The Status of Transportation in the West Bank

Hanna Maoh & Jad Isaac

Introduction

The varied, often mountainous topography of the West Bank's 5659.34 km², as well as the region's hot and primarily dry climate, helped shape an ancient system of road links that was distinctively impacted by the natural geography of the land. Mountains or harsh deserts regions separated many cities and villages that were in close proximity, requiring circuitous systems of access. High altitude cities such as Nablus or Hebron, which are 600-800m above sea level and might even receive snow in winter, are separated by steep mountain passes and ridges from low altitude areas in the Jordan Valley, which are at or below sea level and experience semi-tropical conditions. Access between major West Bank population centres, therefore, was via an historical road system that followed the mountainous contours of cultivated valleys or ancient desert river beds, known as *wadis.*

In recent years, however, the political conflict over the West Bank has become the major factor impacting on the modern development of transportation. During 30 years of Israeli occupation, large tracts of West Bank land were confiscated from Arab villages and private landowners for the establishment of Jewish settlements and, more recently, for the construction of an extensive system of bypass roads linking these settlements to each other and to Israel. Land use has thus been drastically altered in a relatively short period.

Another period of transition began in 1993, when the Israeli-Palestinian peace process commenced. Palestinians, for the first time, secured the right to develop lands in the major West Bank urban centres that came under their control. Since then, Palestinian institutions and agencies have begun to formulate plans for land use and natural resource development in both the West Bank and Gaza, where respectively 1,873,476 and 1,022,207 Palestinians live today (PCBS, 1997). One of the most pressing challenges facing Palestinians now is the planning of the current transportation system in both the West Bank and Gaza. This cheaper focuses on the larger and more complex. West Bank system, although many of the observations noted here may also be characteristic of Gaza.

Road transportation is the only mode of transport available in the West Bank, and motorized vehicles are by far the dominant mode on the network, while ancient forms of animal transport are gradually disappearing. Most West Bank roads suffered from a lack of

Applied Research Institute – Jerusalem (ARIJ)
P.O.Box 860, Caritas St.
Bethlehem, Palestine
Tel: +972-(02)-277-0535
Tel: +972-(02)-274-1889

maintenance for decades and were inferior in quality to those in neighbouring Israel. During more than 30 years of Israeli occupation, no serious attempt was made to plan for Palestinian future travel demands. The rapid growth of population – over 3 per cent annually in the West Bank and 4 per cent annually in Gaza – as well as the dependency on the automobile as the primary mode of travel, combined to create serious defects in the system on the eve of the new millennium. Increased rates of vehicle accidents, traffic congestion and air pollution, as well as disorder in systems of urban street signaling, etc, are just a few examples of the problems today.

The remainder of this chapter is in four parts.[1] The first section presents original data on the growth in the rate of motorization, the makeup of the car fleet, travel modes and trip destinations – data that have primarily been collected in surveys by the authors as part of an ongoing project designed to develop a comprehensive West Bank transport dataset that previously did not exist. The second part describes the land use composition in the West Bank in an attempt to show linkages between land use and transportation. Moreover, the section presents a preliminary model of pollution emissions for the Palestinian and Jewish settler car fleets in an attempt to test how the presence of settler cars affects air pollution in the West Bank. The third section presents the dual structure of the road network in the West Bank, both Palestinian and Israeli settler, and offers a case study of how that dual network worsens pollution levels, travel continuity and the Palestinian economy. Finally, the last section outlines the pressing problems in land use and transport planning that must be confronted in the system, and offers recommendations and scenarios for sustainable future development.

Basic Features of the Vehicle System

The number of motorized vehicles has increased in the West Bank by an average of 12 per cent per annum over the past two decades. In 1975, there were only 12,964 vehicles in the West Bank. By 1996, there were 133,386 vehicles registered in the names of Palestinians living in West Bank areas other than east Jerusalem (ARIJ, 1997a). There are, meanwhile, an estimated 25,000 cars for a population of 152,000 Israeli settlers who are residing in West Bank settlements other than east Jerusalem (ICBS, 1997).

Despite such growth, the motorization rate in the West Bank remains very low when compared to Israeli rates. In its 1997 census survey, the Palestinian Central Bureau of Statistics reported that there were 80,000 private cars in the West Bank, yielding a rate of 42.7 cards per 1000 Palestinians. In comparison, there were over 171 cars per 1000 for the Jewish inhabitants of the West Bank and over 208 cars per 1000 for Israel as a whole (ICBS, 1997). Approximately, 23.2 per cent of Palestinian households own a car, reflecting the relatively low access to motor vehicles even among more affluent sectors of Palestinian society.

Rapid growth in Palestinian car ownership can be expected to continue under almost any transport development scenario, particularly in view of the fact that the median age of the Palestinian population is 17 years, and cars increasingly viewed as a symbol of mobility and social status. Dependency on car transport in the West Bank urban centres is growing especially fast, as more and more Palestinians leave traditional vocations on farms and villages and commute to factory, construction and service employment in Palestinian cities or even in Israel.

The overall age of the Palestinian fleet has grave implications for pollution emissions. Approximately one-third of the private cars on the roads today were manufactured in the 1970s. About 60 per cent of the fleet is composed of cars manufactured between 1980and 1989 and only 10 per cent are relatively new cars that were manufactured between 1990 and 1996 (ARIJ, 1997b). Comparing the age composition of the Palestinian car fleet to the Israeli car fleet, one can see that there is a huge difference, ICBS (1997) statistics indicate that 5.95 per cent of cars in Israel were built before 1981, 29.17 per cent between 1982 and 1989 and the majority of the fleet – about 64.88 per cent – are sever years old, having been built between 1990 and 1997.

Table 24.1 summarizes the distribution of vehicles over the major West Bank cities, excluding Jericho and Jerusalem. Despite the low motorization rate, there is a relatively high incidence of road traffic accidents (RTAs). The most recently available figures from 1993 indicate that 2781 accidents resulting in injuries occurred in that year, with 128 accidents resulting in fatalities. The relatively high rate of accidents – nearly 2 per cent of vehicles annually – is partly attributed to the poor quality of the road network, which is discussed below.

Table 24.1 *Motorized vehicles in the West Bank, 1997*

	Private cars	*Trucks and commercial cars*	*Buses and minibuses*	*Taxis*	*Motorcycles and scooters*	*Tractors*	*Special services and other vehicles*	*Total*
Jenin	7604	2262	46	72	6	952	4	10,946
Nablus	16,267	3791	165	556	23	520	16	21,338
Tulkarm	11,231	2654	14	102	25	416	11	14,453
Ramallah	14,083	3691	152	642	23	350	19	18,960
Bethlehem	10,816	1862	67	84	22	121	5	12,977
Hebron	18,161	4097	84	108	108	1006	15	23,579

Source: ARIJ (1997b)

Note: figures on motorized vehicles for Jerusalem and Jericho are not available in this dataset

Applied Research Institute – Jerusalem (ARIJ)
P.O.Box 860, Caritas St.
Bethlehem, Palestine
Tel: +972-(02)-277-0535
Tel: +972-(02)-274-1889

The proportion of private cars to total vehicles varies widely among the various cities of the West Bank (see Table 24.2). Overall, those differences reflect a greater dependence on public transportation in the city of Ramallah, which is today's affluent centre of commerce, culture and political life, and the northern West Bank city of Nablus, which was a traditional economic and cultural stronghold in the pre-1967 period of Jordanian rule. Notably, Ramallah and Nablus contain 41 per cent and 35.5 per cent of the total number of taxis in the West Bank respectively. Some 24.7 per cent of the West Bank bus fleet is located in Ramallah and 30 per cent in Nablus.

Table 24.2 *Private cars as a proportion of the total vehicle fleet*

Jenin	*Nablus*	*Tulkarm*	*Ramallah*	*Bethlehem*	*Hebron*
69%	*76%*	*77%*	*74%*	*83%*	*77%*

Travel destinations

Results of a month-long traffic survey conducted by the authors indicate that a large majority of Palestinian intra-district trips are work trips. The exception noted is in the northern West Bank district of Jenin, where family farming is still a primary vocation. Special trips, such as family visits and recreational excursions, are the second most common type, while shopping ranks third, except for Jenin. Table 24.3 shows the distribution of these trips for each district.

Table 24.3 *Intra-district journeys by type for one month (%)*

Location	*Work*	*Shopping*	*Official*	*Special*
Jenin	35	41	0	23
Tulkarm	63	8	3	26
Bethlehem	60	10	0	29
Ramallah	63	8	3	27
Nablus	66	13	1	20
Jerusalem	61	8	5	25
Hebron	66	7	6	21

Source: ARIJ (1997b)

Land use and its impact on transport

The West Bank has a total area of 5659.34km^2. Land use in this region is given in Table 24.4.

Table 24.4 *Land use in the West Bank*

Land use	%
Palestinian built-up area	6.53
Israeli built-up area	1.91
Palestinian cultivated land	28.31
Israeli cultivated land	0.95
Nature reserves and forests	5.84
Closed Israeli military areas and bases	22.14
Other (including grazing and unused land)	34.32

Source: ARIJ (1999)

Most Palestinian cities have been in existence since antiquity, and have developed around a traditional Middle Eastern *souk* (a mixed commercial and residential area noted for its narrow, winding streets and covered alleys) housing small shops, craftspeople and cottage industries that formed the basis for the traditional economy. Pedestrian transport was and is the dominant mode in this environment. Western-style business districts shaped along two-lane paved roads eventually developed around that core, gradually encroaching somewhat on the pedestrian areas. But the basic design of the Palestinian town and city today remains relatively compact, although higher rates of motorization are now generating new residential development on former farmland and orchards at the far-flung peripherals of cities.

Jewish settlements, unlike the traditional Palestinian cities and villages, are at most only 30 years old. With approximately 200 settlements and neighbourhoods around the West Bank, most settlements are marked by low population densities and function primarily as suburban satellites of existing Israeli cities. A marked feature of the settlements, therefore, has been their dependence on automobile transport due to the absence of employment and services within the settlements themselves. Per capita car ownership in the settlements reflects this far greater dependency on private car travel for work, shopping and recreational functions.

A comparison of the population densities of Palestinian and Jewish settlement built-up areas reflects the generally more dispersed and car-dependant pattern of the Jewish settlements on an approximate order of 2:1. There is approximately 369.55km^2 of built-up space for a population of 1.87m Palestinians as compared to 108.09km^2 of built space for a West Bank Jewish settlement community of 300,000, including east Jerusalem. That translates to a population density of 2775.46 Israelis per km^2 of built space in the Jewish settlements, as compared to 5069.61 Palestinians per km^2 of built space.

Congestion and pollution emissions

The rapid increase in motorization and the age of the car fleet have combined to create severe problems of traffic congestion and air pollution in and around major Palestinian cities over the past decade. Given the higher motorization rate of the settler population, settlement cars add to the pollution load disproportionately. A preliminary model of pollution emissions for the Palestinian and settler car fleets suggests that total emissions of major pollutants from cars may be 27-32 per cent higher in the West Bank due to the presence of the settler vehicles.

This preliminary model of pollution emissions is based on figures surveyed by the authors for the Palestinian car fleet and by the Israeli Census Bureau of Statistics (ICBS, 1997) for the Israeli settler car fleet. The model is sensitive to differences such as the older age of the Palestinian car fleet and the greater average annual travel distance per Palestinian vehicle. The pollutant values are based on the transportation air emission inventories (Economopoulos, 1993). These inventories provide the emission factors for carbon monoxide, sulphur oxides, nitrogen oxides, hydrocarbons and lead, and vary according to the age and engine capacity of a vehicle.

The values of harmful pollutants are summarized in Table 24.5 for both the Palestinian and Israeli setter car fleets. With regard to the Palestinian figures, emissions were calculated for cars in the following age categories: 1970-1979, 1980-1989 and 1990-1996. In all cases the authors assumed an engine capacity of 1.41-2.01. The annual average kilometrage per vehicle for the Palestinian cars is estimated to be 20,000km (ARIJ, 1997b). The same calculation was carried out for the Israeli car fleet according to the age composition. The 1997 Israeli statistics (ICBS, 1997) indicate that the annual average kilometrage per vehicle is approximately 17,000km. Moreover, the assumption was made that the average engine capacity for the settlers' cars is in the 1.41-2.01 category.

Table 24.5 *Estimated emissions from private cars in the West Bank*

	Emissions (tonnes/year)			
	Emissions from Palestinian cars	*Emissions from Israeli cars*	*Total emissions*	*% change in emissions due to presence of Israeli settlers' cars*
Carbon monoxide	52,534	16,762	69,296	31.91
Sulphur oxides	2985	875	3860	29.31
Nitrogen oxides	2879	786	3666	27.31
Hydrocarbons	5015	1497	6512	29.84
Lead	198	60	257	29.74

The West Bank Road System: The Dual Israeli-Palestinian System

While Israel's road system is sometimes described by highway planners as relatively underdeveloped by North American and European standards, the West Bank system suffers from far greater deficiencies. There are 0.51km of road per km² in the West Bank, as compared to 0.70km per km² in Israel. The West Bank has 1.86km of road per thousand inhabitants as compared to 2.5km per thousand inhabitants inside Israel (ARIJ, 1997a). Moreover, the road system in the West Bank is essentially comprised of three systems, which at times duplicate each other and in other instances fail to provide adequate travel continuity. Some 1255km of main roads are shared by both Israelis and Palestinians but are usually under Israeli control; Israeli bypass roads comprising 255km link Jewish West Bank settlements and are used primarily by Israelis. Another 2556km of secondary roads are poorly maintained and are used primarily by Palestinians. Due to this multi-tiered system, road access and road development have become key issues in the political conflict.

Since signing the 1993 Oslo accords, Palestinians have wielded control over land use, road planning and maintenance only in the limited geographical area of seven major Palestinian urban areas, known as Area A. (Accessibility in the region is governed by the Oslo I and Oslo II agreements signed between the Palestinians and the Israelis in the early 1990s. The Oslo II agreement divided the land use of the West Bank into three major classes. These are Area A, Area B, and Area C. Land in Area A covers the main cities of the West Bank, except for Hebron, which has a special agreement. The city of Hebron is divided into areas of different control called H1 and H2. Area H1 is defined as Area A and Area H2, which houses 400 settlers, and remains under Israeli control. In Area B, the Palestinians have full control over civil society except that Israel continues to have overriding responsibility for security. These areas comprise most of the Palestinian towns and villages. Area C covers the area that falls outside Area A and B. In this area, the Palestinian Authority provides civil services. However, Israel retains full control over land, security, people and natural resources. The majority of Palestinian agricultural land lies in these areas.)

The Israeli bypass system, comprising some 25 roads today, is by far the most modern and well maintained part of the West Bank road system. The system is designed to improve accessibility between the different Jewish settlements in the West Bank and the rest of Israel. The bypass roads average 25-30m in width, with an average 120m-buffer zone around the road.

The bypass roads are located in the Israeli-controlled Area C. Along with providing a traffic bypass around major Palestinian cities and communities in the West Bank, the roads also create a rigid boundary limiting Palestinian growth and development. This is particularly evident on the crowded urban outskirts of Jerusalem, ie Bethlehem and its environs. In rural areas, the bypass roads also consume open space as well as valuable farmland in fertile valleys and river beds, as well as fragmenting agricultural land use.

Applied Research Institute – Jerusalem (ARIJ)
P.O.Box 860, Caritas St.
Bethlehem, Palestine
Tel: +972-(02)-277-0535
Tel: +972-(02)-274-1889

Although, technically, Palestinians may travel on the bypass roads, in most cases the system does not serve Palestinian travel destination needs efficiently, and Palestinians are also discouraged from traveling on the system by army roadblocks. The total land consumed by today's existing network of bypass roads is 27.8km². Plans are underway, however, for the construction of another 14 bypass roads in the West Bank, extending 196.01km and consuming another area of 23.5km² (ARIJ, 1999). Once constructed, bypass roads will comprise nearly 1 per cent of the West Bank's total land area.

The main roads in the West Bank were constructed during the British Mandate (1917-1948) and the period of Jordanian administration (1948-1967). Their primary function is to link major Palestinian urban areas with each other, even though these roads after provide intermediary links between different sectors of Israeli bypass roads as well. Typically, main roads in the Palestinian network average only 10-12 in width. Even after 1993, major Palestinian road works programmes became feasible only in areas under the jurisdiction of the Palestinian Authority, resulting in visible road improvements along limited stretches of urban systems. Access to the main roads is also sometimes blocked by Israeli military checkpoints, which control traffic to and from West Bank areas that remain under partial or full Israeli security control (Areas B and C).

Secondary roads are typically 4-8m in width, and most began as unpaved tracks. The curved structure of many roads follow ancient trails around mountains and hillsides making them dangerous for modern traffic. However, in cases where main roads are blocked by military checkpoints, secondary roads may become primary travel arteries, as can be seen in the case study of the Wadi Al-Nar route below.

Road and Access – Wadi Al-Nar as a Case Study

Wadi Al-Nar became a critical commercial and passenger road link for Palestinians in the late 1980s, when Israel began to limit Palestinian access to Jerusalem's main north-south highway, blocking the historical road artery that links the northern West Bank cities of Nablus and Ramallah to the southern West Bank cities of Bethlehem and Hebron along a relatively flat mountain plateau.

Once a series of dirt tracks and footpaths, Wadi Al-Nar was paved by the Israelis as an improvisational move after direct access to Jerusalem was blocked in the early 1990s by repeated curfews. Today's two-lane road averages 4-5m width in total. The road descends from the northeastern Bethlehem hills into a steep mountain valley, and then ascends around another mountain in that area revealing many hidden curves along, the route. The curved sections of the road are impassable to two-lane traffic when one lane is occupied by a freight vehicle. Due to the slopes, winter rain conditions enhance the risk of skidding and accidents. Such conditions impede trade between key West Bank economic centres such as Bethlehem and Ramallah, which lie in close geographical proximity to each other on the northern and

southern outskirts of metropolitan Jerusalem. Although the Wadi Al-Nar road skirts the eastern outskirts of Jerusalem, it fails to serve the vital functions of a bypass road due both to design and trajectory.

The distance between Bethlehem and Ramallah on the Wadi Al-Nar road is 47km as compared to 26km on the main Jerusalem highway, and travel time as well as fuel consumption in nearly double, yielding increased travel costs as well as increased pollution emissions. Daily pollution emissions were estimated for cars traveling on both the Jerusalem road and Wadi Al-Nar from Bethlehem and Ramallah. Figure 24.1 indicates that amount of emissions increased by a rate of 2:1 on the Wadi Al-Nar road. The increased emissions might even be higher if factors such as road conditions and capacity were considered.

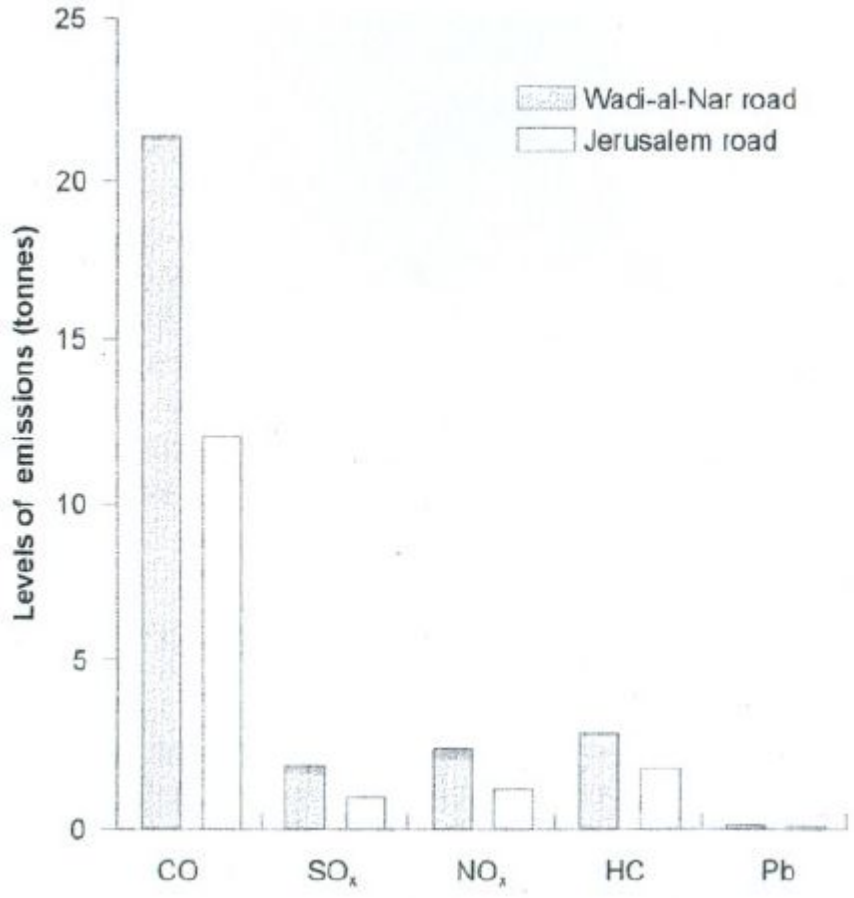

Figure 24.1 ***Daily harmful emissions on Wadi Al-Nar and Jerusalem roads***

In terms of the economic toll, the total cost for one car traveling from Bethlehem to Ramallah on the Wadi Al-Nar route and the main Jerusalem highway is estimated at US $310 and US$ 120 respectively. Such an excess cost causes significant damage to the

Palestinian gross national product (GNP), estimated at US$ 22.8m (Qattoush, 1999), considering the large amount of commercial traffic traveling between these two cities.

Transport and Land Use in Palestine – Dilemmas and Choices

While research so far has focused on the burning questions of travel discontinuity and Palestinian access to the present transport system, new issues loom on the horizon as the Palestinian Authority expands its jurisdictional authority over West Bank land use and transport systems, and simultaneously develops the planning mechanisms of a sovereign state.

The experience of the West has shown that the modern urban structure gains its formation from the linkage between urban land use and transport road systems. Historically, this change in the shape began first with the onset of public transportation, when cities became more dispersed and greater separation between land uses such as commercial, industrial and residential became possible (Anderson et al, 1996). The post-World War Two construction of highways and expressways achieved another revolution, spawning vast new suburbs – particularly in the USA – and effectively turning the historic metropolitan core inside out (Hanson, 1986).

As noted earlier, during the Oslo peace process, land development in many areas on the outskirts of major West Bank Palestinian cities has remained under Israeli control (Area B or C), and thus tightly restricted. In addition, the bypass roads have created a physical obstacle to development. Yet even so, the trends of suburbanization are also beginning to make their impact in Palestine. In areas on the periphery of major Palestinian cities such as Bethlehem and Ramallah, the conversion of farmland to residential housing has accelerated. Fruit orchards and vineyards are giving way to residential housing, spurring sprawl as well as a high dependency on motor vehicles.

As Palestinians gain more control over their own urban periphery, residential and commercial land use development is likely to accelerate even more dramatically. The question then must be asked: how can this development be channelled or shaped to gain the widest benefit for millions of Palestinians? Recent political events in the region have brought an end to Palestinian control. This, and its associated problems of terror and intense military activity, now casts considerable doubts over the possibility of an independent Palestinian style of development.

In Palestine, most cities today still retain their monocentric urban forms, where business is concentrated in the central core. Planners now must decide whether they want to encourage even greater urban centralization, or promote a polycentric development pattern. The first strategy would require decision-makers to strictly limit residential development in the outer suburbs and encourage the intensified development of inner suburbs and urban cores via the construction of high rises that could accommodate the growing population

densities that can forecast for the future. The second, polycentric option would create new nodes of commercial and residential development outside the traditional central business district.

In either scenario, however, forms of mixed land use and an employment-housing balance that offers people places to work in close proximity to where they live, and opportunities for walking or public transport, are essential to overcome growing problems of sprawl and commuting. However, more awareness of land use issues needs to be built at the municipal level and the national level before transport and land use planning can become effective development tools.

Whether the decision is for a centralized urban core or for a polycentric form, public transport planning is key to reducing the dependency on the private car. Improved public transport can make Palestinian society more equitable by offering transport solutions to social sectors with moderate incomes that cannot afford to own a private vehicle.

Shared taxis and small paratransit vehicles, accommodating 5-12 passengers, are the dominant modes of transportation in the West Bank today. One visible change evident since the arrival of the Palestinian Authority is the fact that multiple private taxi companies have come under a single regulatory agency. Service taxis and small vans that will accommodate 5-12 passengers have been painted a uniform bright yellow colour, allotted special license plates, and are now readily identifiable in all areas of the West Bank as public transport vehicles. Paratransit vans are used not only in urban situations, but also in inter-urban transits as a mode of transport for workers crossing the Israeli border to work in Israel or for travelers moving from the northern part of the West Bank to the southern part. However, these privately run taxis and service vehicles – which do not run on a fixed schedule of stops and frequencies – are not a comprehensive alternative to a public bus system, which remains skeletal. Moreover, there is no organized system of route planning and control even for the paratransit vehicles.

Most of the new paratransit vehicles are also diesel-powered. As these types of vehicle are used increasingly in the cities, respirable particulate emissions can be expected to increase significantly (Whiteman, 1988). Yet given the far lower cost of diesel fuel in the West Bank, these vehicles also represent significance economic savings for the Palestinian economy. Environmental drawbacks thus are weighted against economic benefits.

Within Palestinian cities, there is a dearth of traffic signals and signs, as well as a lack of directional planning in the form of one-way roads and downtown bypasses. These features, together with a partial social disregard for traffic law, adds to the sense of disorder that permeates the transport system, as well as to the noise and congestion burden of the urban core.

Planning for the millennium has provided an opportunity to grapple with some of these problems, at least in the context of the Bethlehem 2000 project, which is revitalizing the ancient city's historic downtown area. Bethlehem 2000 has seen a major revamping of

the traffic routes throughout the city to ease the flow of tourist vehicles, but particularly in the ancient city core.

One of the chief features of the project is the extensive re-pedestrianization of Bethlehem's Old City that is now underway, reversing a trend which saw narrow alleys of the Crusader and Byzantine period converted into streets for car access over the past several decades. The area around the famous Church of the Nativity, once a neglected parking lot, has been converted into a pedestrian plaza with elegant paving stones, benches and trees. The programme has already made a marked impact on residential quality of life in the core areas and the benefits of reduced congestion, noise and air pollution should become even more apparent over time, as the centre city becomes more attractive for residential living as well as tourism.

Similar programmers should be undertaken in most of the core Palestinian urban areas, which share similar urban street patterns and contain buildings and facades of great historic and religious value even if they are not as well known as Bethlehem. Such pedestrian precincts would not only prove environmentally friendly, but would also improve living standards and provide better living amenities in the core where restaurants, parks and leisure sites could become more readily available even to populations that do not own cars. Pedestrian districts would make other Palestinian cities more attractive and accessible to foreign tourists, and generate new economic growth by boosting open air markets, souvenir industries, hotels and restaurants.

In certain cases, where the terrain is not too hilly, cycling networks could even be integrated into such precincts as they have been in the West, and be supported as a cheap and low pollution alternative to motorized transport. Cycling is not a popular transport method among Palestinians today. Perhaps the greatest potential for cycling today lies in the Mediterranean seacoast area of Gaza where urban densities are also very high. While a thorough review of Gaza's transport system lies outside the scope of this chapter, it seems obvious that cycling should be supported by the Palestinian Authority as a transport mode in Gaza that holds great potential.

As mentioned earlier, road vehicles constitute the only mode of long distance transport in the West Bank and Gaza today. In a new era when Palestinian land is controlled by Palestinians, decision-makers should consider other modes as well. A rail link has already been proposed as a means of connection the southern West Bank to Gaza, via Israel. A rail link should also be considered as a means to connect the major population centres of the West Bank along the north-south axis of Hebron, Bethlehem, Jerusalem, Ramallah, Nablus and Jenin, where population densities are highest, pollution and traffic are most intensive, and where a natural transport corridor already exists through otherwise mountainous terrain. Rail should be a travel mode available for both commercial and personal trips, and should eventually become part of a regional system connecting Israel, Jordan and Syria.

A Palestinian national system would help to promote economic growth and regional economic integration, and support the existence of a Palestinian state, not only by providing a link between Gaza and the West Bank, but also by increasing interaction between different sectors of the Palestinian economy and easing the passage of goods through border crossings. However, given the investment capital that would be required for basic infrastructure investment in rail, such a project could only become reality with the assistance of a coordinated effort from the world community. International donors, as well as the Palestinian Authority, should consider such a project as they look for solutions to the problems of high population density and land scarcity that a Palestinian state in the West Bank and Gaza will face in the first decades of the new millennium.

Conclusion

The transportation network in the West Bank suffers from years of neglect during three decades of Israeli occupation, and major investments will be needed in order to restructure the system, beginning with a greater investment in planning, as well as in travel demand modelling.

Congestion and pollution are becoming commonly observed phenomena in the West Bank cities and urban centres due to increases in motorization, the placement of Israeli military checkpoints and an inadequate system of roads, signalling and public transport. Traffic pollution is exacerbated by the presence of Israeli settlers' cars. The Israeli confiscation of land for settlements and bypass roads has created obstacles to rational land use and transport planning: such land confiscation and settlement expansion should cease. Other measures are imperative:

- Palestinian road access must be improved. Israeli checkpoints that still mark the entrances to West Bank Palestinian cities should be removed. Free access for Palestinians on the critical Jerusalem road axis must be ensured in order to facilitate traffic and commerce between various West Bank cities.
- Due to the sub-standard nature of the road system, and the rapid growth in population and motorization, the road network in the West Bank will have to be improved and expanded in the future. The natural geography of the region does not allow for the easy construction of roads. New technology using GIS techniques is essential to identify suitable corridors.
- More emphasis should also be placed on managed land use. Decision-makers should promote policies that reduce car dependency and long travel times and promote public transport, including alternatives to road transport. Current patterns of land use development must be assessed, and strategies promulgated for the prevention of urban sprawl through the development of mixed land uses and/or compact urban

forms in city centres. These strategies will help to reduce air pollution and promote social equity by allowing easier access to education, jobs, services and shopping for women, children, the elderly and poor people, who typically do not have access to cars.

- Simultaneously, the Palestinian Authority should promote walking and cycling as a means of reducing air pollution.

Modern research on transport systems in Palestine is very meager indeed. More studies will be required in transportation modelling and modelling of land use planning, in addition to utilizing modern methodology as well as the experience of developed countries in developing more sustainable transportation system in Palestine.

Notes

1 This chapter was first published as a paper in *World Transport Policy & Practice,* vol 5, no 4, pp18-29. The authors would like to express their gratitude to the Deutsche Forschungsgemeinschaft (DFG) for funding the Applied Research Institute at Jerusalem (ARIJ) to undertake research on transport planning and land use. Also to Elaine Fletcher for her useful comments, discussion and feedback. A thank you goes to Violette Qumsieh, Isam Ishaq and Nezar Qattoush for their useful comments.

References

Anderson, W, Kanaroglou, P and Miller, E (1996) 'Urban forms, energy and the environment: a review of issues, evidence and policy', *Urban Studies*, vol 33, pp7-35

ARIJ (1997a) *The Status of the Environment in the West Bank,* Applied Research Institute, Jerusalem

ARIJ (1997b) *Traffic Survey for the West Bank,* Applied Research Institute, Jerusalem

ARIJ (1999) *ARIJ GIS Database,* Applied Research Institute, Jerusalem

Economopoulos, A (1993) *Assessments of Sources of Air, Water and Land Pollution: A Guide to Rapid Source Inventory Techniques and their Use in Formulating Control Strategies, Part 1,* World Health Organization, Geneva

Hanson, S (1986) *The Geography of Urban Transportation,* The Guildford Press, New York

ICBS (1995) *Judea, Samaria and Gaza Area Statistics,* Israeli Central Bureau of Statistics, Jerusalem

ICBS (1997) *Statistical Abstract of Israel* (vol 48), Israeli Central Bureau of Statistics,

Jerusalem
PCBS (1997) *Census Data for the West Bank and Gaza,* Palestinian Central Bureau of Statistics, Gaza
Qattoush, N (1999) "Transportation difficulties: Wadi Al-Nar as a case study', unpublished report presented at the Applied Research Institute, Jerusalem
Whiteman, J (1988) *The Environment in Israel,* Environmental Protection Service, Ministry of the Interior, Jerusalem

Applied Research Institute – Jerusalem (ARIJ)
P.O.Box 860, Caritas St.
Bethlehem, Palestine
Tel: +972-(02)-277-0535
Tel: +972-(02)-274-1889