Car ownership in Aruba in 2010

The prevalence of a high level of motorization

Aruba
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Contents

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Introduction

The car has become an indispensible part of our daily living. The possession of a car provides the means to move around freely any time and at own convenience. The car is not only important as a means of transport but often symbolizes prosperity and personal status as well. Important determinants for why we use the own car in the first place is the lack of easy access to alternative means of (public) transport or the lack of safety on the road (Buehler, 2010). On the other hand, concerns about the impact on the environment inspire to search for alternative (cleaner) means of transport, more safe opportunities for cycling or walking and easier access to public transport or the combination thereof.

Another downside of car ownership is that it brings along costs and when the use of a private car is crucial but the financial means are limited, these costs are likely to go at the expense of other direct needs. Car ownership is positively related to the growth of income, but the elasticity of this relationship is more apparent in the city centers as it is in the more rural communities. A model by Dargay (Dargay, 1999) shows that car ownership in rural communities is less sensitive to costs of motorization than in the urban areas. In the more distant regions inhabitants simply rely more on the car as there is little alternative means of transport available. In Aruba, a clear distinction between rural and urban areas cannot be made but a similar geographical and socioeconomic differentiation as described above may just as well apply. Insight into such geographical differences is important for urban planning.

Road traffic is known as a common source of a number of health impacts[1]. Residents are exposed to noise and air pollution and not only the driver of car but also as a pedestrian they are vulnerable to become victim to traffic injuries (EU, 2010). Confronted with an increase in intensity of daily traffic one may feel apprehensive about how the future will look like in Aruba. The daily phenomenon of slow moving lines of cars on the way to work or school and back to home have become a nuisance that many complain about. Specifically, during peak hours in early-morning, at noon and at five, roads in Aruba clutter and a 'ten minutes' drive can easily take half an hour or longer.

In order to gain insight in the location of traffic related concerns, we present an overview of the level of accidents and the changes thereof over the years as well as provide a detailed geographical representation of the traffic and noise related inconveniences that are felt in the direct vicinity of living quarters. One of the interests in this study is to define the characteristics of car ownership in relation to geographical location of households and population growth. We will review the density of cars in different zones[2] and compare the motorization rate in Aruba internationally.

This paper is a first of two papers that focus on traffic related aspects in Aruba. In a second paper (Derix, 2013), we will focus in more detail on the pattern of daily commuting between home, work and school and the characterization of car ownership by the more vulnerable groups and their accessibility to the network of public transport.

The analyses in this paper are based mainly on the data from the Census in 1991, 2000 and 2010. Detailed information about the methodology of the Censuses can be found in the subsequent Census Population and Housing reports (Census, 1991) (Census, 2000) (Census, 2010).

[1] Studies on the relationship between car noise and exhaust and environment and health: (EU, 2010) (McCreanor, 2007) (Krämer, 2010) (Ketzel, 2007) (Braback, 2009)

[2] see Appendix A for an overview of administrative zones in Aruba

A growing number of motorized vehicles

A common perception amongst traffic users is that in recent years the number of cars on the road must have increased dramatically. In this study we have our focus on passenger cars[3] as this is the type of information that we retrieved from the Census survey. Cars owned by companies or (non-) governmental organizations (see Appendix B for an overview), have not been included in this study.

According to the Census in 2010 there were 44,739 cars owned by households[4] (Table 1). Over the last 10 years the number of passenger cars in Aruba increased by 36.4% (approx. 12,000 cars). In numbers this increase equals to the decade before (approx. 12,500 cars) but in relative growth (to the period before) the number of cars in Aruba appears to have slow down (36.4% in recent decade versus a 62.1% growth between 1991 and 2000).

In population numbers, however, over the same periods, the relative growth is not only much less but the slowing down of this growth is much stronger as well. We see a 36.8% followed by 11.9% growth in population numbers and a 52.1% respectively 19.1% increase in housing units during the successive two decades.

Thus the growth in number of cars appears to be somewhat stronger than in population and number of housing units. We find that the average number of cars per housing unit increased from 1.05 cars per housing unit in 1991, to 1.12 cars in 2000 and as high as 1.28 cars per housing unit in 2010, i.e. an increase from 6.6% to 14.5% in relative growth between the two decennia.

Table 1 Comparison between the numbers of private owned cars, population size and (non-collective) housing units between consecutive Censuses in 1991, 2000 and 2010.

N	1991	2000	2010	increase 1991- 2000		increase 2000- 2010	
Cars	20,236	32,801	44,739	12,565	*62.1 %*	11,938	*36.4 %*
Population	65,807	89,990	100,696	23,303	*36.8 %*	10,706	*11.9 %*
Housing units	19,224	29,246	34,845	10,022	*52.1 %*	5,599	*19.1 %*
Cars per housing unit	1.05	1.12	1.28	0.07	*6.6 %*	0.16	*14.5 %*

Source: CBS Aruba. *Reports from Population and Housing Census: Selected tables in* 1991, 2000 and 2010.

Note: *The figures refer to the situation at respective Census moments and not at the end of year.*
The number of cars (N) is calculated as the sum of all households multiplied by the corresponding number of cars in possession (see also table 2). The Census questionnaire limited the information about number of cars in household possession to '5 or more'. Households that mentioned to have '5 cars or more' in their possession were conveniently treated as to own 5 cars exactly. Consequently, we expect to have introduced a small bias on the calculated total number of cars. Households that have failed to provide information on the number of cars owned were treated as to own the average number of cars. The non-response was small however (1% of all households).

The abovementioned growth in the number of cars per household is supported by data from the Tax Collectors' Office based on yearly registrations (CBS Aruba). The data accentuate the increase in passenger cars during the last twenty years with a slight downturn in numbers in 2007 (Figure 1, Appendix B). The origin of this dip is not sure, but at that time a worldwide economic crisis was developing (US Dept. Energy, 2010). Also, import duties had changed in 2006 and in 2007 a new system of taxation (BBO) was introduced that was followed by an increase in local prices. It may be their combined effect that resulted in the dip in vehicle registrations after 2006.

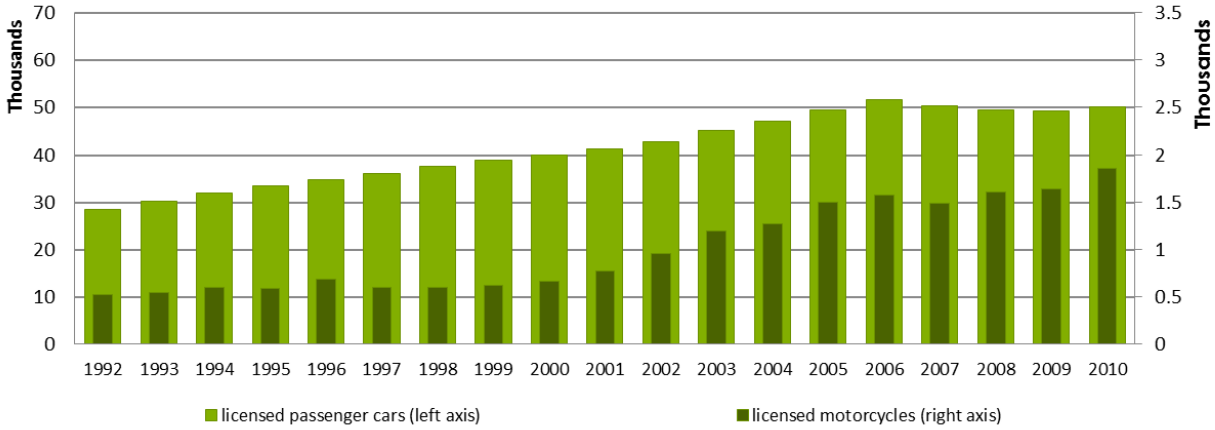
We present the number of registered motor vehicles as well as these serve as an alternative means to motorized private transport. The distribution of registered motorcycles (right axis in Figure 1) follows a similar pattern with a dip in 2007 but the recovery in 2010 is more prevalent. Note, that the total

[3] In the questionnaires of the Census in 2010 we used more explicitly the term 'working car' to refer to a private passenger car in order to emphasize that we do not refer to cars in repair or otherwise unused cars. Throughout this paper we will use the term 'car' when we refer to a 'working car'.

[4] Per definition, a housing unit is occupied by exactly one household in all three consecutive censuses.

number of motorcycles however is only a few percent of the total number of cars (for instance close to 2,000 motorcycles versus roughly 50,000 passenger cars in 2010).

Figure 1 Number of licensed motorized vehicles in Aruba



Source: Tax Collector's Office, Aruba (see full table in Appendix B). For reference of the data we refer to the respective statistical yearbooks from the CBS Aruba.

We compared consecutive censuses with respect to the number of cars in a household (Table 2). The table shows the number of households for each of the situations where there is none, a single, or several (two, three, four, or five and up) cars present in the household. We observe a trend that there are fewer households without a car but more households with 2 cars or even more.
The data show that in 2010 compared 2000 and 1991, nearly an equal amount of households have no car (6,243 respectively 6,989 and 5,112), but the absolute numbers are misleading as the number households over these years increased. Proportionally, in 2010, only 17% of households had no car, against 23.9% in 2000 and 26.6% in 1991. Also, in 2010, more so than in 2000 and 1991, there are more households that own two or more cars. In 2010, 27.9% of households owned two cars against 23.9% in 2000, whereas in 1991, 21% possess two cars.

So, in 2010, close to five out of six households own a private car and more than one in three households own even more than a single car and this percentage has been increasing in recent decennia. Interestingly, the average household size decreased from 3.5 persons per household in 1991 towards 3.1 in 2000 and 2.9 in 2010 (we refer to subsequent Census Population and Housing reports). Thus, contrasting to what we expect on the basis of a tendency towards a smaller household size, we observe even slightly more cars per housing unit and this is remarkable. Despite this shift, during all three consecutive censuses the percentage of households with a single car in possession remained more or less stable (respectively 47.4%, 45.6% and 45.3% in 1991, 2000 and 2010).

Table 2 Comparison of housing units with a given number of cars in ownership in 1991, 200 and 2010.

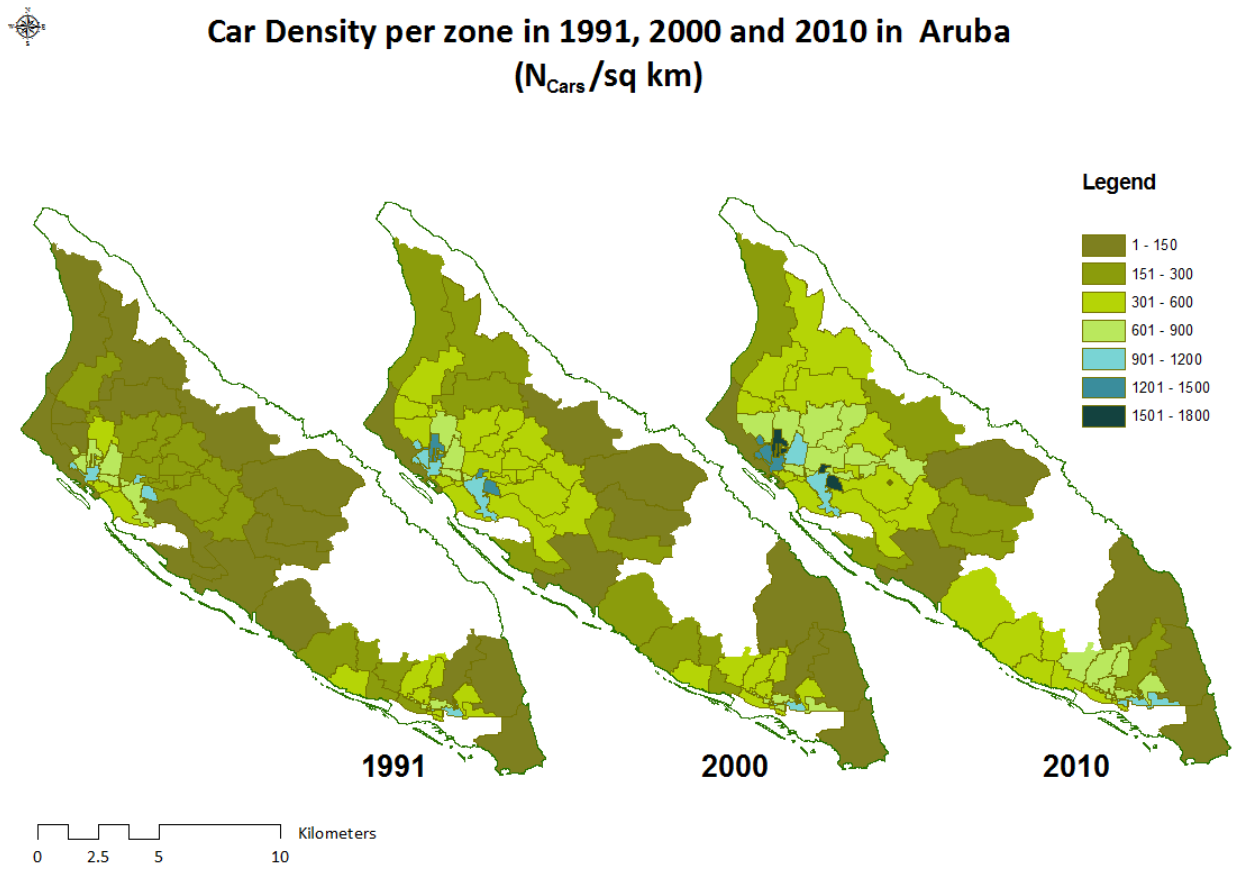
	Number of housing units per given number of cars							% of housing units per given number of cars						
Cars	0	1	2	3	4	5+		0	1	2	3	4	5+	
2010	6,243	15,776	9,731	2,185	493	120	34,845	*17.9*	*45.3*	*27.9*	*6.3*	*1.4*	*0.3*	*100 %*
2000	6,989	13,349	6,980	1,347	282	64	29,246	*23.9*	*45.6*	*23.9*	*4.6*	*1.0*	*0.2*	*100 %*
1991	5,112	9,120	4,036	710	150	47	19,224	*26.6*	*47.4*	*21.0*	*3.7*	*0.8*	*0.2*	*100 %*

Source: CBS Aruba. Reports from Population and Housing Census: Selected tables in 1991, 2000 and 2010.

Changes in the geographical distribution of private cars between 1991, 2000 and 2010

The growth of the car park in Aruba over the last three decennia and its geographical shift is visualized in figure 2 and expressed as the 'density of passenger cars per GAC zone'. We note that the change in the number of cars per zone relates directly to the growth of the Aruban economy, i.e. the expansion of the population size and number of households in these zones (underlying data are presented in Appendix C).

Figure 2 Car density (number of passenger cars per km^2) per zone[5] in Aruba in 1991, 2000 and 2010.



Source: CBS, Aruba. Census 1991, 2000 and 2010.

Note: The white areas in the maps above are uninhabited (i.e. the *National Park Arikok,* the Spray park long the northeast coast, the location of the *Oil Refinery* just south of San Nicolas, and, the *Airport Reina Beatrix*, south of Oranjestad.

The maps of three successive decennia clearly reveal the amount of (sub-)urbanization that took place in Aruba. There is a shift from predominantly car ownership in and around the dense population centers Oranjestad and San Nicolas in 1991 outwards to surrounding regions. In particular in the populated zones *36-Tarabana* and *25-Paradijswijk/Santa Helena* (indicated by the dark color on the map from 2010) car density has become extremely high in 2010 (approx. 1,700 cars per sq.km; we refer to Appendix C). Absence of an increase is observed yet in only a few of the less densely populated zones, i.e. in the area northeast of San Nicolas and more central halfway on the island. During the last decennium, we observe a strong growth in the density of cars in the Northern part of Aruba, in conjunction with the increase in the number of households in these areas. In 2010, the density of cars is considerable almost everywhere in Aruba and increased from 113 cars per sq.km on average for all of populated zones in Aruba in 1991 towards 183 cars per sq.km in 2000 and 249 cars per sq.km in 2010.

[5] For a listing of the names and locations of the administrative zones in Aruba we refer to Appendix A.

Changes in the rate of motorization in recent years

Motorization rate[6] is an important indicator and is frequently used to describe economic development (Torre, 2009) (Sharma et al, 2011). A high motorization rate (number of cars per 1000 persons) generally corresponds well with a high level of economic development and a high level of income, but this relationship is influenced by the extent of the public transportation system as it may make car ownership less obligatory (Ingram and Zhi Liu, 1999), (Huggins, 2009). When motorization rate is high and the road infrastructure is not up to its required status, the indicator is sometimes used to address local issues of human well-being as well. For instance, it is recognized that prolonged exposure to car exhausts and noise (WHO, 1998) has an adverse impact on public health. So, the indicator is used to describe development as well as sustainability (WHO, 2012). A high motorization rate should be in balance with the extent and accessibility of public transport and the efficiency of the road network. Suitable indicators of the latter are unfortunately not yet established.

Figure 3 Motorization rate in Aruba and Curacao 2000-2010

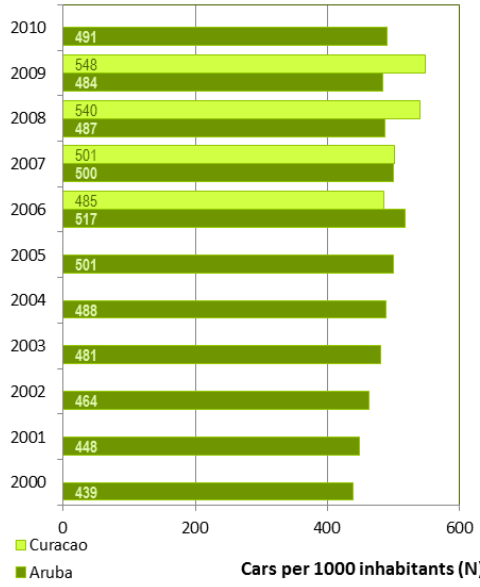
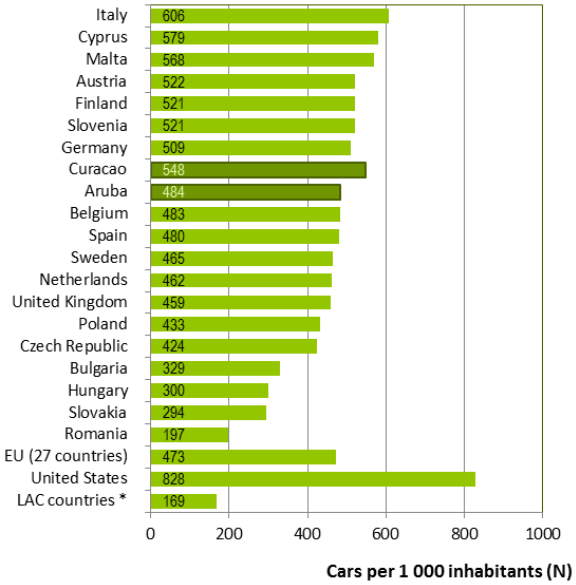


Figure 4 International comparison of motorization rates, 2009



Sources: CBS Aruba, CBS Curacao, Eurostat, Tax Collector Office, Aruba, US Dept. of Energy, World Bank
Note: LAC: Latin America and Caribbean countries

An overview of the motorization rate in Aruba for the last decennium is presented by figure 3 (data are presented in Appendix B). The results indicate that the motorization rate has increased steadily up to 2007. Over the whole period from 2000 to 2010 the motorization rate in Aruba increased by 11.8%, i.e. from 439 up to 491 cars per 1,000 inhabitants.

A comparison between Aruba and Curacao (Curacao, 2010) for the years 2006 up to 2009 shows similar high motorization rates in Curacao although the motorization rate in Curacao increases yearly whereas in Aruba the motorization rate remains at the same level throughout these years.

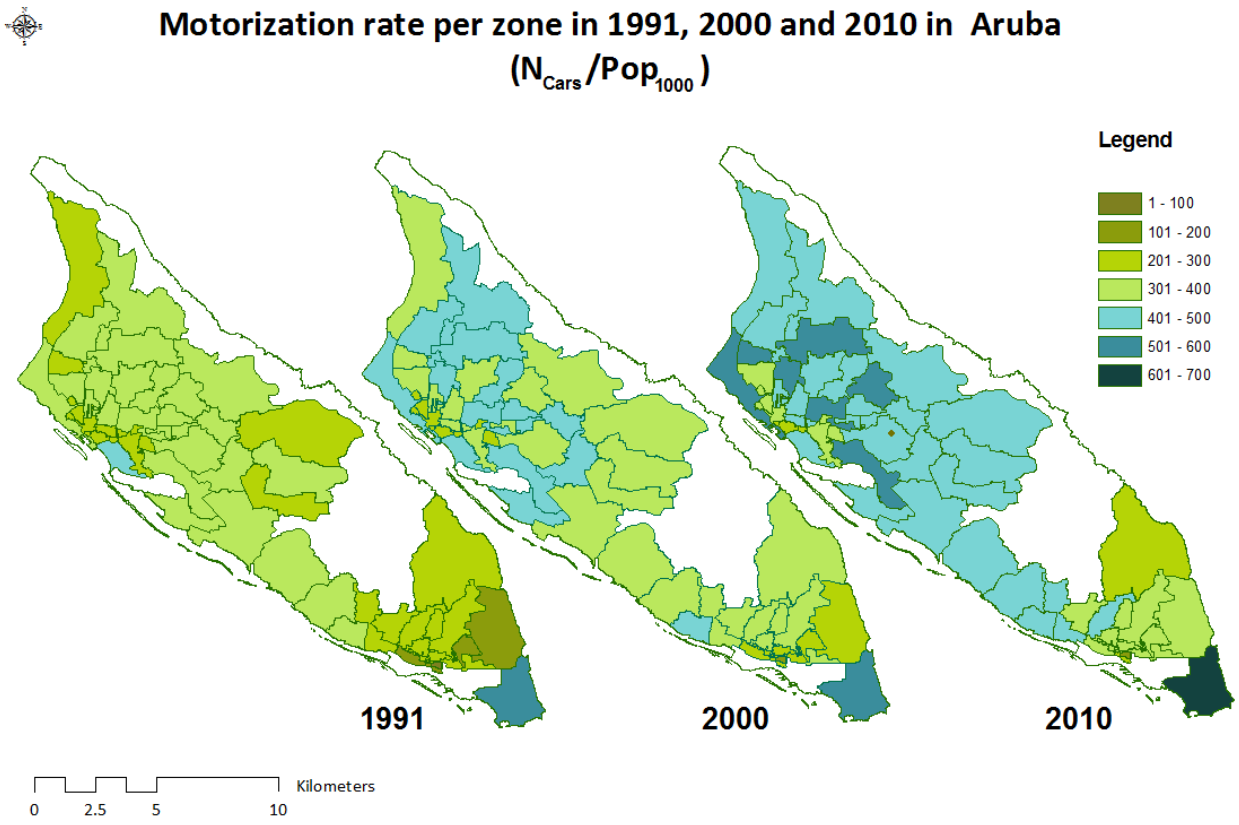
A comparison of the motorization rate in Aruba and Curacao (see figure 4) with the average rates from the so-called LAC countries (Latin America and Caribbean countries), the U.S. and the EU-27 countries (Torre, 2009) (Huggins, 2009), shows that Aruba and Curacao have rates similar to the high income countries. With 484 passenger cars per 1,000 inhabitants in 2009, the motorization rate in Aruba is nearly equal to the average of the 27 EU countries, i.e. 473 passenger cars per in 1,000 inhabitants. In comparison to most Latin American and Caribbean countries, the rate in Aruba is nearly three times as high.

[6] The motorization rate is defined as the number of licensed passenger cars per 1,000 inhabitants.

The comparison is based on data from the year 2009 (Eurostat, 2010). There is quite some variation in the level of the motorization rates from the reported countries, ranging from 197 passenger cars in Romania to 606 cars per 1,000 inhabitants in Italy. The only extreme is the US with 828 passenger cars in operation per 1,000 inhabitants[7].

The density of cars is expected to follow closely the density of households and the density of the population, but the economic development may not have been equal in all parts in Aruba. Therefore, in addition, it is interesting to present the rate of motorization[8] geographically over the three consecutive Censuses, as this measure corrects for population numbers. Figure 5 presents the geographical distribution of motorization rates over the different zones in Aruba during each of the three consecutive Censuses, in 1991, 2000 and 2010.

Figure 5 Motorization rate (number of passenger cars per 1000 people) per zone in Aruba in 1991, 2000 and 2010.



Source: CBS, Aruba. Census 1991, 2000 and 2010.

The results show that over the three decennia, the motorization rate increased strongly in nearly all zones in Aruba (see Appendix C for details)[9]. On average, over all zones in Aruba, the motorization rate went from 303 cars in 1991 towards 364 cars in 2000, and up to 444 cars per 1,000 individuals in 2010. This is a steady increase by respectively 20.3% and 21.9% during the last two decennia.

[7] In the US the motorization rate is generally considered high, even though the average may be biased by the extremes in some US states. In these states light company vans and company pick-up trucks are commonly considered private cars because these vehicles are often in use for private transport as well.

[8] The Motorization rate is expressed as the number of passenger cars per 1,000 people

[9] Only in the area just north of San Nicolas, i.e. zone *77-San Nicolas North*, the motorization rate appears to drop after 2000. However, we like to note that in this area there is very sparse habitation and a change by few people may influence the results disproportionally. The motorization rate is not a good parameter in areas with such low population numbers.

In a number of zones in 2010, we observe very high motorization rates; even more than 500 cars per 1000 persons, whereas in the city centers of Oranjestad and San Nicolas we observe the lowest motorization rates in Aruba (Table 3, respectively left and right column).

Table 3

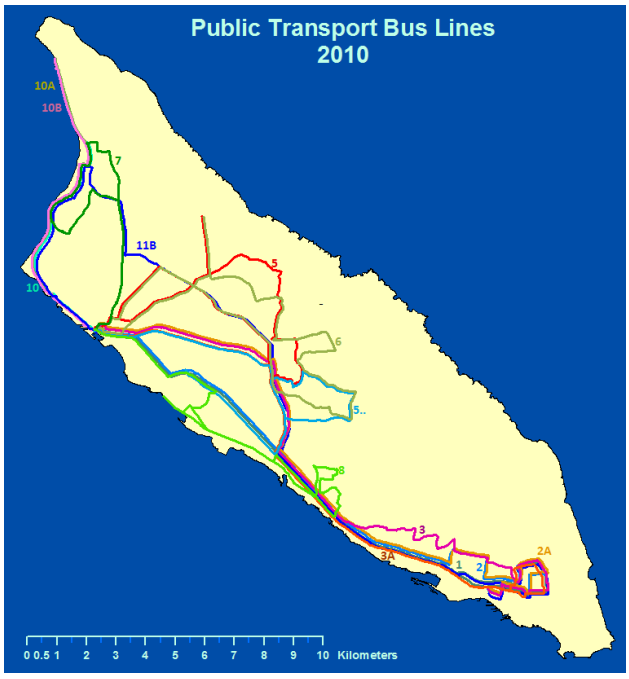
Zone ID	Zone Name	N_{cars}/Pop_{1000}	Zone ID	Zone Name	N_{cars}/Pop_{1000}
87	*SeroeColorado*	*654*	***31***	*Nassaustraat (center of O'stad)*	232
14	*Moco/Tanki Flip*	501	***83***	*Van de Veen Zeppenfeldstraat*	212
42	*Paradera*	507	***84***	*Village (center of San Nicolas)*	147
34	*SeroBlanco/Cumana*	507			
21	*PosAbao/Cunucu Abao*	*504*			
22	*Eagle/Paardenbaai*	545			
37	*SabanaBlanco/Mahuma*	*501*			

Some of the zones near the city centers also have relatively low motorization rates. We feel inclined to explain these low numbers in view of a better connection to public means (see next section), but the relatively high population density in these areas, a smaller distance to work or lower income may serve explanatory value as well. Besides, the location of these zones does not clearly coincide with the line buss network. Our data are insufficient to investigate their degree of correlation in more detail.

Public transport

Public transport in Aruba in 2010 is organized by a number of line busses (ARUBUS, 2010) that cover most of the inhabited areas. At the time of the Census in 2010, 16 busses run on a daily basis but with a time plan that varies greatly between regions (figure 6). Some lines continue with only a few minutes time interval, whereas some run on an hourly basis or even less regularly. In most areas outside Oranjestad and San Nicolas[10] busses frequent only in early morning and late afternoon. In between San Nicolas and Oranjestad and in between Oranjestad and the hotel area, line busses frequent seven days a week and at 5 to 10 minutes interval. A few (school) busses run once in early morning and once in late afternoon and connect the more distant locations with some of the larger schools.

Figure 6 ARUBUS line bus network in 2010



Source: ARUBUS NV, Aruba

Aside from public transport by ARUBUS, about 95 privately owned mini-busses/vans cover major parts of the island. These busses are registered to a specific area, but have not strict route. Except for the hotel zone (where these busses are prohibited) they roam freely in between registered locations. These mini-busses follow no strict time schedule either, and if so it is not publicly known or only to their frequent customers. Based on registration, the following routes are operational:

- 33 mini-busses follow a route more or less in straight connection between San Nicolas and Oranjestad
- 8 mini-busses connect between similar centers but are more flexible in their routes
- 25 mini-busses take a similar route but via St Cruz
- 11 mini-busses frequent between Noord and Oranjestad
- A few remaining mini-busses connect between the city centers and the other regions filling the gaps left by line busses.

[10] We refer to Appendix A for a description and mapping of specific locations in Aruba

Third, a number of private or company-owned taxis carry passengers but they concentrate mainly in the areas that are visited by tourists.

Traffic accidents

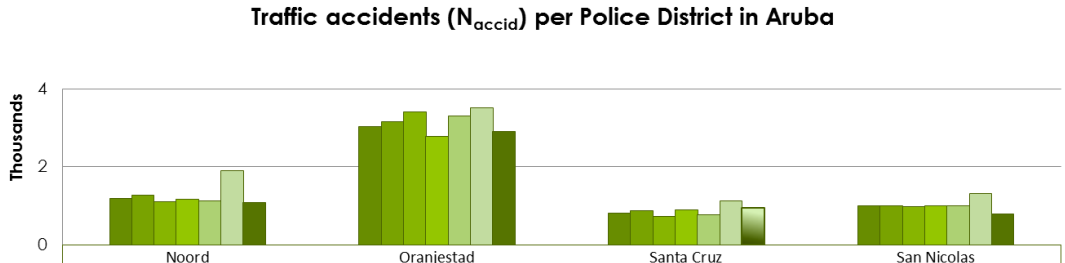
A high car density often goes with more road incidents (Kopits and Cropper, 2003). Traffic accidents not only cause substantial personal suffering (physical, psychological or financial) to the drivers and their passengers, but in 15–20% of cases to pedestrians as well (Eurostat, 2009). Traffic accidents create a liability to the whole community. Estimates of the costs of road accidents count to up 2% of GDP, estimated for the so-called 'Highly Motorized Countries' (Jacobs and Aeron-Thomas, 1999). Estimations of the costs in Aruba have not been made, but the level of motorization in Aruba is equally high as in these countries.

Accidents

The Central Bureau of Statistics annually receives information about the number of traffic accidents in Aruba from the Department of Police (KPA, 2010). This information is presented in figure 7 and figure 8 (and in Appendix C). It is difficult to draw any strong conclusions from these data as the information is minimal and seems not always consistent. But we decided to present the little information that is available. Information from the period 1998–2003 is lacking, as is additional information about the nature or the circumstances of incidents. Due to mutual assistance between police districts, incidents have not always been linked to the correct District but the registration of incidents and system administration has improved considerably in past years.

The number of traffic accidents per police district is presented in figure 7. By far, most accidents occur in the District Oranjestad. As we mentioned before, the area Oranjestad is also the area where the density of passenger cars is highest. The District is characterized by intense traffic congestion as a result of the high concentration of traffic destinations (shops, administration offices, schools, companies, etc.) as well as a transit between traffic from South and North (Derix, 2013). Contrary to what we expect on the basis of the yearly increasing car density and population numbers during these years, we observe little change in the number of car accidents in all four different police districts in between 2004 and 2010. A considerable rise in the number of car accidents occurs in 2009 in all four police districts, but as we have noted before, these figures have to be considered with care.

Figure 7 Comparison of Traffic accidents in Aruba between 2004 to 2010

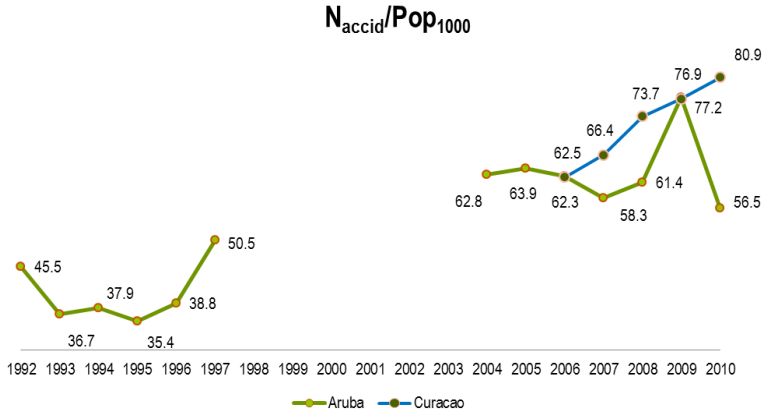


	Noord	Oranjestad	Santa Cruz	San Nicolas
2004	1,192	3,038	805	1,010
2005	1,266	3,172	880	1,004
2006	1,108	3,410	736	992
2007	1,174	2,790	895	999
2008	1,136	3,306	779	1,002
2009	1,895	3,512	1,133	1,316
2010	1,095	2,914	956★	791

Source: *Statistical Yearbook Aruba, 2010.*
Yearbook Police (KPA) Aruba, 2010
Note: Aruba is divided into four police districts.
No information about the number of traffic accidents is available by the District in Santa Cruz in 2010★.
We use the average of two previous years to estimate the missing data.

We present the results as the rate of number of accidents per 1000 inhabitants (N_{accid}/Pop_{1000}). Despite strong fluctuations, it is safe to assume that the number of accidents over the last six years (period 2004–2010) is high when compared to the situation fifteen years ago (period 1992–1997). Except for the information that was received for the year 2009, the results show that on average yearly approx. 60 of 1000 persons in Aruba have been involved in a traffic accident at minimum. This is roughly one in every sixteen persons in Aruba.
The data from Curacao have been added to the graph as to compare both countries in the region. In contrast to what we observe in Curacao there is no annual increase in accidents relative to population growth in Aruba. Only in 2006 and 2009, the rate of accidents in Aruba (per 1000 people) is at a similar level as Curacao. If we leave the high record of number of accidents in 2009 aside, we may even conclude that the rate of accidents in Aruba shows a decreasing trend over recent years. So, the high peak in 2009 puzzles, but we have not found a plausible explanation, yet[11].

Figure 8 The Number of accidents per 1000 inhabitants in Aruba and Curacao, 1992 - 2010



Source: *Statistical Yearbook Curacao, 2010 and Statistical Yearbook Aruba, 2010, original source: Yearbook Police (KPA).*

Fatalities

More so than the frequency of traffic accidents, the *Road Fatality Index*, i.e. the frequency of fatal accidents per 100,000 inhabitants ($N_{fatal}/Pop_{100,000}$) is used worldwide as an index for traffic safety (OECD, 2010). The results for Aruba are presented in figure 9.

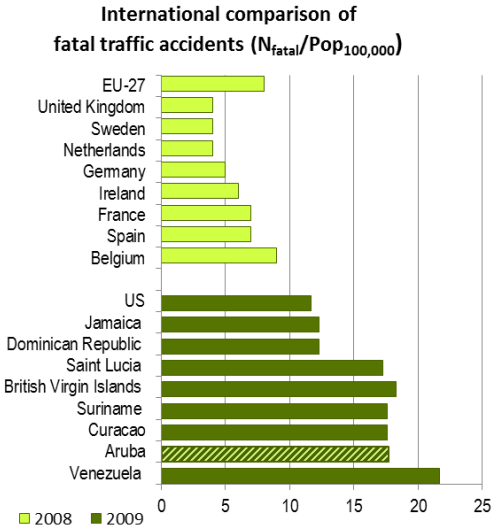
The high peak in number of accidents in 2009 compared to 2010 and the years before (figure 8) is not reflected by a similar change in the number of road fatalities (we refer to Appendix B for detailed information). In 2009 and 2010 there have been 18 fatalities against 20 fatal accidents in 2008. Over the last decade, the frequency of fatal accidents varies from 13 to 20 yearly cases. With a population of just above 100,000 inhabitants, any single additional road fatality will be reflected directly in a change of the road fatality index[12].

[11] In 2010, the data from one of the four Police Districts, Santa Cruz, was missing and we have decided to infer the missing data from this District by assuming the average of the data from the two previous years, 2008 and 2009. We choose to average two previous years as the number of accidents in St. Cruz in 2009 was high compared to the years before. However, even when we use the figure of 2009 only, the calculated rate of accidents in 2010 would not differ so much (58.2 instead of 56.5). This is because, in contrast to 2010, the number of recorded accidents in 2009 was extremely high in all four Districts.

[12] The absolute number of road fatalities may not be such a good determinant for traffic safety in small island communities. The total frequency of road fatalities is highly influenced by any occasional mishap. For instance, early in 2007 (Police yearbook Aruba, 2007), three people were killed in traffic accidents in just one day. This number is quite high when compared to the total number of fatal accidents in that year and the incidence consequently had a high impact on the calculated level of the index in that year.

On a global scale the road fatality index ranges from 1.7 on the Marshall Islands up to 48 deaths per 100,000 inhabitants in Eritrea (OECD, International Traffic Safety Data and Analysis Group. IRTAD annual report., 2010). In Latin America the scale is between 4.3 in Uruguay to more than 20 in Venezuela and Mexico (WHO, 2010). At the international comparison (figure 9), Aruba (similar to Curacao) is high on the scale of fatality indices when compared to other countries in the region and when compared to most countries in the EU. A a high road fatality index is more common amongst low- and middle income countries[13]

Figure 9 Road fatality index in 2008 and 2009 for a number of countries.



Note: The upper and lower part of the graph refers to figures from different years.
Source: *EuroStat, 2010.*
CBS Aruba. Statistical Yearbook, 2010
CBS Curacao. Statistical Yearbook, 2010

According to the World Health Organization (WHO, 2009) by 2030 road fatality will be the fifth leading cause of death worldwide. The absence of seatbelts, child safety seats, or the not wearing of a helmet, often in combination with insufficient legislation, law enforcement, or alternative means of transportation as well as the inefficient traffic planning, should receive primary attention.

Personal impairment

The social impact of road fatalities is high, but traffic injuries can also lead to permanent impairment. During the Census, we asked a subset of respondents if they had a handicap and whether this handicap was caused by a traffic incident in the past. In total 6,471 respondents participated in the sample questionnaire of which 3.6% indeed mentioned to have a handicap. One in eight of those individuals with a handicap (12.5%) also confirmed that the cause of the handicap was from a traffic accident. No further information was retrieved about the circumstances or type of handicap.

Inconveniences from traffic near the living quarter

According to studies (WHO, 2012), exposure to long-term high road traffic noise levels has negative impacts on health and behavior. Even at lower noise levels, prolonged annoyance may lead to health hazard. So, even though the local infrastructure may be adequate to prevent direct traffic accidents, there is the risk of an indirect impact on public health by intense local traffic. Aruba may not have the

[13] The referenced publication by the WHO includes the following note to better understand some conditions that relate to the usage of the road fatality index. Whether a traffic death is to be attributed to the accident or to other (later) physical circumstances or subsequent complications is often defined by the timespan between the moment of death and the accident. This definition however varies between countries and accompanying information that may be relevant is not always provided or only described in general terms. The data from the US partly underlie such a different interpretation, possibly due to liability questions. A strict definition in Aruba is not common as well, but in general a fatality is considered a road fatality in case death results either directly or as a result of complications without limitation for a specific number of days after the road incident.

traffic intensity of major cities and traffic intensity may not be prolonged but unequally spread during the day, but insight in the location of existent annoyances may aid future policy-making. Information about traffic inconveniences and nuisance due to elevated noise levels have been collected in the recent Census in 2010 and in 2000. This offers an opportunity to compare experiences over time, as how it is perceived in different regions in Aruba.

At the Census in 2010, information was collected about '*inconveniences'* by individual household members specifically in relation to '*traffic in the direct neighborhood of the living quarter'* (as for instance exists as an unsafe situation or a situation with intense traffic) or '*nuisance'* about '*noise in the direct neighborhood of their living quarter'* (for instance by road traffic, airplanes or even by neighbors). The results are presented in figure 10 and 11. The results are presented in a tessellation of 200x200 meter grid square areas[14] and not according to the usual representation in GAC zones or GAC regions (see also the map in Appendix A). The reason why we chose for the grid tessellation is that the smaller areas can be better linked to specific landmarks (for instance in relation to the local road network, the location of the Airport, etc.). A representation by administrative zones would lack such spatial detail. The downside of the use of grids is that the grid square areas are difficult to label or identify with a familiar local name for the specific grid area. As a consequence the visual representation serves more its explanatory purpose then can be read from corresponding tables. At this moment we lack detailed information about traffic intensity on the road segments and thus, a correlation between traffic intensity and inconvenience from traffic (or noise) could not be calculated.

In 2010, in 22.4% of *all households* traffic in the environment of the home was considered a problem by at least one of the household members, i.e. about one in every five households responds affirmative to the question whether he/she or some other household member experiences an inconvenience from *traffic* in the immediate environment of the home (data is presented in Appendix D).
We observe that these inconveniences are concentrated in certain areas. If we characterize each grid area by the number of households that responded affirmative as a ratio over negative responding households (n_{aff}/n_{neg}), we find that in in 12.9% of all the *inhabited grid square* areas[15] (total grids with households N=2,071) a majority or equal number of the households respond affirmative ($n_{affirmative} >= n_{negative}$). When we analyze only the 200x200m square areas where there are more than 3 households per grid area ($Grid_{HH>3}$=1,756), we still find that in 8.6% of the grid areas there is a majority of households that experience inconveniences from *traffic*.
Thus, almost in one out of every eleven inhabited (200x200m) grid areas, when there reside at least 3 households, a majority of households experiences annoyance by the local traffic.

We observe increased inconvenience from local traffic or from noise all over the island (figure 10 and 11). The percentage of households in a given area that experience such inconveniences generally remains low (beneath 20% of all households per grid area) but in some locations, however, the percentage of households with annoyance can be well above 80%. If we compare the locations where the inhabitants feel strong inconvenience from traffic and from noise, we are able to recognize a relationship with specific landmarks.

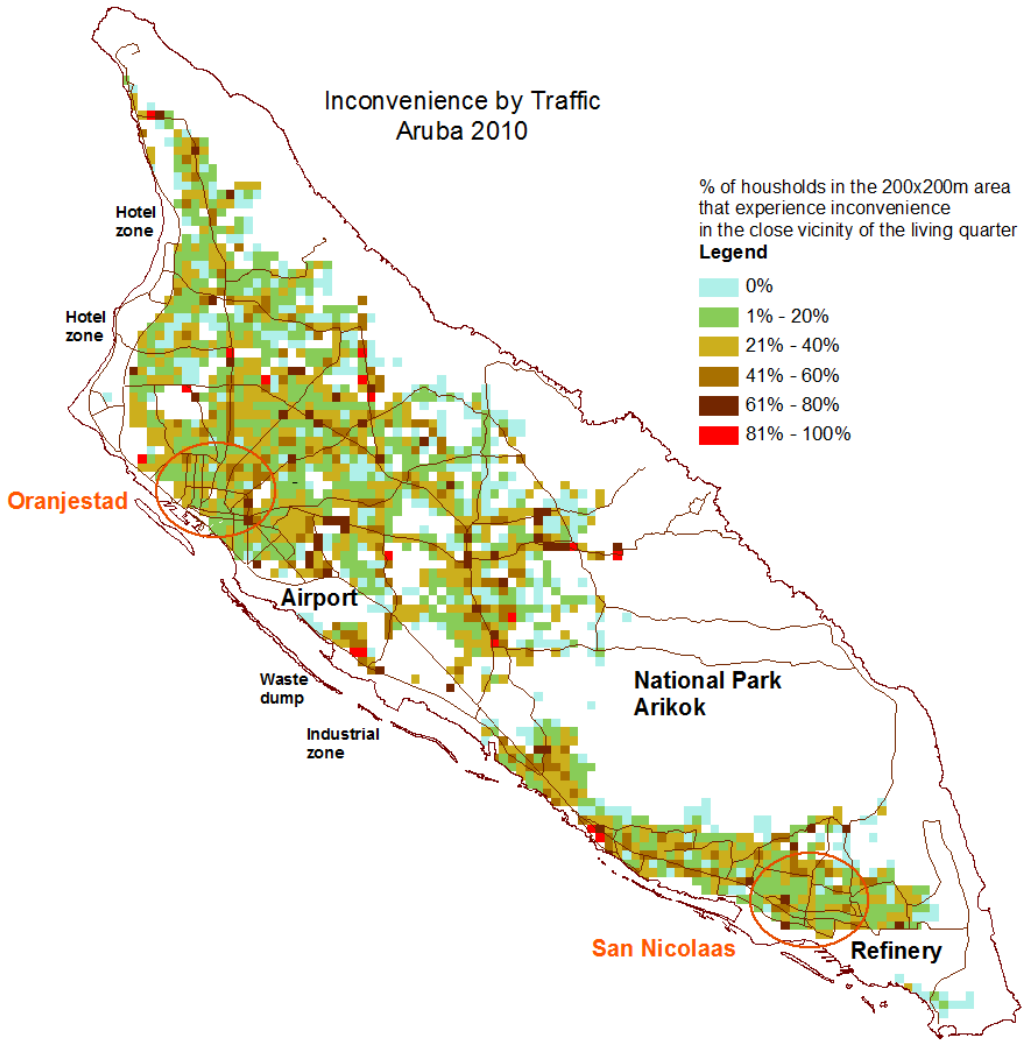
Firstly, inconvenience from traffic seems to be spread over the whole island, but the areas where it is felt most are alongside segments of the major road network (figure 10) and in some isolated pockets as

[14] The figures show a grid tessellation of 200x200 m square areas. For each of the grid squares we present the percentage of households where at least one household member experiences inconvenience from traffic (respectively from noise) in the direct vicinity of the living quarter. Square areas in which there are 3 or less households have been excluded from the presentation to preserve privacy in such less densely populated areas.

[15] The average frequency for all Aruba per inhabited 200x200 m square area is 17 households but in some areas this may be up to a maximum of 136 households per grid square. In total 34,845 households were included in our analyses.

well. Obviously, not everywhere, but at specific spots along the main road network, local inconvenience from traffic intensity is high. A few small pockets with a relatively high incidence of annoyance situate aside from the major roads and inside residential areas, where we might not expect them. Such areas seem to coincide with residential roads that connect between major roads. It suggests that the annoyance may be caused by the frequenting of traffic during peak hours, as drivers take a shortcut, but we need further verification on the spot, to determine the exact origin of the inconvenience.

Figure 10 Inconveniences by *traffic*



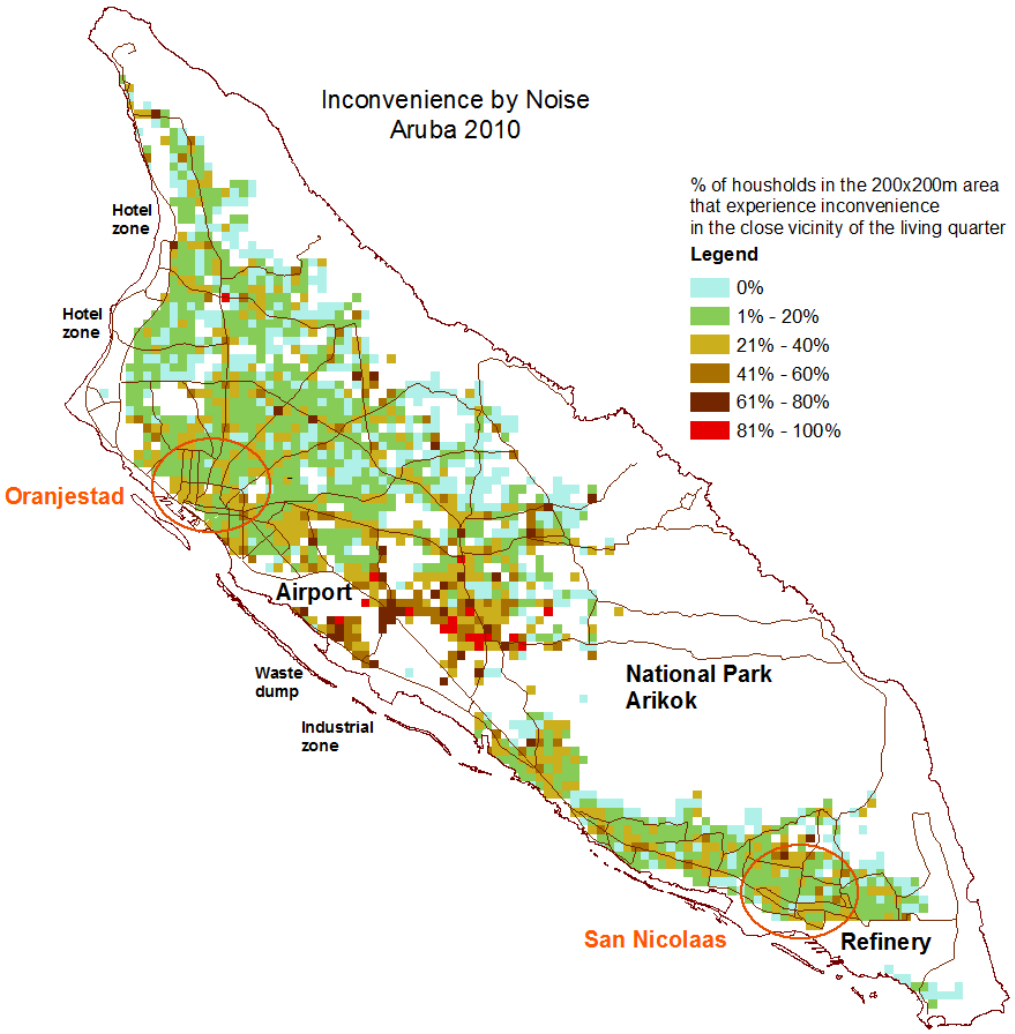
Source: *CBS Aruba. Census data, 2010*
Note: Lines represent the main road network. We like to note that the frequency of households that show annoyance from traffic is high in and near the center of Oranjestad and San Nicolas, but this is not reflected in the map as we chose to present inconvenience percentagewise, relative to the number of households.

The distribution of households that experience inconvenience from noise follows a similar pattern as the distribution for inconvenience from traffic, but the level of annoyance is less. Overall, in 18.3% of *all households* the *noise* level in the direct vicinity of the home was considered a problem. In many of the 200x200m areas along the main road network inconvenience from noise is felt in about 20-60% of households. The most striking pattern is in the area southeast of the Airport, i.e. off wind by the Northeast Passat as the wind may carry the noise from arriving and departing airplanes (see figure 11).

In 9.3% of *all 200x200 meter grid squares*, there is a majority of households to respond affirmative to the Census question whether they experience inconvenience from noise in the direct vicinity of their

home. If we examine only the 200x200m square areas with more than 3 households inside (84.8% of cases), we observe in 6.0% of the 200x200m areas a majority of households annoyed by *noise*, i.e. in one out of every sixteen more inhabited areas. But more interesting, besides the more obvious ones (like the area surrounding the Airport), may be the more specific spots where inconvenience is felt strongly (see figure 11).

Figure 11 Inconveniences by *noise*



Source: *CBS Aruba. Census data, 2010*

From a total of 496 households in the 200x200m square areas with 3 or less households, 79 households (15.9%) indicate to be annoyed by noise, whereas in the majority of situations, from the total of 34,350 households that situate in 200x200m square areas with more than 3 households, 6,309 households (18.4%) experience inconvenience from noise. Thus, interestingly, in the less inhabited areas, where there is a low density of households, percentagewise the experience of inconvenience from noise is a little less but close to similar as in the more populated areas, which we would not expect.

With respect to inconvenience from traffic the situation is different. From a total of 496 households in the 200x200m square areas with 3 or less households, 81 households (16.4%) indicate to be annoyed by traffic, whereas in the majority of situations, from the total of 34,350 households that situate in 200x200m square areas with more than 3 households, 7,720 households (22.4%) experience inconvenience from traffic. Thus, in the more inhabited areas, traffic is indeed more likely to be an issue of concern.

Summarizing remarks and discussion

Over the last decade, in particular over its first five years, the *number of private passenger cars* in Aruba increased by more than a third up to almost 45,000 working cars and these are owned by just less than 35,000 households. Over the same period, the population and number of households increased as well but at a slower pace. We observe a trend towards more cars in household ownership, towards smaller households but also towards fewer households that have no car at all. Even though the increase in total number of cars is slowing down, there is still a considerable increase and this increase is larger as we would expect on the basis of the population increase. Households are smaller but possess more cars than before.

It seems clear that the traffic infrastructure has stayed behind to the rapid economic growth as traffic congestion has become a daily phenomenon. The problems we experience today, however, are not only to be traced back to an increase in number of cars on the road but may also follow the pattern of changes in the geography of car ownership and daily destinations. In this paper we have our focus on car ownership whereas the geography of destinations is investigated in a second paper (Derix, 2013). The current administration already has initiated a series of improvements in the road infrastructure that are meant to alleviate connectedness and structural traffic congestions.
Unfortunately, road repairs can add to the impression of too many cars on the road. Similar to an inadequate road infrastructure, when road repairs remain open for too long we find ourselves in constant lines of slow traffic and we may be misled to think that the number of cars on the road have increased even more drastically. Amongst other findings, our study shows that the number of cars does increase and that some locations are likely to be hotspots of infrastructural problems, simply because the spatial dynamics and density of cars, but the extent that road works add to the buildup of traffic lines during rush hour can be studied in a more elaborate traffic model.

Car density (number of passenger cars per surface area) increased in almost all locations in Aruba over the last twenty years. In particular in the urban centers Oranjestad and San Nicolas *car density* is high. Censuses offer an opportunity to compare motorization rates (frequency of passenger cars per population size) at the level of geographical zones and in between successive periods. In most locations, in 1991, the motorization rate was relatively low, except just south of Oranjestad and Seroe Colorado (the isolated southern point of the island), whereas in 2010, the motorization rate is high all over the island and in particular in some zones directly outside Oranjestad. There is a clear spread of urban areas recognizable from the distribution of motorization rates. However, the motorization rate didn't change much since 2007 and slowly increases with population numbers. In international comparison Aruba ranks at equal level with the high income countries in Europe with regard to the *motorization rate*.

The rate of accidents is high, particularly in the region Oranjestad where car intensity is high. There is little change in the number of traffic accidents over the last seven years, though. Similarly, the number of fatal traffic injuries hasn't changed much, although there is considerable variation in between years. In comparison to former high income countries in Europe, the so-called fatality index in Aruba is high. Furthermore, as the census information reveals, the percentage of handicaps caused by traffic accidents seems quite high in Aruba, i.e. in about one of eight cases of a handicap, the handicap is attributable to an incidence in traffic.

Inconvenience from traffic (and noise) in the close vicinity of the living quarter is common in Aruba but observed predominantly along specific parts of the main road network. Annoyance from traffic and noise is high in a number of small residential pockets as well. Our analyses show that southeast of the Airport, off wind, there is a particular high incidence of households that experience inconveniences from noise. Although the phenomenon may be straightforward, the difference with other parts in Aruba is striking. The analyses of inconveniences in the vicinity of the home, is addressed during the

Census by only a wide defined question. It would be very interesting, however, to further research the actual causes of the nuisance in specific areas.

The findings in this study highlight the fact that car density in and near the center of Oranjestad is particularly high and that this area is responsible for many of the traffic accidents. Interestingly however, the inconvenience that household members experience from traffic and noise in these areas is not different from elsewhere on the island. Only along some parts of the main road network habitants suffer from traffic in particular.

The number of cars is likely to increase further in the near future, the locations of work and school are unlikely to change, and also the number of school-goers is unlikely to decrease (Eelens, 2010).
In 2010, information about the routes and schedules of public line busses and of mini-busses is such that even though most areas are covered, the irregular time schedules are insufficient to provide a real alternative to transport by the own car and some walking will still be necessary. Most lines connect between the densely populated areas, such as San Nicolas, Oranjestad, Santa Cruz and Noord at regular time intervals. The hotel area, in particular, is very well connected to Oranjestad. However, the more distant locations are still difficult to reach at any moment and a trip from or to a less populated area have to be made in combination with transport by local mini-busses. Transfers between lines are cumbersome and most connections have to go via the main bus terminals in Oranjestad and San Nicolas. But, for those that have a good connection between home, work or school, public transport is still an interesting option. Recent purchases of new busses (partly smaller) and further development of the public transport network goes hand in hand with public awareness and increased use, as the coverage of the costs for a more widespread network of connections in Aruba is otherwise difficult to attain.

Besides the infrastructural improvements and the improvements in the public bus line network in recent years, the decision to invest in bicycle paths is heartily welcomed. Active transport by bicycle or on foot, in combination with other means of transport, is a valued alternative to transport by private car and particularly suitable for short distances. In recent years, with a growing insight in the aspects of environmental sustainability in urban areas, active transport is already stimulated in cities worldwide. The development of safe bicycle paths might be interesting, in particular for school goers, as it might relief traffic pressure in many locations. The current traffic situation and road infrastructure in Aruba, however, is designed to carry as many cars as possible. At current, roads are considered unsafe for cycling or walking, not just because of the intensity of traffic or lack of quality, but also because of free-roaming dogs and drivers that show little consideration for slow moving traffic. With this and a second paper (Derix, 2013), we aim to collect relevant information on traffic in Aruba. We hope to contribute to a better insight in the current characteristics of car ownership, and its related geographical dynamics.

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Appendix A Geographical distribution of Aruban households in 2010

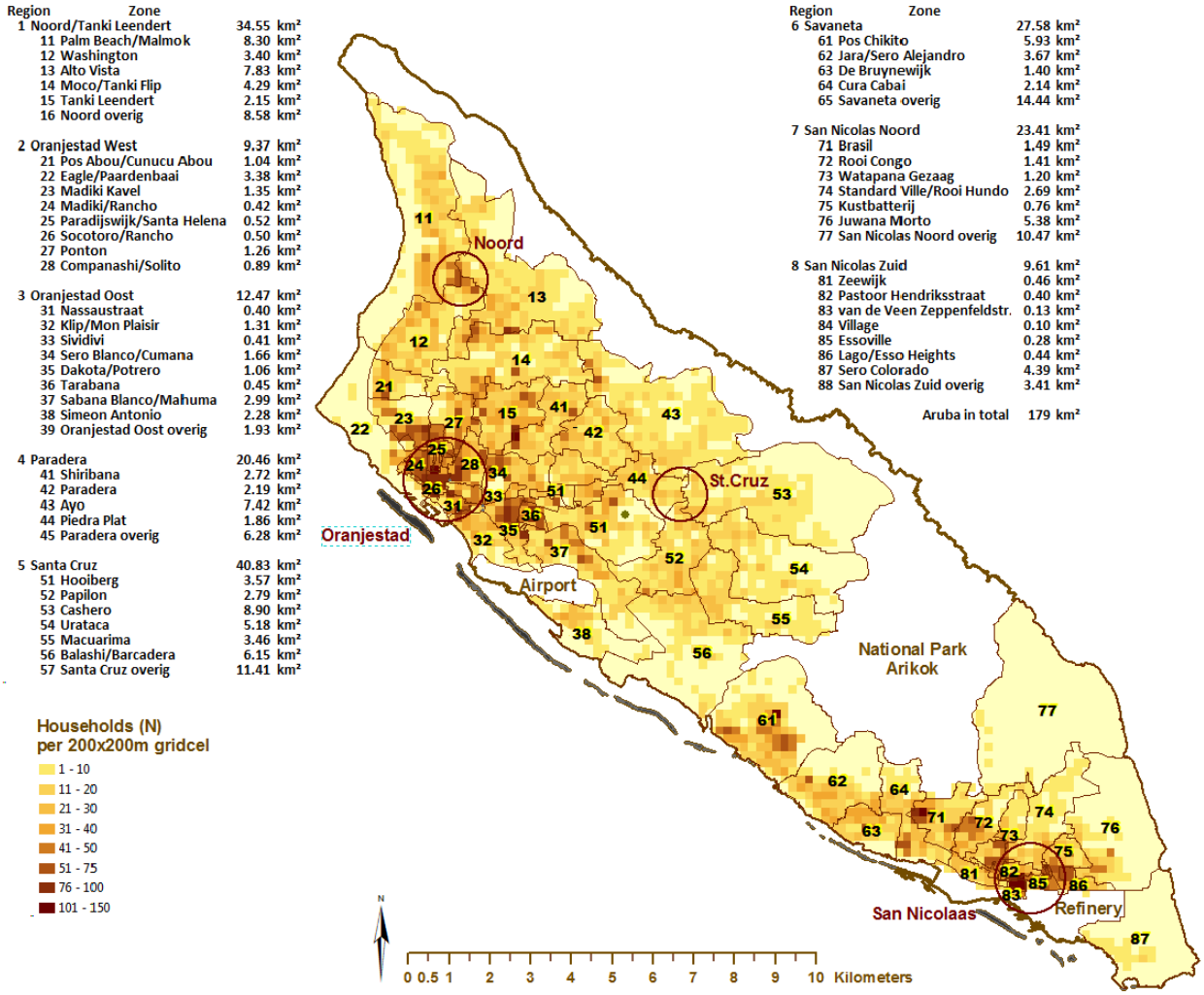

Figure *The map shows the spatial distribution of households in Aruba in 2010 (based on a tessellation of grid cells) as well as extent and number ID of overlaying administrative zones in Aruba (based on the GAC system).*

Notes: *The naming of the administrative areas and regions follows the definitions of the GAC - Address Geographical Classification - system. A GAC-zone is indicated by a double number (Zone ID) in accordance with the names in the list. A GAC region refers to a collection of zones and is indicated with only the first number (Region ID).*
Next, throughout the text, we will use the GAC system as well as the Grid 200x220m tessellation System to represent any findings.

The color map shows the spatial distribution of households in Aruba in 2010. For each of 200 x 200 meters surface areas, which are arranged like a tessellation grid of squares, the density of households is displayed as color intensity. A dark color corresponds to more households in the designated area (see the legend on the left side of the map).

The position of historical centers Noord, Oranjestad, Santa Cruz and San Nicolaas is indicated by circles on the map. Additional landmarks are indicated as well

Source: *CBS Aruba, Fifth Population and Housing Census 2010 Aruba: Selected Tables.*
CBS Aruba, Geographical Address Classification System: GAC 2012.

Appendix B Transportation Statistics

Transportation Statistics	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Licensed passenger cars [1]	28,541	30,144	31,817	33,417	34,712	36,112	37,569	38,834	39,995	41,168	42,802	45,217	47,031	49,521	51,680	50,211	49,372	49,255	50,028
Transportation cars	64	68	73	75	85	105	101	97	118	122	123	119	122	133	135	136	144	147	145
Trucks	558	574	645	654	705	708	734	749	804	810	804	828	861	907	1,001	1,002	1,013	910	917
Buses	112	112	112	113	115	122	123	120	123	124	128	129	128	129	127	119	120	114	118
Tour buses	80	95	105	111	126	150	115	111	131	138	140	136	143	171	160	148	159	171	179
Taxis	332	341	351	355	370	399	401	399	400	400	398	400	400	398	399	371	367	365	374
Rental cars	2,395	2,.612	2,947	3,202	3,458	3,881	3,067	3,240	3,389	3,484	3,324	3,419	3,486	3,514	3,727	3,506	3,603	3,545	3,566
Government cars	556	533	543	549	550	556	401	409	447	459	520	498	533	549	526	526	518	457	468
Other cars	17	19	21	27	30	31	27	30	31	30	29	29	27	27	28	23	26	27	23
Special plates	219	216	231	219	221	229	245	226	246	254	245	233	235	256	279	327	348	318	336
Licensed cars (all types)	32,874	34,714	36,845	38,722	40,372	42,293	42,783	44,215	45,684	46,989	48,513	51,008	52,966	55,605	58,062	56,369	55,670	55,309	56,154
Licensed motorcycles (incl. mopeds)	526	550	599	589	684	603	604	624	669	772	960	1,191	1,275	1,499	1,573	1,482	1,604	1,638	1,852
Licensed motorized vehicles	33,400	35,264	37,444	39,311	41,056	42,896	43,387	44,839	46,353	47,761	49,473	52,199	54,241	57,104	59,635	57,851	57,274	56,947	58,006

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Population Size [2]	70,629	76,741	78,449	81,160	84,882	87,719	89,183	90,135	91,040	91,837	92,311	93,946	96,330	98,939	99,871	100,427	101,406	101,802	101,918

Traffic Indicators	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
total number of accidents	3,217	2,816	2,970	2,873	3,290	4,431							6,045	6,322	6,246	5,858	6,.223	7,.856	*5,756*[3]
fatal accidents	12	11	15	24	13	12					16	18	14	13	14	18	20	18	18
accidents/1,000 passenger cars	112.7	93.4	93.3	86.0	94.8	122.7							128.5	127.7	120.9	116.7	126.0	159.5	118.6
fatal accidents/1,000 passenger cars	0.42	0.36	0.47	0.72	0.37	0.33					0.37	0.40	0.30	0.26	0.27	0.36	0.41	0.37	0.36
passenger cars / 1,000 inhabitants	404	393	406	412	409	412	421	431	439	448	464	481	488	501	517	500	487	484	491
accidents / 1,000 inhabitants	45.5	36.7	37.9	35.4	38.8	50.5							62.8	63.9	62.5	58.3	61.4	77.2	*56.5*[3]
fatal accidents/100,000 inhabitants	17.0	14.3	19.1	29.5	15.3	13.7					17.3	19.1	14.5	13.1	14.0	17.9	19.7	17.7	17.7
fatal accidents/1,000 accidents	3.73	3.91	5.05	8.35	3.95	2.71							2.32	2.06	2.24	3.07	3.21	2.29	3.03

Source: *CBS Aruba, Statistical yearbook of 2010 and of 2011 (Original sources: Tax Collecter's Office Aruba; KPA, Yearbook Police, Aruba. 2009 and 2010); CBS Census data.*

Note [1] *Above information on licensed passenger cars is based on the administration of tax payments at the Tax Collecter's Office. These numbers of passenger cars (including special name plates) fall higher than the figures received from the Census respondents for the number of 'working' passenger cars in a household. The difference can be explained as that passenger cars during the Census are defined as 'private-owned' and 'working' passenger cars, and do not include company cars (although they may be used as such).*

Note [2] *The calculated population size in 2010 is the population size at the end of the year and an interpolation of the population size at Census moment (29 Sept 2010) and previous estimates of the population size.*

Note [3] *The information about the number of accidents in 2010 did not include data from the Police District of Santa Cruz, i.e. one of the four major Police Districts in Aruba. To estimate the total number of accidents in 2010 we assumed that the number of accidents in Santa Cruz in 2010 equals the average of last two years The alternative, assuming that the number of accidents in Santa Cruz was equal to the high figure in 2009, would result in an estimated total of 5.933 accidents in 2010. The difference on the final index would remain small, i.e. 58.2 instead of 56.5*

Appendix C *Geographical listing of a number of indicators of car ownership*

Zone	Zone Name	sq.km	Population size			Number of Cars per HH			Total Number of Cars			Cars per sq.km			Motorization rate		
			1991	2000	2010	1991	2000	2010	1991	2000	2010	1991	2000	2010	1991	2000	2010
11	Palm Beach/Malmok	8.30	2,447	4,024	5,105	1.01	1.22	1.43	685	1,528	2,469	83	184	298	280	380	484
12	Washington	3.40	2,117	3,147	3,883	1.14	1.28	1.43	678	1,264	1,904	199	372	560	319	402	490
13	Alto Vista	7.83	2,055	3,380	4,819	1.16	1.28	1.44	679	1,371	2,399	87	175	306	330	406	498
14	Moko/Tanki Flip	4.29	1,656	3,127	3,840	1.29	1.22	1.45	618	1,271	1,922	144	296	448	372	406	501
15	Tanki Leendert	2.15	1,780	3,219	3,797	1.24	1.20	1.36	639	1,279	1,844	297	595	858	359	397	486
21	Pos Abao/Cunucu Abao	1.04	419	932	1,179	1.08	1.20	1.52	123	369	594	118	354	571	293	395	504
22	Eagle/Paardenbaai	3.38	371	377	405	1.04	1.37	1.28	147	183	221	43	54	65	395	485	545
23	Madiki Kavel	1.35	453	1,523	2,375	1.21	1.00	1.07	163	503	888	121	373	658	361	330	374
24	Madiki/Rancho	0.42	1,329	1,651	1,541	0.89	0.77	1.01	346	432	549	824	1,028	1,307	260	261	356
25	Paradijswijk/Santa Helena	0.52	1,380	1,807	2,005	1.10	1.18	1.29	452	697	882	869	1,341	1,696	327	386	440
26	Socotoro/Rancho	0.50	1,863	2,001	1,928	0.87	0.66	0.80	515	503	601	1,029	1,006	1,203	272	251	312
27	Ponton	1.26	1,300	1,789	2,057	1.30	1.31	1.39	496	790	1,034	394	627	821	382	441	503
28	Companashi/Solito	0.89	1,663	2,016	2,437	1.16	1.02	1.16	594	771	1,040	667	866	1,169	357	382	427
31	Nassaustraat	0.40	952	773	754	0.55	0.59	0.51	198	185	175	495	462	437	208	239	232
32	Klip/Mon Plaisir	1.31	1,508	1,554	1,377	1.37	1.17	1.28	619	646	665	473	493	507	410	416	483
33	Sividivi	0.41	930	847	788	0.97	0.89	1.01	271	275	317	662	671	774	288	325	402
34	Seroe Blanco/Cumana	1.66	1,326	2,403	2,577	1.09	1.18	1.38	427	975	1,308	257	588	788	322	406	507
35	Dakota/Potrero	1.06	2,594	2,850	2,639	0.95	1.00	1.03	761	967	1,025	718	912	967	293	339	389
36	Tarabana	0.45	2,040	2,199	2,051	0.85	1.04	1.19	438	659	783	973	1,465	1,740	215	300	382
37	Sabana Blanco/Mahuma	2.99	1,058	2,534	2,921	1.16	1.26	1.48	356	1,028	1,464	119	344	490	336	406	501
38	Simeon Antonio	2.28	859	956	1,015	1.20	1.21	1.40	300	389	475	131	170	208	345	407	468
41	Shiribana	2.72	1,378	2,073	3,700	1.19	1.26	1.36	447	857	1,652	164	315	608	325	413	447
42	Paradera	2.19	1,577	2,211	2,445	1.28	1.32	1.53	547	869	1,240	250	397	566	347	393	507
43	Ayo	7.42	1,692	2,704	3,418	1.18	1.27	1.40	551	1,069	1,584	74	144	214	326	395	464
44	Piedra Plat	1.86	1,541	2,050	2,419	1.27	1.45	1.54	510	844	1,181	274	454	635	331	412	488
51	Hooiberg	3.57	1,737	2,806	2,741	1.22	1.30	1.44	604	1,116	1,320	169	313	370	348	398	482
52	Papilon	2.79	2,002	2,443	2,514	1.28	1.34	1.41	680	1008	1,190	244	361	427	338	413	473
53	Cashero	8.90	1,607	2,020	2,233	1.11	1.28	1.44	447	758	1,011	50	85	114	278	375	453
54	Urataca	5.18	1,329	1,481	1,749	1.20	1.21	1.47	420	554	816	81	107	157	315	374	466
55	Macuarima	3.46	1,510	1,856	1,892	1.09	1.22	1.44	421	662	875	122	191	253	279	356	463
56	Balashi/Barcadera	6.15	1,402	1,670	1,690	1.11	1.24	1.39	435	653	802	71	106	130	310	391	475
61	Pos Chiquito	5.93	2,252	4,121	5,244	1.16	1.12	1.29	726	1,449	2,251	122	244	380	322	352	429
62	Jara/Seroe Alejandro	3.67	1,884	2,269	2,421	1.21	1.26	1.35	620	897	1,120	169	244	305	329	395	462
63	De Bruynewijk	1.40	1,600	1,603	1,678	1.26	1.25	1.30	570	678	792	407	485	565	355	423	472
64	Cura Cabai	2.14	1,537	1,914	2,091	1.03	1.03	1.17	450	630	861	210	294	402	293	329	412
71	Brasil	1.49	1,289	2,338	2,522	0.92	0.96	1.15	321	720	967	216	483	649	249	308	383
72	Rooi Congo	1.41	1,844	2,297	2,262	1.04	1.14	1.29	536	816	959	380	579	680	290	355	424
73	Watapana Gezaag	1.20	1,670	1,820	1,817	0.97	0.97	1.17	498	566	723	415	472	603	298	311	398
74	Standardville/Rooi Hundo	2.69	1,288	1,191	1,177	0.88	1.00	1.18	304	378	461	113	141	171	236	317	392
75	Kustbatterij	0.76	1,268	1,555	1,328	0.64	0.88	0.97	250	450	472	329	593	621	197	290	355
76	Juana Morto	5.38	812	873	1,017	0.78	0.73	0.87	136	224	327	25	42	61	168	256	322
77	San Nicolas North other	10.47	35	44	43	0.83	1.36	1.38	10	16	12	1	2	1	294	357	275
81	Zeewijk	0.46	735	780	596	0.55	0.72	0.83	134	191	189	292	415	411	182	245	317
82	Pastoor Hendrikstraat	0.40	1,099	1,031	921	0.80	0.86	0.96	276	293	324	691	732	811	251	284	352
83	v.d.Veen Zeppenfeldstraat	0.13	337	282	193	0.40	0.50	0.45	56	57	41	427	436	315	165	201	212
84	Village	0.10	645	753	730	0.17	0.26	0.33	49	83	108	492	830	1,075	76	110	147
85	Essoville	0.28	1,029	1,176	1,046	0.80	0.77	0.94	277	297	334	988	1,061	1,194	269	253	320
86	Lago/Esso Heights	0.44	969	1,132	1,112	0.88	0.99	1.11	255	372	434	579	845	986	263	328	390
87	Seroe Colorado	4.39	376	345	203	1.39	1.37	1.56	200	202	133	45	46	30	530	584	654
All	**Aruba**	**179**	**65,807**	**89,990**	**100,696**	**1.05**	**1.12**	**1.28**	**20,207**	**32,801**	**44,739**	**113**	**183**	**249**	**303**	**364**	**444**

Appendix D Inconveniences from Traffic and Noise

Inconvenience from NOISE?								
	N				%			
Response:	Yes	No	NR	TOT	Yes	No	NR	TOT
Number of Households - N(HH)	6,388	28,238	219	34,845	18.3%	81.0%	0.6%	100%
Number of grid cells - N(grid cells)	1,378	2,022	178	2,071	66.5%	97.6%	8.6%	100%
Average N(HH)/grid cell[1]	3.1	13.6	0.1	16.8				
Max N(HH)/ grid cell	41	119	3	136				
Median N(HH)/grid cell	1	10	0	12				
Number of grid cells with a:								
majority per grid cell responds YES: Ratio $N(HH_{Yes})/N(HH_{No})$ >=1				192				9.3%
majority per grid cell responds YES: Ratio $N(HH_{Yes})/N(HH_{No})$ >=1 and including only grid cells with at least 3 HH: N(HH)/ grid cell >3				125				6.0%

Inconvenience from TRAFFIC?								
	N				%			
Response:	Yes	No	NR	TOT	Yes	No	NR	TOT
Number of Households - N(HH)	7,801	26,814	231	34,845	22.4%	77.0%	0.7%	100%
Number of grid cells - N(grid cells)	1,478	2,027	189	2,071	71.4%	97.9%	9.1%	100%
Average N(HH)/Grid cell[1]	3.8	12.9	0.1	16.8				
Max N(HH)/ grid cell	50	114	3	136				
Median frequency N(HH)/grid cell	2	9	0	12				
Number of grid cells with a:								
majority per grid cell responds YES: Ratio $N(HH_{Yes})/N(HH_{No})$ >=1				268				12.9%
majority per grid cell responds YES: Ratio $N(HH_{Yes})/N(HH_{No})$ >=1 and including only grid cells with at least 3 HH: N(HH)/ grid cell >3				178				8.6%

Source: *CBS, Aruba, Census data.*

Note *The table lists the data from the grid tessellation of 200x200m square areas that each represent the percentage of households that respond affirmative or negative to the question 'Do you or more members in the household, have any inconvenience in your immediate environment from Noise, respectively Traffic?' In the table we refer to each of the 200x200m areas as a 'grid cell'.*

1 *The average number of households per grid cell is calculated including all grid cells in which at least one household resides, i.e. also including those grid cells in which there was no affirmative respectively negative household response.*