



Vehicle Washing and Water Security in Pakistan

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Abstract

Vehicle washing is a universal phenomenon. Automobile services stations are increasing in Pakistan due to increasing number of vehicles. This study is conducted to observe the people's behavior towards the use of water for vehicle washing and to check how much amount of water is used to clean vehicles at service stations in Faisalabad city. Large quantity of water is pumped from underground water for washing purposes that causes exhaustion of water, deterioration of underground water and surface water as well. A questionnaire is used to collect data from twenty five vehicle service stations to determine number of vehicles being washed per day and water utilization per day. On average 28 vehicles which include bikes, cars, jeeps, vans and land cruisers are washed daily on every vehicle wash service station while on the special occasions or on weekend number of vehicles being washed increases. Pakistan is already facing the shortage of water reported in different researches. Descriptive analysis of water consumption per vehicle and total amount of water used to wash the vehicles is carried out and found that about 78 to 240 liters of water is consumed to wash a vehicle depending upon the size of the vehicle. It is concluded that use of drinking water for washing vehicles in the city is being viewed as a criminal waste of water which needs to be avoided by utilizing recycled water and use of water reclamation system.

Introduction

Water is vital resource provided by nature to humans. Water is necessary for any kind of activity to occur. It is also basic necessity of life. We being humans have greater responsibility to use water in an efficient and reasonable way. But for our convenience we use water intensively. There is also misuse of water in the world which may also lead to water pollution. The available

fresh water to man is hardly 0.5% of the total water available on the earth (WBCSD, 2005). Population growth, urbanization and industrialization, migration along with increases in production and consumption, have generated ever-increasing demands for freshwater resources (WWDR, 2015). Over the last few decades, the rate of demand for water has doubled as compared

to rate of population growth (Shiklomanov, 1999; USCB, 2012).

There are three main sources of water in Pakistan; ground water, surface water and rain water. The potential of surface water in Pakistan is 151.58 MAF annually. This includes 143.18 MAF from the three western rivers and 8.40 MAF from the eastern rivers. The ground water has a potential of 41.6 MAF in Pakistan (Pakistan Water Strategy Report, 2002). Water is used for both irrigation and non-irrigation purposes in Pakistan. The mainly used source of water in Pakistan is ground water except electricity production and irrigation. No doubt ground water is used for irrigation but surface water is also used. Ground water is used for various purposes in Pakistan like irrigation, household use, industrial purposes and other domestic purposes such as vehicles washing. At present, ground water contribution to water availability in Pakistan is 48 MAF (Ahmed *et al.*, 2013). Ground water supplies are diminishing, with an estimated 20 percent of the world's aquifers being over exploited (Gleeson *et al.*, 2012) leading to serious consequences such as land subsidence and salt water intrusion (USGS, 2013).

Major proportion where water is misused comes from industrial processes and vehicle washing. We are rapidly extracting ground water for vehicle wash which will be full of dirt in 20-30 minutes. The vehicle washing industry is one of major sources of depletion of ground water. In Pakistan ground water is considered a public good. Anybody can install a hydraulic pump and extract ground water for its use. Nobody can ask you to don't do that.

We are depleting our water resources very quickly. If we go some 15 years back, the water table was high. We found water at 30-40 feet depth. But with advancement in life everyone is having its own pump to explore water. The water table has gone deep. Now a

day's water is found at 100 feet depth and in some areas even deep than this. According to the data released by the World Resources Institute (WRI), Pakistan is predicted to be the most water stressed country in the region by the year 2040 (Maddocks *et al.*, 2015). There is no concept of rain harvesting in Pakistan. Billions of gallons of surface water are disposed into sea due to lack of conservation structures.

In Pakistan per capita water availability has sharply declined from 5600 cubic meters in 1947 to around 1100 cubic meters for a current population of approximately 180 million. This situation is worsening as the population increases, which is expected to reach 220 million by 2025. Based on these trends it is likely that per capita water availability will decline to around 800 cubic meters by 2025 (GOP, 2015).

The number of vehicle service stations in Pakistan is rapidly increasing due to more preference to private transport. Every vehicleservice station deals with at least 20 to 30 vehicles daily and each vehicle takes an average of 150 to 227 liters of water depending on size of the vehicle (Yasin *et al.*, 2012). The source of water in vehicle eservice stations of Pakistan is ground water. We are recklessly exploring ground water ignoring the condition of ground water in future.

Vehicle wash industry is also a source of water pollution (ground water and surface water). The petroleum products (grease, anti-corrosive sprays etc.) are also used in vehicle wash industry to avoid corrosion of iron products (Yasin *et al.*, 2012). In vehicle wash industry different detergents are used. The components of these detergents flow towards drains some of which leach down to ground water and some reaches rivers and canals and deteriorate surface water quality.

These products are sources of pollutants such as hydrocarbons which are organic in nature. The Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), oil and grease values of waste water from Car wash industry is higher than National Environmental Quality Standards (NEQS). The waste water from vehicle wash industry is very harmful for aquatic life as well as human life. We conducted a study in Faisalabad city. A large number of vehicles are present in the city. The number of vehicle service stations is immeasurable in this city because many service stations are unregistered that's why collection of data is laborious job and takes long time.

Studies carried out in the different parts of the world have shown that waste water from vehicle wash service stations constitutes a potential source of water, air and soil pollution (Kumar *et al.*, 2014; Muzamder and Mukherjee 2011; Paxues 1996; WEF 1995; US-EPA 1991). The average consumption of water per vehicle wash reported by Rosenblum (2001) is 177 L per vehicle and by Brown (2002) are 57 L, 129 L and 163 L for self-services, conveyor and in-bay car wash categories, respectively. In contrast, it is reported that in Queensland, Australia use of 70L of fresh water for vehicle washing is mandatory in a single vehicle wash some countries in Europe restrict the water consumption 60 to 70 L for single vehicle wash (QWC, 2008 a, b; boussu *et al.*, 2007). While in Pakistan 150 to 200 L fresh water is used to wash a single vehicle (Malik 2012; Yasin *et al.*, 2012).

The results presented in this paper focus on the vehicle washing industry. The specific objective of this study is to determine volume of fresh water used in vehicle washing industry and its impact on our water resources.

Methodology

Many petrol pumps and service stations are surveyed to examine current practices and to collect data for

analysis. There are four major petrol pump companies operating in Faisalabad city; Shell, Pakistan State Oil (PSO), Caltex and Total Parco. For survey, twenty two petrol pumps and three private vehicle service stations are conveniently selected and it is tried to cover major areas of Faisalabad i.e. General Taxi Stand, Faisalabad Clock Tower, Jail Road, D-Ground, People's Colony, Nishatabad, Ghulam Muhammadabad and Gulberg.

A questionnaire was prepared to inquire the employees about practices adopted at the vehicleservice stations. Questionnaire includes questions about number of vehicles washed per day, usage of water per vehicle wash, source of water and disposal of waste water. Amount of water consumed per vehicle wash cannot be properly estimated because all vehicle service stations that were visited during survey, none of them take into account that how much water they are using. There are no meters to check how much water is utilized by a service station daily. Hence to encounter this problem, five liters of bottle was filled through same pressure nozzle that was used to spray water on vehicle at selected twenty five vehicle service stations. A stopwatch was used to note time for filling of the bottle. Then time consumed for washing of a vehicle was noted and it was estimated that how much water is consumed per vehicle wash.

The information so collected is used to estimate the wastewater generation fromvehicle service stations in the Faisalabad city. Then it is calculated forper day and per year water consumed at each vehicle service station. On each vehicle wash station, average consumption of water per vehicle wash is calculated by using following relationship:

$$\bar{x} = \frac{\sum_{i=1}^n x_i}{n}$$

\bar{x} = Average volume of water used per vehicle
(Liters)

x_i = Volume of water consumed per vehicle wash
(Liters)

n = Total number of vehicles visit per day

Results and Discussions

Companies in vehicles wash industry provide washing, exterior and interior cleaning, vacuuming, polishing and waxing services for cars, trucks, vans, and trailers. Some service stations offer vehicle maintenance and repair and safety inspection services and sell automotive products. The waste water from vehicle washing process contains oils, suspended matter, lubricants, tar, heavy metals and micro-organisms, which often end up in soils and thus are a danger to the groundwater.

Table 1 shows the duration and volume of water used to wash a vehicle. The average water use is determined primarily by the size of the vehicle but the wash procedure (pressure hoses and guns), the experience of the operator and how dirty vehicle is may influence water requirement and time duration. While a bike requires an average of almost 80 L during approximately 7 minutes of wash time, a compact car requires 168 L during 14 minutes wash time and a jeep or van needs approximately 240 L and 20 minutes. Each vehicle takes an average of 151 to 227 liters of water depending on the size of vehicle (Yasin et. al., 2012) is similar to the range of mean values (78 to 240 L per vehicle, Table 2) observed at vehicles service stations of Faisalabad.

Table 1: Water use and service duration per vehicle for wash

Type of vehicle	Average time required to wash a vehicle	Average time required to fill 5 liters bottle at given pressure	Average volume of water used per vehicle
Bike	6.5 min	25 sec	78 L
Car	14 min	25 sec	168 L
Jeep/Van	20 min	25 sec	240 L

During the visits to several service stations, it is observed that the client are owners of bikes, small cars, jeep, land cruisers, van and vans. Heavy vehicles like buses and truck are not washed in these type of public service stations. Most of the truck and bus companies have their own wash stations. Table 2 shows the average number of vehicles of several types washed in 22 petrol pump’s vehicle wash stations and 3 private vehicles service stations. On average 11 bikes, 14 small cars and 3 to 4 jeeps or vans are washed daily in each vehicle wash station. This number, however, increases on special occasion such as Eid or after rain fall.

Table 3 shows the average time duration per vehicle wash depending upon the size of vehicle. Almost 6 to 7 minutes are required to wash a bike with pressure nozzle. Almost 2 to 3 times (before and after use of detergents and soap and final wash) water is used during complete washing of a vehicle. A small car needs approximately 14 to 15 minutes for full wash with pressure nozzle and a van or jeep requires approximately 20 minutes wash time.

Table 2: Number of vehicles washed per day

Type of vehicle	N	Mean	Min-Max	Std. Dev.	CV (%)
Bike	25	11	8-20	2.72	24.7
Car	25	14	10-22	3.71	26.5
Jeep/Van	25	3	2-4	0.73	24.3

Min – Max= Minimum-Maximum; CV (%): Coefficient of variation = (100 * Std. Dev. /Mean); Std. Dev. = Standard deviation; N= Total number of vehicle service stations visited.

Table 3: Duration of vehicle wash (min)

Type of vehicle	N	Mean	Min-Max	Std. Dev.	CV (%)
Bike	25	6.5	5-8	1.04	16
Car	25	14	13-16	1.05	7.5
Jeep/Van	25	20	16-25	2.32	21.6

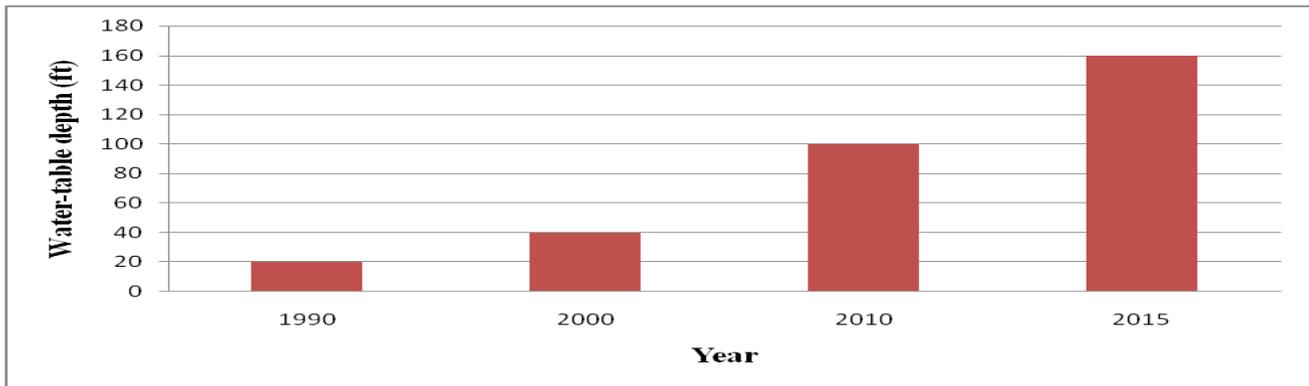
Above data is useful for setting the range of capacity for the reclaims systems that are needed in vehicle wash sector of Faisalbad. The use of drinking water for washing more than 1 million vehicles in the city is being viewed as a criminal waste of water which needs to be avoided by utilizing recycled water. Assuming an average of a vehicle wash every week the water use comes to 17.2 million liters per day. At 2.5 liters per day, this represents drinking needs of 6.86 million people, about double of Faisalabad’s population. Table 4 shows the total number of vehicles washed per day in 25 vehicle service stations visited in Faisalabad, average consumption of water per vehicle and total consumption of water in one day, one month and one year.

Table 4: Total number of vehicles washed per day and total water utilization per day

Type of vehicle	No. of vehicles	Average volume of water used per vehicle	Total volume of water use per day	Total volume of water use per month	Total volume of water use per year
Bike	277	78 L	21606 L	648180 L	7778160 L
Car	355	168 L	59640 L	1789200 L	21470400 L
Large size vehicles (Jeep/Van)	74	240 L	17760 L	532800 L	6393600 L

The source of water at all service stations was underground water. They do not take into account that how much water they are using which negatively impacts the level of our underground water tables. Underground quality of water in Faisalabad is already poor which more deteriorate due to these activities as washing of vehicles release very harmful substances in sewage water which is ultimately seeps into ground water. According to Punjab irrigation department, the water table in the province is going down by three feet per year. In Faisalabad, for instance, water could be extracted at 20 feet 25 to 30 years ago but now drilling has to be done up to 160 feet to reach water. Figure 1 shows the behavior of ground water level in Faisalabad city.

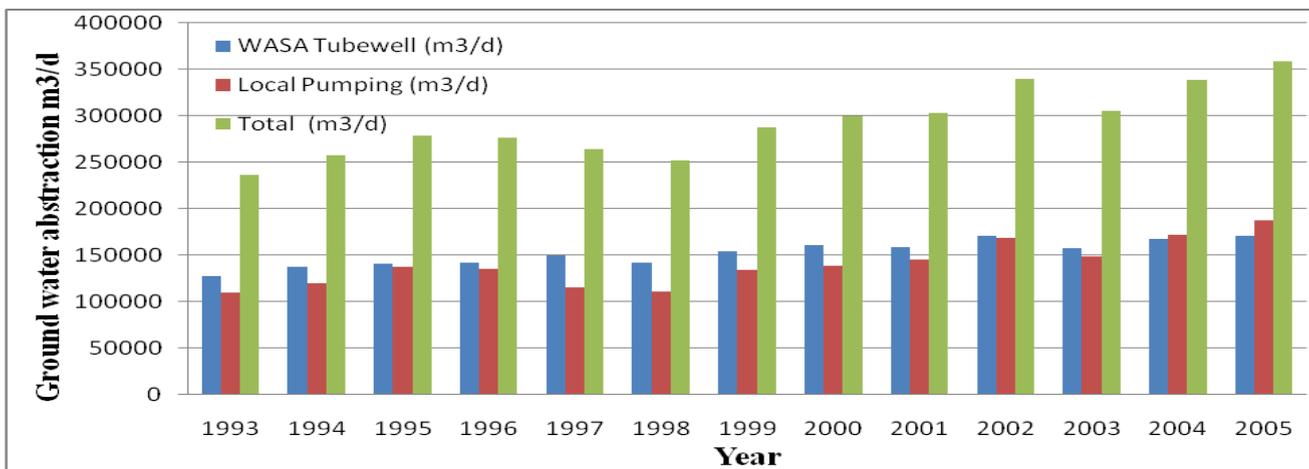
Figure 1: Ground water level behavior in Faisalabad



The World Bank and the Asian Development Bank have already categorized Pakistan as a water-stressed country, likely to face an acute water shortage over the next five years due to the lack of surface water availability for irrigation, industry and human consumption. If this trend continues, the ground water table will come under severe pressure. Ground water abstraction has significantly increased from almost last

one decade. Due to this, ground water table is going down. According to water and sanitation authority (WASA), its tubewells pump water from an average depth of 150 meters. Figure 2 shows the abstraction of water by WASA tubewells and local pumps in cubic meters per day in Faisalabad city. This trend shows a huge increase in total abstraction of water from 1990s to 2005.

Figure 2 Abstraction of ground water in Faisalabad city from 1993 to 2005



Conclusion

Pakistan is facing the shortage of water due to intensive use of water resources particularly ground water. People don't take into account the future concerns about water availability. Pakistan is one of the leading

countries in the misuse of water; there is no legislation regarding the water exploration from groundwater and there is no specific mechanism developed for rain harvesting.

Results show that there is an average 4000 liters of water is consumed at one service station per day in Faisalabad. Underground quality of water in Faisalabad is already poor which more deteriorate due to these activity as washing of vehicles release very harmful substances in sewage water which is ultimately seeps into ground water.

The leading misuse of water in Pakistan is in the textile industry, vehicle washing and agriculture sector. We conducted survey about the consumption of water in vehicle wash industry. It is found that approximately 78 to 240 L of water is consumed for washing one vehicle. It is estimated that there is almost one million gallons of water utilized annually on these 25vehicle services stations. Thus use of drinking water for washing vehicles in the city is being viewed as a criminal waste of water which needs to be avoided by utilizing recycled water.

Policy Recommendations

There are many ways to reduce the water consumption and the impact of vehicle wash runoff includes outreach on management practices to reduce discharge to storm drains. Vehicles wash installation with water recycling system is a best way to utilize water efficiently during vehicle washing and to avoid water, soil and air pollution. Approximately 75-90% of the fresh water that is required can be saved in such a system.

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