when they are full. This table clarifies the revenues and expenses per trip, day, month, and year.

<https://jasps.com>

Road Name	Buses Number	passengers/Bus	Fare of the Rider (JOD)*	daily trips** (trip/day)	Revenues (JOD)				expenses (JOD)						
					per trip	per day	per month	per year	per trip	per day***	per month****	per year*****	trip distance one way (km)	distance/month (km)	services and maintenance cost/month (JOD)
Julfar-rihed	9	22	0.65	5	28.6	143	3718	44616	11	80	2230	27810	32	8320	150
Kofer Al-hrihed	5	22	0.65	5	28.6	143	3718	44616	11.5	82.5	2295	28590	34	8840	150
Kufir Al-hrihed	6	22	0.65	5	28.6	143	3718	44616	11.25	81.25	2262.5	28200	33	8580	150
Brid-rihed	4	22	0.6	5	26.4	132	3432	41184	10.25	76.25	2112.5	26400	30	7800	130
Kufir Rahe-rihed	5	22	0.6	5	26.4	132	3432	41184	10	75	2080	26010	29	7540	130
Ashraf-rihed	5	22	0.57	5	25.08	125.4	3260.4	3924.8	8.5	67.5	1865	23430	25	6500	110
Kafir Al-hrihed	5	22	0.55	5	24.2	121	3146	37752	8	65	1800	22650	24	6240	110
Abu al-agh-rihed	1	22	0.57	5	25.08	125.4	3260.4	3924.8	9.5	72.5	2015	25230	28	7280	130
Der Abu Sa'ih-rihed	11	22	0.5	5	22	110	2860	34320	7.5	62.5	1775	21750	22	5720	100
Julfar-rihed	2	22	0.55	5	24.2	121	3146	37752	9	70	1945	24390	26	6760	125
Tomeh-rihed	4	22	0.55	5	24.2	121	3146	37752	8	65	1800	22650	24	6240	110
Jerin Sa'ih-rihed	2	22	0.4	5	17.6	88	2288	27456	8	65	1800	22650	24	6240	110
Zna'ihed	2	22	0.37	5	16.28	81.4	2116.4	25396.8	6	55	1510	19170	18	4680	80
Simone-rihed	4	22	0.35	5	15.4	77	2002	24024	5.5	52.5	1440	18330	16	4160	75
Kafir Kifa-rihed	1	22	0.4	5	17.6	88	2288	27456	5.75	53.75	1472.5	18720	17	4420	75

notes

* The fare value considered in this table is a one way trip cost.

** The trip considered in this study is two way.

*** the expenses per day includes driver daily salary (25 JOD/day).

**** the expenses per month includes services and maintenance cost.

***** the expenses per year includes Vehicle Licensing tax and insurance (1050 JOD/year).

Table 3.3.3: The revenues and expenses per trip, day, month, and year.

<https://jasps.com>

Through the study, in the previous table, it was found that the annual revenue of the longest route to the center of Irbid city is from the village of Jedita and the total revenue was 16,000 dinars per year. The shortest route to the center of Irbid is the village of Sammou, and the total annual revenue for one bus is 6000 dinars.

This leads to the fact that the economic feasibility is good for the bus owner, and this leads to the fact that increasing the number of buses will not greatly affect the financial return of buses. Among the proposals it is recommended to create special bus routes, which means less arrival time, less passenger fare, therefore less fuel consumption, and less expenses on buses

The fare structure and method of calculation may be a crucial factor in this issue. Flat fare level is normally determined based on occupancy value of 60%. This assumption is made to reduce waiting time in terminals, and ultimately reduce waiting of passengers, especially during off-peak hours. Therefore, reduction of fair levels may encourage non-transit users to use the transit; and ultimately might reduce congestion problems.

It is recommended to increase the number of buses for each village, and replace the minibuses with Buses, because they run high ratio in traffic. Furthermore, the study provides alternatives to improve the transportation performance which are creating an independent route for buses, or reducing the use of private vehicles, since they increase traffic jams.

Based on the above utilization figures and fleet size in Table 1 the public transit carried nearly 5,175 passengers per trip day in 2023. This figure is relatively low for population of 190'000. Also, this ratio is also very low compared with most statistics, which reported that the ratio was ranged from 0.5 to 1.2 buses per 1000 inhabitants of population (Brooking Institute 2010). Thus, an increase of the fleet size is recommended for all investigated villages.

IV. CONCLUSTION

This study investigated the performance of urban public transit in Al-Kourah District Results of analyses indicated that accessibility of urban public transit, within walking distance of 400 m, was relatively low. The mobility of buses was low, while the mobility of mini-buses was found to be not acceptable. Compared with the operating ratio for developed countries, the operating ratio of buses or mini-buses, in all investigated cities, was considerably very large.

<https://jasps.com>

Also, the results indicated that the number of buses per one-thousand inhabitants was very low. Field surveys showed that bus operation was not scheduled, and average waiting time of passengers for buses was marginally high, specifically during peak hours.

Finally, approximately 62% of users' rated the comfort inside transit vehicles as poor. Thus, suggestions to improve transit services were made in this study.

REFERENCES

- [1]. Dr. Amir Shtayat Performance of Urban Transit in Jordan 2016
- [2]. Brookings Institute (2010). The Suburbanization of Poverty: Trends in Metropolitan America, , Analysis of Transit Agency, Nielsen Pop-Facts, 2010.
- [3]. Dublin Bus Annual Report (2011), Dublin, Ireland: Dublin Bus
- [4]. Eboli, L. Mazzulla, G. (2011). A methodology for evaluating transit service quality based on subjective and objective measures from the passenger's point of view. *Transport Policy*, 18(1), 172-181.
- [5]. El-Geneidy, A., Grimsrud M., Paul T., Wasfi R., and Legart J. S. (2013). "New Evidence On Walking Distances To Transit Stops: Identifying Redundancies And Gaps Using Variable Service Areas". *Transportation*, 41(1), 193-210.
- [6]. Govender, K. (2014). Exploring Public Transport Service Quality – The Case of Mini-Bus Taxi Service In South Africa. *Mediterranean Journal of Social Sciences*, 8(10), 317-326.
- [7]. Highway Capacity Manual, (2010). Transportation Research Board (TRB). Fifth Edition, (HCM 2010), Washington D.C.
- [8]. Jason, C. Yu (1982), "Transportation Engineering". New York: Elsevier.