Pak. J. Engg. & Appl. Sci. Vol. 16, Jan., 2015 (*p.1*–16)

An Environmental Evaluation of School Transport in Islamabad: A Case Study of Sector H-8

Zafar Iqbal Zafar [1] Ghulam Abbas Anjum[2] Nomana Anjum[3] and Nazia Iftikhar[4] Saima Manzar[5]

1. Town Planner, Capital Development Authority (CDA), Islamabad, Pakistan
2. Town Planner (CDA) / University of Engineering and Technology, Lahore, Pakistan
3. Environmental Design Programme, Allama Iqbal Open University, AIOU
4. Nadirshaw Edulji Dinshaw University, NED, Karachi, Pakistan
5. Civil Engineer, Environmental Design Programme, Allama Iqbal Open University, AIOU

Corresponding e-mail: anjums41@hotmail.com

Abstract

Due to varying educational standards and thirst for better education, the idea of private school system has become very strong. The gap between public and private education has increased and private schools are inevitable for upper and upper middle classes. Like any other city; in Islamabad, the private schools were initially opened in residential plots that caused different traffic issues and deteriorated the living environment around schools. Due to these issues and to save the peace and tranquillity of the residents, CDA decided to shift these private schools from residential area to institutional area in sector H-8 and H-11. The institutional area is away from the residential sectors; therefore students have to use some mode of transport. Since there is no mass transit system introduced in the city therefore majority of them use their private transport. As a result, the road network of sector H-8 remains choked during school opening and closing times. This diversified private transport is not only creating traffic hazard but also affecting the environment. In addition, it also poses a burden on natural resources as well as financial constraint for parents.

The research was designed to explore and analyze the aforementioned issues and to suggest necessary measures for sustainable transport system for schools generally and specifically for sectors H-8 and H-11. Questionnaire was used to collect data from all stakeholders (including school children, school management and authorities such as police and CDA). Site photographs, layout plans and images were used to accentuate the problem areas. Sound level meter was used to measure the noise level. Deliberations were made with all stakeholders. Finally, all data was compiled, analyzed and concluded for possible recommendations. A model was also proposed for sustainable transport system for schools in the study area.

Key Words: Sustainable transport system, Private schools, Traffic hazard

1. Introduction

School transport management programs are usually initiated by school authorities, parent organizations or students, often as a response to traffic and parking problems. They can be implemented as part of neighbourhood traffic management program with combination of transportation modes when schools are sited and designed. The report of Victoria Transport Policy institute (2007) mentioned that travel to school represents 10-15% peak period motor vehicle trips which can be reduced 10-20% at particular school or even more when schools are sited and designed for good accessibility [1]. Litman (2007) argued that accessibility is affected not only by design of a school itself but also the design and management of sidewalks and road of the neighbourhoods [2]. Even relatively modest location and design factors can affect school accessibility. A pedestrian shortcut between residential streets and schools can increase non-motorized travel.

H-series of sectors in Islamabad has been planned for institutions only with no provision of

residential units which is an extraordinary example. Hence usual parameters of land use mix, neighbourhood design and density are not applicable. According to standards of education in government schools, plots were allotted to private schools in sector H-8 and H-11 which attracted upper middle class from other sectors. Now there are about 30 educational institutions in sector H-8 and 23 in sector H-11 [3]. Considering just two schools i.e. Beacon House and City School, H-8 there are approximately 6000 students. Each day about 3000 vehicles commute to these schools for pick and drop causes major traffic blockade and congestion in the area along with pollution and other hazards. This could have been minimized by providing accessibility to schools through walkways or bicycle ride which is pivotal to sustainable transport provision. According to the location strategy cycling is not been considered as feasible design parameter for students safety.

The current clustering of educational institutions invites traffic from all over Islamabad and as well as other neighbouring cities. Proper transport system is not provided for students' mobility. No research could be found in Pakistan, which addressed the issue school transport. Therefore the study is the first step toward problem of school transport faced by students in pursuit of quality education. It provides guidelines for school administration, city management and private transporters to provide sustainable transport system for schools located in sector H-8 as well as in other sectors.

2. Sustainable Transport System

European Union Council of Ministers of Transport, defines a sustainable transportation system as one that allows the basic access and development needs of individuals, companies and society to be met safely and in a manner consistent with human and ecosystem health and promotes equity within and between successive generations [5]. It is about finding ways to move people, goods and information that reduce its impact on environment, economy and society. It improves transport choice by increasing quality of public transport, cycling and walking facilities, services and environments, using cleaner fuels and technologies. It is affordable and supports competitive economy as well as balanced regional development.

"It should promote human health both mental and physical and provide the opportunity for social interaction by enriching urban experiences" [6]. Sustainable transport system contributes positively to the environmental, social and economic sustainability of the community it serves. Thomas (2003) has reported three changes that are required to achieve the goals of sustainable transport;

i) Reduction in the need to travel where people have to travel particularly for those essential journeys to work, school and shops which account for 46% of journeys of more than one mile.

ii) Need to change mode of travel for people from car to foot or bicycle for shorter and public transport for longer transport.

iii) Need to make more energy efficient, less polluting cars [6].

Over last 30 years there has been dramatic increase in proportion of school journeys made by car with reduction in made by foot or bicycle. Ridgewell et al., (2005) observed that in United States, trips to school by walking and cycling dropped by 40 percent in the past 20 years and in 2001 only 10 percent of children walked or cycled to school.

2.1 Factors Influencing School Transport

2.1.1 Built Environment

Sustainable transport system requires integrating environmental, social and economic factors in order to develop optimal solutions to climate change [7]. It exists to provide social and economic connections, and people quickly take up the opportunities offered by increased mobility. The increased mobility need to be weighed against the environmental, social and economic costs that are caused by transport system. World Health Organization, Europe (2008) traffic congestion imposes economic costs by wasting people's time and by slowing delivery of goods and services [8]. In United States new schools are being built along major thoroughfares instead within neighbourhood to accommodate buses and cars [9].

2.1.2 Social Influences

The term car culture was used to explain how car went beyond its role as a mode of transport to one of image, social status and self expression [10]. Wenban-Smith (1997) concluded that car dependence was deep-rooted in all levels of society including children. Also school culture has an influence on school travel modes [11]. Levels of walking and cycling tend to be lower where a walking/cycling culture has not been fostered at the school.

2.1.3 Safety and Danger Perception

As roads and footpaths are deserted by walking or cycling, the car becomes more dominant and remaining pedestrians and cyclist become isolated and exposed [12]. With more children being driven to and form school, traffic problems escalate near schools. Around school car congestion during peak hours creates a dangerous environment for those children who walk, cycle or catch public transport. Engwicht (1992) identified that the increasing traffic has forced parents to drive their children to school because it is dangerous to walk [13].

2.1.4 Health Impacts

Collins and Kearns (2001) believed that this retreat by children into the car and indoors has been motivated in large part by adults' concern for their safety and this phenomenon has increasingly been linked to inactive lifestyles, declining fitness and weight problems [14]. High rates of child obesity point towards a systematic link between environmental conditions, personal behaviour and body weight [15]. Major factor is that children are simply not getting enough physical activity.

2.2 Alternative Travel to School

In many countries there are people and organizations working towards enabling and encouraging more children to make their own way whether it is by foot or bicycle with or without a parent [16]. Sustrans (1999) proposed following as a "Way to Go" strategies [17]:

- safe walking/cycling zones
- walking buddies
- walking school bus

Ridgewell, et al., (2005) found that the walking school bus idea originated in Brisbane in 1992, and has since spread to many other countries around the world. This idea was to engage parents to escort small groups of children to school by walking [12]. The idea got popular and increased international awareness of the journey to school and the need to reduce cars used to limit widespread problems resulting from this trend.

2.3 Initiatives towards Provision of School Transport in Islamabad

Islamabad Traffic Authority (ITA) is responsible for issuing transport routes to commercial vehicles in Islamabad in the larger public interest. The authority initiated a programme to provide school transport for schools in sector H-8 and H-11. According to their report [18] there are 71,018 school students in Islamabad details shown in table 1.

Table 1 Total strength of Private Schools in Islamabad

S.No.	Sectors	No. of Students
1	F-Sectors (F-6, F-7, F-8, F-10, F-11)	20,371
2	G-Sectors (G-6 to G-11)	15,853
3	H-Sectors (H-8, H-9)	20,967
4	I-Sectors (I-8 to I-11)	7,429
	Total	**64,620**

Source: Secretary Islamabad Transport Authority, Islamabad, 2010.

Currently 65 buses are available to government sector schools to pick and drop the students whereas; private schools do not own buses for school transport. Secretary ITA prepared a proposal of provision of 60 buses in the phased programme for safe transport facility for school going students. They prepared PC-I in the first phase to purchase 20 buses for students. The estimated total cost was Rs.198 millions which was to be funded through Islamabad Development

Package out of block provision of Rs.2189 millions. The project benefits were highlighted as under:

- To provide transportation facility for school going students on a safe manner by adopting necessary safety measures in Islamabad.
- Satisfaction of parents by saving their time which is being used for pick and drop of their children, fuel cost reduction, students' safety and no traffic hindrance during school time. Project also has employment chance for about 70 persons.
- Socio-economic condition of people of Islamabad would be improving by reducing load on natural resources like gas, diesel and petrol.

The implementation of the project was to be started from February 2010 subject to provision of funds and was to be completed up to January 2011. Unfortunately, could not get government attention and hence could not be initiated as yet.

3. Research Design

Sector H-8 in Islamabad, designed for institutions and having most of the top most private schools. Therefore, the research covers the schools of sector H-8. Figure 1 shows the location of educational institutions in sector H-8.

3.1 Sampling

Five major schools were selected in sector H-8 as they were considered having similar characteristics as compared to all other units. Total population of the target group was 10000 students. 10% random sample was considered appropriate to get understanding of the problem. The semi structured questionnaires and interviews were established and distributed among 1000 students, out of which only 450 were received back.

3.2 Research Methodology

Secondary data was collected from various organizations. Master plan of Islamabad, layout plans of sector H-8 and H-11 were obtained from CDA. Data regarding ambient air quality in H-8 was collected from Central Laboratory for Environmental Protection Agency (CLEAN), Ministry of Environment Islamabad, Islamabad transport Authority (ITA). National Transport Research Center (NTRC) was also visited to collect information. Data was also collected from school management through interviews. Personal observations were made through frequent visits during morning and evening. Islamabad Traffic Police was also contacted to find out most vulnerable points from traffic point of view and their efforts to regulate the traffic.

To measure the noise level, Sound Level Meter was used at different points around schools as CLEAN does not have data on noise of school transport around schools. After findings data was analysed graphically through chart and tables.

3.3 Case Studies Profile

To study the school transport system in sector H-8, 5 schools were selected to collect the required data. Following schools were selected for survey purpose to identify the problem:

- City School, Capital Campus, Sector H-8/1
- Beaconhouse School, Margalla Campus, Sector H-8/4
- Islamabad Convent School, Sector H-8/4
- OPF Boys College, Sector H-8/4
- Global System of Integrated Studies (GSIS), Sector H-8/1

The location of schools can be seen in plan (figure 2). The profile of selected schools as per information provided by the respective school administration has been given in table 1.

4. Findings

4.1 School Traffic

A questionnaire was designed and 1000 questionnaires were distributed among the students of these schools in which 450 questionnaires were returned. According to the survey, maximum numbers of students come from Sector I-8 i.e. 23.7% as compared to other sectors of Islamabad due to its proximity with Sector H-8 as shown in figure 3.

Table 2: Profile of Selected Schools in Sector H-8, Islamabad (Source: Data collected from School Administrations)

Aspects	**Schools**				
	City	**Beacon**	**Convent**	**OPF**	**GSIS**
Location	H-8/1	H-8/4	H-8/4	H-8/4	H-8/1
Status	Higher Secondary	Higher Secondary	Secondary	Higher Secondary	Higher Secondary
Type	Private	Private	Private	Semi-Government.	Private
Plot area (Acres)	2.70	4.91	3.87	6.12	1.21
Total No. of students	2400	3550	1220	1150	2000
Opening Time (am)	7:50	7:30	7:45	8:00	8:00
Closing Time (pm)	1:45	1:30	1:30	2:00	2:00
No. of vehicles coming to school	1000	2000	300	200	500
Owned school transport	No	No	No	Yes	No
Intention to provide school transport	No	No	Yes	Already provided	No

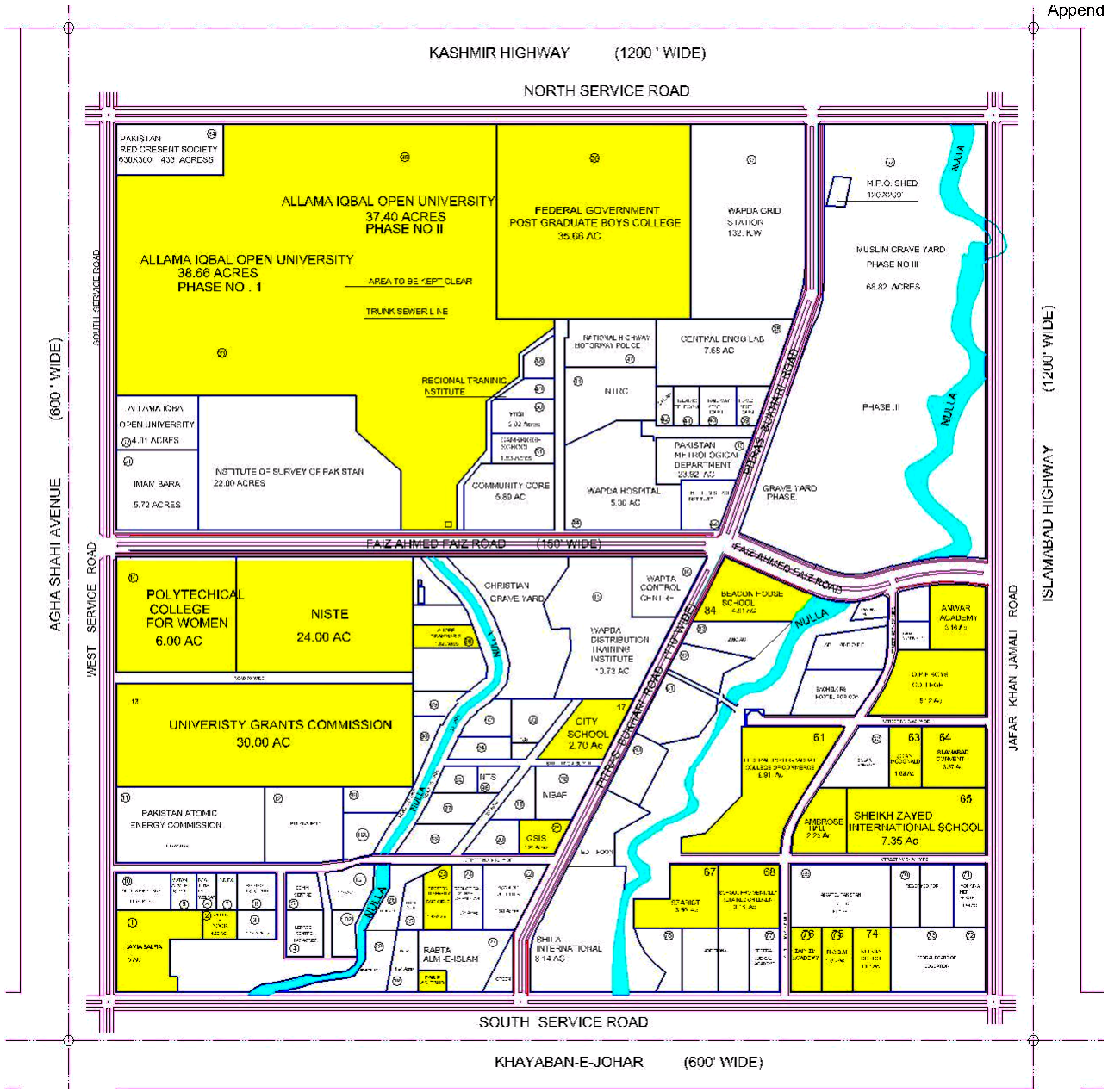

Fig. 1: Layout Plan of Sector H-8 showing Location of Educational Institutions (Source: CDA, Master Plan Department)

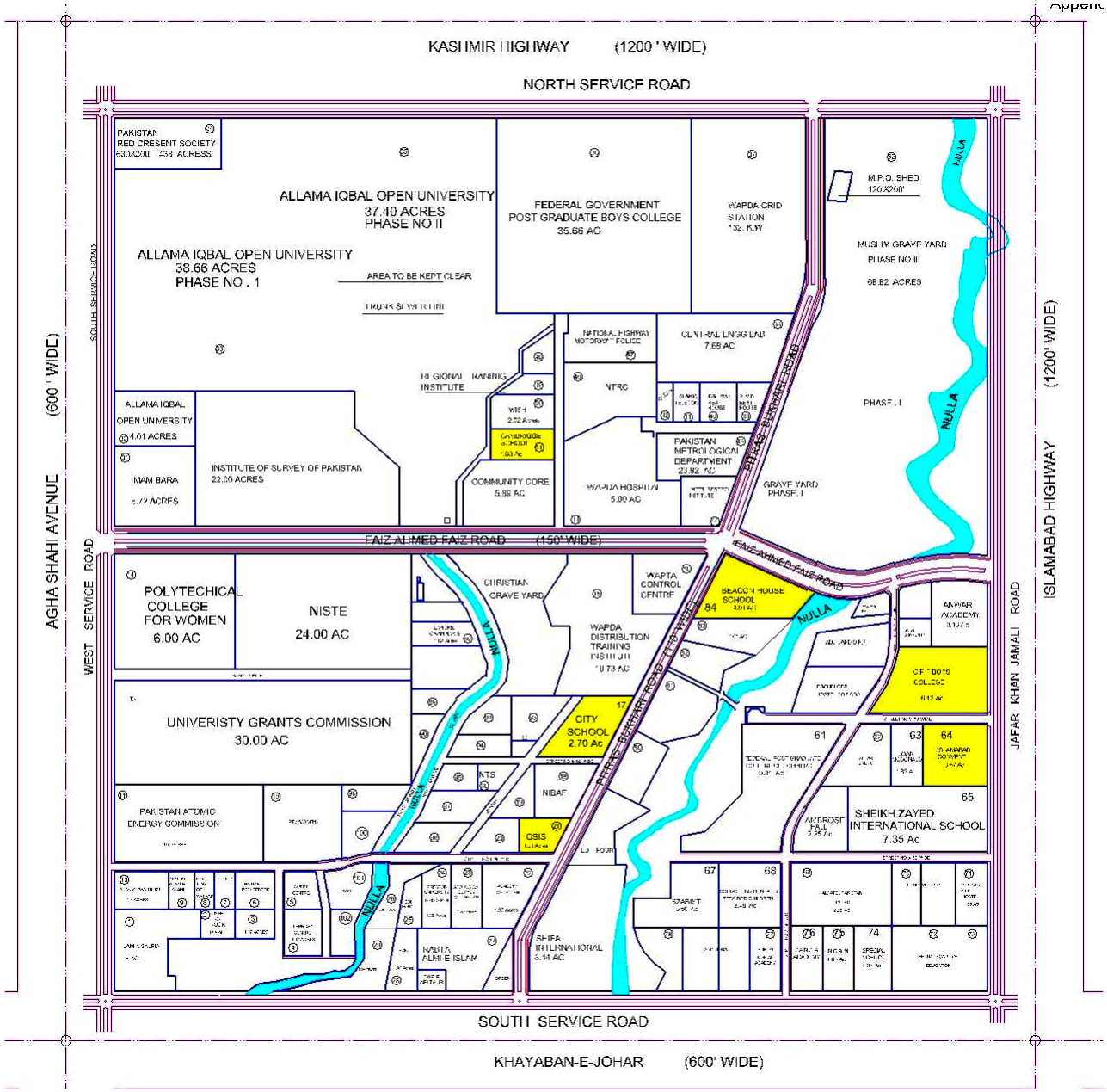

Fig. 2: Layout Plan of Sector H-8 showing location of Schools Selected for Research (Source: CDA, Master Plan Department)

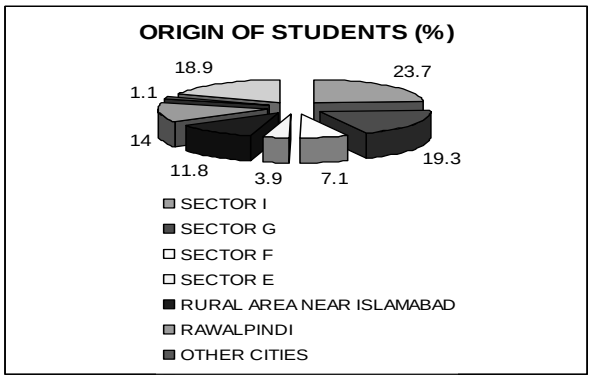

Fig 3: Origin of Students (Source: Questionnaire Survey)

Conducted survey also shows the distance travelled by students from home to school. Details are shown in table 2**.**

Table 3: Distance Travelled by Students from Home to School (Source: Questionnaire Survey)

S.No.	Distance (Kms)	No. of Students	Percentage
1	Less than 5	95	21.11
2	5-10	108	24.00
3	11-15	157	34.89
4	More than 15	5	01.11
5	No answer	85	18.89
	Total	**450**	**100.00**

Regarding provision of public transport from residences of students to their school, survey shows the result shown in table 3.

Table 4: Availability of Public Transport (Source: Questionnaire Survey)

Sr. No.	Availability of Public Transport	No. of Students	Percentage
1	Public transport available	386	85.78
2	Public transport not available	54	12.00
3	No response	10	2.22
	Total	**450**	**100.00**

Although the public transport is available in the city but surprisingly majority of parents prefer to use their private transport as they think it is safer for their children and consumes less time. Public transport does not run on scheduled timings. Vehicles are sub standard and do not fully comply with safety and security requirements. Figure 4 shows the details of transportation modes currently used by students. Table 4 has the details of time consumption with reference to the mode of available transport used by students to reach their school.

From all selected case studies only OPF Boys College has provided transport facility in form of school buses for their students. In this provision 43.48% of students are satisfied with the performance and quality of the bus service whereas, 39.13% are not satisfied and 17.39% gave no opinion about this. Students were asked about the school transport facility arrangement for them, 59.84% agreed to use it, while 40.16 refused to use school provided transport.

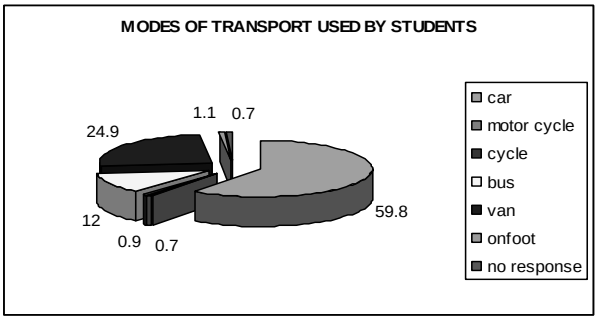

Fig. 4 Modes of Transport used by Students to Reach their Schools (%) (Source: Questionnaire Survey)

Table 5: Mode of Transport vs. Time Taken to Reach School (Source: Questionnaire Survey)

Mode of Transport	Time Taken to Reach School					Total (%)
	Less than 15 mins. (%)	15 to 30 mins. (%)	31 to 45 mins. (%)	46 to 690 mins. (%)	More than 60 mins. (%)	
Car	42.8	40.9	14.1	1.5	0.7	100%
Motor Cycle	33.3	66.7	0	0	0	100%
Cycle	50	25	0	0	25	100%
Bus	9.3	35.2	14.8	16.7	24.1	100%
Van	19.6	37.5	30.4	8	4.5	100%
On foot	40	40	0	0	20	100%
Total	**32.9**	**39.4**	**17.9**	**4.9**	**4.9**	**100%**

Also according to survey 19.8% students spend less than 1000 rupees on transport and 20.2% spend up to 2000 rupees per month to reach their school. School transport is available to students in only OPF School and 43.5% of students were satisfied with the performance and quality of bus service.

4.2 Traffic Condition

Sector H-8 in Islamabad is an institutional non residential sector having public and private educational institutes, hospitals and large public offices. Therefore walking behaviour from home to school was not considered in the present study. Road network in this area is sufficient to meet requirements of vehicular movements. Sector is accessible from all four sides with 1200 ft. wide Kashmir Highway in North, 600 ft. wide road in south, 1200 ft. wide Islamabad Highway in East and 600 ft. wide 9th Avenue (Agha Shahi Avenue). Major roads divide the sector into four sub sectors. The road pattern of sector H-8 can be seen in figure 5.

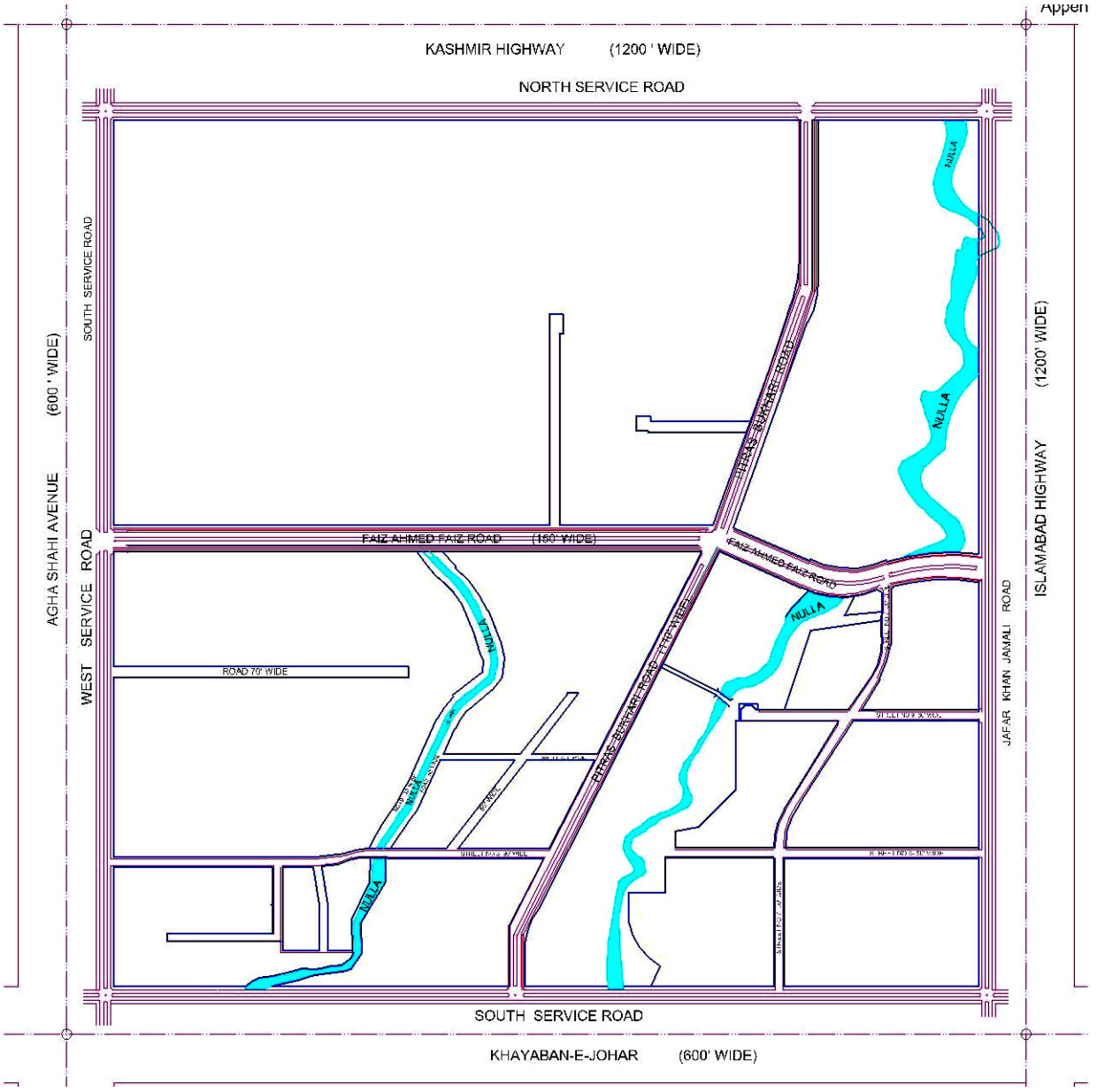

Fig. 5: Road Pattern of Sector H-8, Islamabad (Source: CDA, Master Plan Department)

The major load of traffic is on Pitras Bukhari Road and Faiz Ahmed Faiz Road due to the placement of schools on these roads (figure 5). From survey it is found that 4000 vehicles daily reach to five schools in sector H during opening and closing timing of schools. Although the width of these roads are satisfactory but due to huge vehicular volume and insufficient parking for schools road shoulders and major portion of carriageway of road is blocked by road side parking in 3 lanes at closing time (figure 6 &7).

This high influx of traffic at closing time not only pollutes environment, but also causes traffic jams, load on natural resources, and wastage of time and also causes mental tension.

Fig. 6 Faiz Ahmed Faiz road flooded with traffic near Beaconhouse (width 150') (Source: By Author)

Fig. 7 Pitras Bukhari road at closing time near City School (width 110') (Source: By Author)

4.3 Stakeholder Perspective

4.3.1 Capital Development Authority (CDA)

Concerned officials at CDA shared growing patterns of traffic congestion which were not estimated at the planning stage of sector H-8 as institutional sector. The lesson learned from this sector is now being considered for designing the future sectors exclusively meant for institutional purposes such as sector H-11. Better land use strategies are applied in sector H-11.

4.3.2 Parent's perspective

Parents have shown keen interest to opt for safe and secure mass transit arrangement such as school bus or coach managed by school administration. However, school administration in all schools is not willing to take up this responsibility and shared their reservation stating that they do not want to get into the business of troublesome transport management.

4.3.3 Islamabad Traffic Police

Islamabad Traffic Police is responsible to control traffic flow in the city and also be taken as one of the stakeholder for the research. During opening and closing hours of schools traffic increases much on roads. According to survey conducted by Islamabad Traffic Police (ITP), about 5000 vehicles come to pick and drop the children in sector H-8 schools. Mostly traffic jam was found at closing time when vehicles came before time and wait around school wherever they need space for parking. As a result, it creates hindrance in the smooth traffic flow.

ITP has deputed one mobile car and 12 officials from constable to inspector to regulate traffic during peak times. To create traffic awareness ITP developed education cell in Islamabad. This cell has formed traffic education theme park at Traffic office, sector F-8, Islamabad and launches different campaigns for traffic education. They also visited schools for awareness and to educate students as well. Traffic signals have been erected on major road junctions to control traffic but during school timings these signals are kept off and traffic is regulated by traffic police manually. School administration expressed satisfaction with the duties of ITP and resultantly all schools especially City school and Beacon house also depute their staff on adjoining roads (figure 8).

Fig. 8 Islamabad Traffic Police man at intersection during closing time of school (Source: By Author)

4.4 Parking

Beacon House School, City School, GSIS have developed temporary parking spaces on the adjoining vacant parcels of un-allotted land owned by CDA (figure 9). OPF and Islamabad Convent have made no arrangement for parking and vehicles are parked on road which aggravates the traffic problem and creates hindrance in the smooth flow of traffic. Beacon House and City school have blocked parking lanes outside the school by placing barriers for security purpose (figure 10). These barriers have not only blocked the parking space but have also reduced the road width.

Fig. 9 Temporary Parking lot outside Beaconhouse along Pitras Bukhari Road (Source: By Author)

Fig. 10 Barriers along the wall of Beacon house on Pitras Bukhari Road (Source: By Author)

OPF is the only school which has its own fleet of buses for pick and drop of students. The buses are parked inside the school in a shed (figure 11). Buses use school gate on other road without creating any traffic hazards. They have also provided parking space for staff within the premises.

4.5 Private Bus Service for School in sector H-8

Private bus service providers engaged in Sector H-8 to pick and drop students of City School and Beacon house School were also contacted. They have deployed 8 buses with 33 seating capacity and employed 20 persons to operate this transport. The bus completes its trip from 30 to 45 minutes. This service has reduced 200 cars coming to Sector H-8. The operators have showed willingness to extend the service to provide 50% students in sector H-8.

Fig. 11 Bus Parking sheds in OPF Boys College (Source: By Author)

5. Analysis

5.1 Impact of School Transport on Air Quality

In order to find out environmental impacts of school transport, different agencies had been consulted for the study. Data of air quality was collected from Central Laboratory for Environment Analysis and Networking (CLEAN) [19], Pakistan Environmental Protection Agency (Pak-EPA), Ministry of Climate Change, Islamabad [20], established at sector H-8/2. The intersection of Faiz Ahmed Faiz Road and Pitras Bukhari Road is the most problematic intersection from traffic point of view. During the peak hours this intersection faces maximum traffic load, as the traffic from all the four sub sectors of H-8 has to cross this intersection. In order to compare the effect of school transport on air quality, data of first week of December when schools were open and the last week of December, when schools were closed, was compared and displayed in table 6. The table shows the clear difference in readings between first weeks and last week of December.

Table 6 Comparison of average air values of air quality parameters along with Pakistan Ambient Air Quality Standards (source: CLEAN Pakistan EPA, Islamabad 2009)

Parameters / Time	From 13-14		From14-15		Pakistan Ambient air quality standards	Average time
	First Week	Last Week	First Week	Last Week		
NO_2 (µg/m³)	43.42	75.35	34.13	65.86	80	24 hours
CO (mg/m³)	0.50	1.00	0.42	0.84	5	8 hours
SO_2 (µg/m³)	9.64	17.57	8.56	15.22	120	24 hours
O_3 (µg/m³)	72.34	51.71	84.79	60.99	235	1 hour
PM (µg/m³)	53.07	152.16	35.83	121.66	40	24 hours

5.2 Noise Level near Schools in Sector H-8

According to National Environmental Quality Standards (NEQs) of Pak-EPA 85 dB (A) noise is permissible from a vehicle at a distance of 7.5 meters from the source. Data regarding noise level in sector H-8 was not available from Pak-EPA. In order to collect data, the device named Sound Level Meter (TM 101) was used and readings were collected at different points around schools in sector H-8 in different days i.e. when the schools were closed and when the schools were open.

Table 7 Noise level at Intersection of Islamabad Highway and H-8/I-8 (source: by Researchers; 2010)

S.No.	Time	Noise Level (dB)
1	1:50	68.3
2	1:51	77.8
3	1:52	82.5
4	1:53	62.2
5	1:54	70.3
6	1:55	78.0
7	1:56	76.6
8	1:57	70.5
9	1:58	69.8
10	1:59	80.8
	Average	**73.68**

The noise level at the intersection of Faiz Ahmed Faiz road and Pitras Bukhari road near Beacon house School was measured on two different days. On Saturday 27-11-2010, when there was no school traffic. The noise at this intersection varied from 43.2 dB to 78.8 dB with the average noise level in 10 minutes was 63.79dB and on Monday 29-11-2010 at school closing time. The intersection was full of traffic and noise level was ranging from 59dB to 84 dB with average noise at 70.15dB. Noise level at parking of Beacon house school was found 74 dB and at gate of the school, noise level was 73dB when the name of any student was called on megaphone this level reached 80 dB. Minimum noise level generated by traffic at Islamabad Highway was recorded 62.2 dB and maximum noise level was recorded 82.5 dB. However average noise at this intersection was observed 73.68 dB. This noise level was measured at peak hours when school traffic was also mixed with the normal city traffic.

5.3 Impacts of existing School Transport on the Built Environment

The transport has certain impacts on the built environment. It utilizes space on road, uses fossil fuels, emits green house gases, causes accidents, health hazard etc. Road transport is also a major contributor to local air pollution and smog. As it has been derived from the above study that about 4000 vehicles are daily coming to five schools of Sector H-8 therefore the impacts created by these vehicles can be calculated as under:

5.3.1 Road Occupancy

About 4000 cars come to five schools of Sector H-8, during opening and closing hours. The average car requires a space of 150 square feet on road and 4000 cars require 600000 square feet. With the capacity of a 3 lane road, about 3 kilometers long queue is required to pass 4000 PCUs on the road. Think of the time in which these vehicles can pass smoothly from the road. This calculation does not include traffic from other schools and offices of the same sector.

5.3.2 Parking Requirement

Parking requirement of a car is 150 square feet and for 4000 cars 600000 square feet (13.77 acres land) is required. While along road side parking space is not available. The cost of land in this sector is Rs.9000 per square yard. Thus, Rs.600 millions are required to provide land for parking of the vehicles coming to these five schools in Sector H-8.

5.3.3 Fuel Consumption

Average distance travelled by a student from home to school is 15 kms. A car covers 60 kms daily for school purpose. If the engine condition of the car is assumed very well, it travels 15 kms. with one litre of petrol. Thus, at least 4 litres petrol is required daily for one car and for 4000 cars 16000 litres petrol is required. If the cost of one litre petrol is Rs.80/-, then daily Rs.12, 80,000/- are spent daily by these cars for school trips.

5.3.4 Time Consumption

Average time taken by a car from home to school is 30 minutes. Thus, one hour in the morning and one hour in the evening is consumed by parents daily on one car and 4000 parents are consuming 8000 man hours daily. If these hours are calculated in the scale of money the millions of rupees are daily spent on this transport. Moreover, mental tension to reach the office/work place is also additional impact of this school trip.

5.3.5 Vehicular Emissions

As per notification of National Environmental Quality Standards (NEQS) for Motor Vehicles issued by the Ministry of Environment [21], various vehicles emit variety of Carbon Mono Oxide, Nitrogen Oxide, Hydro Carbons and Particulate Matter. If we compare the emissions of different modes, the pollution emitted by 4.5 cars is equal to one bus and emission of 4000 cars equates the emissions of 889 buses.

6. Conclusions

- In the light of the findings of the research it is concluded that World's 20% to 25% energy is being consumed by transport sector due to which green house gases are emitted in the air. The varying educational standards and thirst for better education compels the students to seek admission in remote areas which are not accessible on foot or bicycle, therefore the students are constrained to use various types of vehicles. Changing travelling modes may have serious threats on the children's physical health.

- The survey conducted for the research work has revealed that institutional area is away from the residential sectors and the students cannot walk to these schools, therefore they have to use various modes of transport. There are 30 planned educational institutions in Sector H-8 and 23 in Sector H-11 with no mass transit system in the city, therefore majority of the students use private transport. As a result the roads of sector H-8 remain choked during school opening and closing times. This diversified private transport is not only creating traffic hazard but also affecting the environment. In addition, it also poses a burden on natural resources and parents of such students.

- Ironically neither the school administrations, nor the government is ready to provide school transport to the students of these private schools. The school administration thinks this job impossible because of its variance in nature of their work. Government is reluctant because it cannot provide transport facility to its owned schools and private schools are out of its ambit. The Local Transport Authority made an effort to resolve the problem of school transport but the Government did not approve the PC-I of the project. However, students are agreed to use buses if they are properly arranged by the school. Private transport operators, who are already providing service at small scale, are also ready to expand this facility to serve at least 50% students strength in these schools, provided school administration and government is also agreed.

- It is finally concluded that personal mode used by the students for school is neither economical, nor environment friendly. This system is neither space effective, nor cost effective, neither environment friendly and not even time effective. Hence this system cannot be called a sustainable transport system and needs to be replaced by a sustainable transport system.

7. Proposed Model for School Transport

Keeping in view the preparedness of students to use school transport and willingness to pay the service charges and foremost the availability of transport provider, a combined transport system

comprising high capacity vehicles is proposed to be adopted for five schools of Sector H-8. Considering, the benefits of this sustainable transport system other schools will also adopt the same system. To provide school transport to 5000 student 83 buses are required. These buses will provide pick and drop facility to the students. For the remaining period, buses will operate as public service vehicle on their specified route. The cost benefit analysis of cars and buses is given below in table 8:

Table 8 Cost Benefit Analysis of Buses and Cars

Sr. No.	Item wise detail	Cars	Buses
1	No. of students	5000	5000
2	No. Vehicles	2000	83
3	No. of PCUs	2000	415
4	Distance travelled (kms)	120000	4980
5	Total Road space consumed (sft)	300000	29050
6	Daily fuel consumption(litres)	8000	1660
7	Daily Cost of fuel(@ Rs.80/liter)	6,40,000	1,32,800
8	Monthly cost of fuel (22 days a month)	1,40,80,000	29,21,600
9	Time consumption (man hours)	2000	332
10	Monthly salaries of the staff(Rs)	20,00,000	20,75,000
11	Monthly fare charges collected from 5000 students @ Rs. 2000 per student		1,00,00,000
12	Monthly maintenance cost (Rs.)	1,00,00,000	12,45,000
13	Emissions (g/km)	5400	1004
14	Total monthly expenditure (8+10+12)	2,60,80,000	62,41,600

Bus transport systems is sustainable because this is fuel-efficient, space-saving and promotes healthy lifestyles on the following grounds:

- Due to reduction of vehicles on road, the capacity of road will be increased. It can be explained in terms of transport engineering concept of passenger car equivalent also known as Passenger Car Unit (P.C.U's). PCU of bus, wagon, car and motorcycle are 4, 2.5,1 and 0.75 respectively. Therefore by using buses instead of other vehicles fewer roads will be used.
- High capacity transport is safe because due to reduction of vehicles on road, number of accidents will also be decreased. Skilled driver would replace untrained wagon and car drivers.
- Buses reduce environmental pollution emitting fewer emissions.
- Buses would reduce load on non-renewable energy resources and hence reduce depletion of resources. They will save precious time of parents/drivers which is wasted in the morning and evening. This time i.e. about 4000 man hours daily can be saved and this saved time can certainly be used in nation building.
- The school transport can reduce the mental tension and other psychological problems created due to the pressure of pick and drop of the children to and from school.

8. Recommendations

- All the private schools in sector H-8 should provide school transport to facilitate at least 50% of their students' strength.
- CDA should revise its policy of providing private schools in a cluster shape like sector H-8.
- CDA should also plan sites for private schools in residential sectors to cater the needs of public for quality education.
- Government should enhance the quality of education in its schools provided in residential sectors on planned school plots.
- Parking of vehicles should not be allowed on the carriageway of road around any school. School administration and Traffic Police should ensure no parking of vehicles on the carriage way of road.
- School administration should engage private parties to provide school buses for students in collaboration with Islamabad Transport Authority and Islamabad Traffic Police.
- CDA should revise cross section of Pitras Bukhari Road and Faiz Ahmed Faiz Roads in

Sector H-8 to provide maximum space for parking along roads by reducing the width of medians and placing New Jersy Barriers.

- The street No. 4 should be linked with newly constructed road along nullah in sector H-8/1.
- Islamabad Transport Authority should revise the public transport routes No.1, 3, 5, 6, 105, 111 & 121. All these routes of public transport should pass through sector H-8 to facilitate the students.
- School administration should encourage shared mode of transport. Parents of the students should be called and persuaded to use shared transport for their children to school.
- School administration should promote cycling for the students coming from nearby sectors where the distance is less than 4 kms. It will not only reduce the impact on environment but will also create confidence among the students to move freely at their own desire. It will also improve health status of the students.

References

[1] Victoria Policy Institute, (Sep.2007). Encouraging Alternatives to Driving to School, in: Online TDM Encyclopaedia, Retrieved from http:www.vtpi.org/tdm/tdm67.htm.

[2] Litman, T. (2007) *Accessible Schools Provide Many Community Benefits*, in:TDM Encyclopedia, Victoria Transport Policy Institute, Canada. Retrieved from http://www.vtpi.org

[3] Malik, M. H. (2000), School Parking Problems, A case study of Beacon house, city schools, Islamabad, national transport research centre, Islamabad.

[4] World Commission on Environment and Development (1987) Our Common Future: Towards Sustainable Development. In *UN Documents: Gathering a body of global agreements.* Retrieved from <http://www.world commission on environment and development>[Accessed on 15-12-2010].

[5] TDM Encyclopedia (2010) Sustainable transportation and TDM: Planning that balances economic, social and ecological objectives, Victoria Transport Policy Institute, retrieved from http://www.vtpi.org/tdm/tdm67.htm [Accessed on 16-02-2011].

[6] Thomas Randall (2003) *Sustainable Urban Design: An environmental approach*. Spon Press New York (p.26).

[7] Schiller Preston L, Bruun Eric & Litman Todd (2010) *An Introduction to Sustainable Transportation,* Earthscan, Global Investor Bookshop, retrieved from <http:/books-global-investor.com/books/444489/Preston-L.-Schiller-and–Eric-Bruun-and-T> [Accessed on 16-02-2011]

[8] WHO, Europe (2008)

[9] Paik, A. (1998) Why Kids don't Walk to School: Car Centred Land Use Makes it a Risky Trek, The News and Observer Publishing Company: Raleigh.

[10] Meaton, J. & Kingham, s. (1998) Children's Perception of Transport Modes: Car Culture in a Classroom? World Transport Policy and Practice. Vol. 4, No. 2, pp. 12-16

[11] Wenban-Smith, J. (1997) safe routes to Schools. Transport Retort, Vol. 20, No. 6 pp.12-13.

[12] Ridgewell Claire, Sipe Neil &Buchanan Nick.(2005) School Travel Modes in Brisbane,*Urban Research Program.* Griffith University. retrieved from http://www. griffith. edu.au/ centre/urp.

[13] Engwicht, D. (1992) Towards an Eco-city: Calming the Traffic. Envirobook, Sydney

[14] Collins, D. & Kearns, R. (2001), The Safe Journeys of an Enterprising School: Negotiating Landscapes of Opportunity and Risk.Health and Place, Vol. 7, pp. 293-306

[15] Frank, L., Engelke, P. & Schmid, T. (2003) Health and Community Design: The Impact of the Built Environment on Physical Activity. Island Press: Washington DC

[16] Ussher, S. (2004) A Ticket to a Sustainable Future for the Walking School Bus Programme: An Evaluation of the Long-Term Durability of the Initiative within the Christchurch Context. Unpublished Master of Arts Thesis: University of Canterbury.

[17] Sustrans (1999) Safe Routes to Schools. Information Sheet, FS01. Sustrans, Bristol.

[18] Crime Correspondent, The News, 2010, Transport system to be improved in capital , article published in International The News, Dec. 7, 2010

[19] CLEAN (2009) *Ambient Air Monitoring for Islamabad December 2009*,Pakistan Environmental Protection Agency, Ministry of Environment, Government of Pakistan.

[20] Pakistan Environmental Protection Agency (Pak-EPA), Ministry of Climate Change, Islamabad.

[21] Ministry of Environment, Government of Pakistan, National Environmental Quality Standards for Motor Vehicle Exhaust and Noise, Gazette of Pakistan. August 20