Traffic between school, work and home in Aruba in 2010

The geography of household destinations

Aruba
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Introduction

Those who come and live in Aruba are surprised by the number of miles that is driven each year on just such small island. Because of the lack of appeal to use a bike and the poor connections in public transport, even small trips tend to be taken by car, and, the new housing developments and business constructions keep changing the socio-economic landscape and make it difficult to decide how to keep the traffic flow running. Measures to extend and improve the road network have long been recognized and a number of major projects are already initiated or planned for the years to come. Because of the small size of Aruba, it is easy to recognize some of the bottlenecks, but nevertheless, detailed information about from where the traffic flow arrives and where it is heading to is lacking. The recent Census in 2010 provides a nice opportunity to fill in some of the information deficits and explore the dynamics of daily traffic destinations in time and in between regions.

There are several reasons why it is eminent to have a good understanding of the geography of transport. An inapt infrastructure not only causes traffic jams but puts an additional burden on public health and on the environment (Krämer, 2010; McCreanor, 2007). All global motorized transportation together accounts for half of the world's oil consumption and attributes to the global greenhouse gas emission and global temperature rise accordingly. But there are other more local and apparent effects from motorized transport such as air and noise pollution that can cause health hazards and stress for those that live in the near vicinity (Worldbank, 2011). In case restrictive measures are to be taken in the future, such as to limit traffic load in certain areas or increase taxes on motorized transportation, etc., it is important to understand the origin of car usage and to what degree road users may have alternatives. The information that is collected during the Census in 2010 (and in earlier Censuses) gives some insight on the socio-economic background of car ownership.

For those who wonder, why there is no more use of a more active mode of transport, walking or cycling, especially since distances are short and the climate is mostly fine, there is a simple answer. Cracks and holes in the road, stray dogs and fast moving traffic can make the use of the bike as a primary mode of transport to work or school a challenge. For the short ride or walk, the hot climate may be acceptable as there is mostly some wind, but then, at times, one may want to refresh at work, and showers are commonly absent and also there is little shade of trees along the roads. Besides, when children are to be taken from school, time may fall short as well. But still, there is more to say to a preference for the car above other means of transportation than just these justifications, particularly, as it is said that in recent past there was indeed much more walking and cycling as we can observe today. Maybe for short distances, the use of the bicycle or even walking might still be an option in some cases and gain in acceptance if just the settings would be right.

With this study, we aim to provide information about the distances to work and school. In particular children might be able to use the bike more often in some cases. As studies abroad show (HDP, 2006), when the risks are felt too high active transport is not a serious option. But, current policy in Aruba recognizes these risks and aims to improve not only the road infrastructure network but also include the construction of safe bicycle path along some stretches of the road. Primarily this is meant for recreation and sports, but a safe and separate bicycle path may solve many of the problems on the road to school. In Aruba, drivers are not accustomed and pay little attention to slow moving traffic, the quality of the roads is often insufficient, a sidewalk is often lacking and stray dogs make an attempt to cycle even more precarious.

Studies show that the decision about how to travel is based not only on social and economic characteristics of the households or the location of the 'home' relative to 'school and work' but also the accessibility of public transportation (McKenzie & Rapino, 2011; Muhammad, Ottens, Ettema, & Jong, 2007). For instance, in the center of Amsterdam, about half of all trips are made by public transport (Ralph Buehler, 2010), whereas in other large cities the dominant means of transport remains by private motorization. Obviously, in Amsterdam, the widespread availability of public transportation has created an inclination towards the use of public transportation or towards a combination of the use of the

train/car[1] and the bike. Nowadays, the cumbersome accessibility of the city center by car has shifted the balance even further. Importantly, the infrastructure and time schedule of public transportation in Amsterdam is well organized. It takes less effort to get to the final destination by public transportation or in combination with the bike than just by car. With regard to transport to school the situation is similar. Inclination towards a more active mode of transport is only an option when the circumstances are favorable. A study in Belgium (Janssens et al., 2011) shows that for transport to school about 30% of children is brought by car, 30% take the bike, 8% go on foot, and 18% use public transport. In the Netherlands (CBS, 2010) at pre-school level 85% of children are brought to school by their parents and most often by car. As children grow older, the likelihood to travel on their own increases. At secondary level, only 14% of children are brought by car, 14% use public transportation, and the majority goes to school by own means, either by bike (48%) or on foot (16%). The likelihood to use a more active mode of transport is expected to be largest on the short daily travel range. The distances between daily home, work and school destinations are described in this paper and analyzed for a number of household-, individual -and geographical characteristics.

In a related paper (Derix, 2013) we have already presented some information about car ownership, the geographical patterns of car densities and motorization rates and the locality of inconveniences from traffic in Aruba in 2010. More specifically, in the current paper we will provide information about the geographical background of daily travel between home, school, and work and subsequent modes of transport. This information is valuable to understand the origin of traffic jams and in order to be able to relate traffic load to the location of schools, homes and work, or, to characterize regions by type of school attendance and job sites. Also, we describe vulnerable households in view of distance to work and school and dependency on own private transportation. Planned measures to control road load and limit the use of the private car may affect those with limited means different than others, and there is a risk on social or economic exclusion of such groups when easy access to public transportation or alternative means of transport may not always be available.

Methodology

The 2010 Census provides information about individual school and job locations. Distances between home, work and school are measured as straight Euclidean distances between two points. We lack any information about the individual routes that are taken on a daily basis in a given time frame. By consequence, no predictions can be made and no weights can be given to specific road loads or explain the causation and potential for traffic jamming. Theoretically, such may be possible when certain (reasonable) assumptions can be made, but the assimilation into a hypothetical traffic model goes beyond the scope of this paper. Our calculations provide more general information about traffic flow between geographical areas and the inherent capacity or attraction of subsequent geographical zones. We have analyzed the daily movements of employees, aged 14 years and above, as well as of scholars, from all ages and per type of school. For some analyses, the data has been compared with the results of previous Censuses in 1991 and in 2000.

Based on the Census 2010, we know that there are 34,845 non-collective households in Aruba (in total 100,696 individuals), excluding some 28 'collective' households (that involve another 782 persons living either in elderly homes, orphanages, nursing homes, prison, or some other type of collective households) and also excluding 6 'counted' homeless persons (that lack a shelter with structural provisioning). Thus, the total population in 2010 is 101,484 inhabitants (table 1). By definition, each household lives in a single housing unit. Consequently, one building or one address may involve several households respectively living quarters/units. The focus of this study is on non-collective households only (excluding the homeless).

To retrieve more detailed information during the Census of 2010, the survey was conducted with a *digital long-form questionnaire* on a handheld netbook computer in a systematic sample of 70 enumeration areas that were drawn out of the total of 1068. The 1068 enumeration areas were first

[1] Next to economic benefits, an increasing number of commuters have become more environmentally aware and object to the use of the private car in favor of public transportation or carpooling.

divided into 56 enumeration districts, and it was taken care that at least one such sample enumeration area is chosen in each of the 56 enumeration districts. The result was a representative and an equal spread of sample enumeration areas. In the remaining enumeration areas the *questionnaire* was *short-form* and on *paper.*

Table 1 Employees and scholars surveyed during Census 2010 in Aruba

	Short-form		Long-form Questionnaire	
School attending population (all ages)	26,615	26.2%	1,656	25.6%
Working population (14+)	46,526	45.8%	2,996	46.3%
Total population	101,484	100%	6,471	100%

Source: Aruba Census 2010

In the sampled areas additional questions were asked by which we are now able to analyze some of the topics in this paper. In the digital questionnaire, for instance, detailed questions were asked about the mode of transport to school or work. All Census questions did conform to 'The Principles and Recommendations for Population and Housing Censuses, 2008', as described by the Statistical Division of the UN (UN, 2008). For more information and background about the Census 2010 we refer to the more elaborate Census report (CBS Aruba, 2010).

The information that we are able to analyze with the Census database is limited, however. Even though we know the exact household composition and number of cars in a household, we do not know who drives with whom and what routes are taken to work or school or what other destinations are important. Individuals may join the same transport vehicle, some join along the way to school or work, although they may have their own private car, and others may have to visit a daycare or school before they drive continue to work, etc. But, we do have the information about the individual's home, work, and school location, age, common mode of transport, etc. First we had to make some assumptions. We decided to treat school-going children and employees as individual road users and for reasons of simplicity we did not correct for those who may possibly share transport vehicle or go on foot, etc. Thus, we will have introduced a potential bias in the results, but our analyses suggest (see this report) that such error is probable small. Over 90% of travelers use motorized vehicles and close to 70% of workers arrive at work as driver of their private vehicle.

The maps in this paper and the corresponding geographical distributions of information have been disseminated with ARCGIS 9.3.1 Geographical Information System (ESRI, 2010). The presentations are based on the Geographical Address Classification system (GAC, 2012). This system of classification was developed in Aruba for the purpose of information analyses. Its hierarchical structure enables users to present information at three different administrative levels. The GAC system divides Aruba into 8 regions. Each of these regions is divided into a number of zones, and each zone consists of a number of streets or neighborhood(s)[2]. Conveniently, an address name on Aruba can be depicted by 5 digits (corresponding to the street/bario name or a 3 letter code shortcut). The hierarchical structure of the 5 digit code is as follows: The first digit depicts the (one-digit) region code, the first and second digits together depict the (two-digit) zone code, and all five-digits correspond to the specific street code. The region code can thus also be read directly from the zone code or from the street code. Regions and zones are outlined by fixed administrative boundaries that do not change in time. Throughout this paper we use the two digit zone code to specify specific areas instead of the lengthy zone name. The full listing of codes can be found in Appendix A.

We decided to represent the information that links where individuals live and where, for instance, children are brought to school or employees go to work in an unconventional but more straightforward

[2] A neighborhood is called a 'bario' in Aruba. Some bario encompass 'streets' that all have the same street name as the barrio name. With the upcoming developments wild areas inside such a barrio may become inhabited and as a consequence the new numbering of such addresses is not always in logical order with the (older) surrounding addresses. The GAC system eases computation of address linked data and enables us to present such data in maps more easily.

manner, i.e. as a tabular matrix representation (see Appendices B to F). A more appealing representation of such data would be as a map but then we would either lose important information or we would need as many maps as there are rows in these tables. A representation in the form of a line diagram would either be too complex or misleading as we have no information about the exact routes that are taken between home, school and work. Drivers often take shortcuts and, for instance, bring their children to a crèche or family member that may live far from the straight road to work. From the representation as a matrix it becomes immediately clear to what zones the school-attenders or employees are heading as final destination and in what zones these road users live. Thus, unfortunately, the Census data provide no information in the precise roads that are taken and we are unable to determine where exactly the traffic load will be highest. But we can still provide good insight on the traffic flow between zones.
In general, the cells near the matrices' upper left and lower right diagonal concern combinations between zones in close proximity to each other. This is because zone ID numbers list in succession from the northwest to southeast part of Aruba and coincidentally Aruba has a slim shape along the same axis (from northwest to southeast). Thus, zones with a successive number ID are likely to border each other or are in close vicinity (given a few exceptions). Similarly, the cells in the upper right or lower left segment of the matrices pair zones that situate most distant from each other (in number as well as in geography). The upper right and lower left part of the matrix describe the location of individuals that live (or work) in the Northwest but attend a school (or have a job) in the Southeast, and vice versa. Interpretation of the matrices has thus become more intuitive for those that have familiarity with Aruba's geography.

Results

In Aruba daily traffic jams have become a topic of discussion. Around certain hotspots, traffic is almost constantly jammed. After solving congestion at one place, congestion shifts towards a next bottleneck. The origin of these traffic jams might be anything, from the vicinity of a school, newspaper sale alongside the road, a junction that connects to the main traffic flow, or, simply, because there is insufficient infrastructure to support all the traffic. There are major infrastructural improvements to come, but whatever the result; in a relatively small area of space and in the limited time frame of only a couple of hours per day during rush hour, many cars will have to find their way between home, school, work, and other locations. Most will use the private car, but others will have to rely on public transport or even go on foot.
In the following we provide detailed information on the geographic destinations of two major subpopulations, school attending children[3] and employees, and, we will provide basic information on their preferred mode of transport and distances between home, work and school.

Transport to school

In a detailed study on active transport to school (D'Haese, 2011), 'distance to school' is observed to be the most important predictor for 'active' commuting to school. At short distances, children tend to walk, but between 1 and 3 km children prefer the bike instead of a walk, and, for distances above 3 km children are likely to be brought to school in motorized vehicles[4].

Type of transport to school in Aruba

At the time of the Census in 2010, 26.2% of the population (26,615 individuals) was school-attending, i.e. including all levels of education programs and all ages. In 2000 and 1991 the percentage of school attenders of the population was roughly similar, respectively 25.8% (N=23,387) and 25.8% (N=17,720). In 2010, from the total 26,615 school attenders, 1,656 individuals (6.2%) were entitled to complete additional questions about their transport behavior to school with the use of a long-form digital questionnaire. This conforms to 25.6% of the selected number of all 6,471 persons that participated in the population sample questioning. Thus, in 2010, the proportion of school-attenders from the sampled respondents (25.6%) is well comparable to the proportion of all school attenders (26.2% from the whole

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3 We use the label 'children', but in fact the category includes those that go to school at all ages. The label 'school visitor' or 'school attender' is also used.

4 It is to no surprise that traffic safety is another strong predictor for active transport, as cyclists and pedestrians are widely recognized as the most vulnerable of road users (IRTAD, 2010). Crime perception was at third place.

population). This confirms that the long form sample population is likely to be a suitable representation of the whole population with regard to the distribution of school attenders (table 1).

Table 2 Prevalence of different means of transport to school in 1991, 2000 and 2010 (Census results[5]).

Transport to school	2010		2000		1991	
	N	%	N	%	N	%
Car/Truck from someone in the household		*76.1*		*65.8*		*55.9*
Car/Truck from outside the household		*4.9*		*9.6*		*10.4*
ARUBUS - public transport		*7.7*		*6.9*		*7.2*
School bus private		*3.9*		*2.2*		*1.4*
Bus/taxi private		*0.5*		*1.4*		*1.2*
Motorcycle/scooter		*0.3*		*0.2*[6]		*0.1*
Walking/bicycle		*5.4*		*11.9*[4]		*21.7*
Motorcycle/scooter /bicycle				*1.5*		
Walking				*10.6*		
Other means of transport		*0.8*				
Not reported		*0.4*		*2.1*		*2.2*
Total N of school children in sample	1,656	*100*				
Total N of school children in population	26,615		23,387	*100*	17,220	*100*
Total N population	101,484		90,506		66,687	

Source: Aruba Census in 2010, 2000 and 1991

Not to our surprise, we observe that in Aruba most transportation to school is done by car (table 2). In 2010, almost 94% of children arrive at school by motorized transport (car/truck, bus, etc.). Only 5.4% of children travel to school by bike or on foot. The majority, 76.1% of children arrive by car or truck from someone within the household. From all school goers, only 4.9% arrive by car with someone from outside the household and still 12.1% arrive by public or other means of organized transport (ARUBUS, taxi/bus or school bus). Thus, one in eight children use some form of school-organized and/or public transport. A small proportion (0.3%) is brought to school on the motorcycle.

A comparison with the Census results from 1991 and 2000 shows that over the last twenty years, significantly fewer children go to school on foot or by bike. The combined category of active transport dropped from 21.7% to 5.4% over the two consecutive decennia. We note that, in 2000, there is clearly more walking then biking to school and we assumed that this will be not much different in 1991 and 2010. In 2000, a distinction was made between transport to school 'by bicycle' and 'on foot'. Combining these facts, it follows that the percentage of transport by bicycle will have been about 1.3% in 2000. In 2010, we observe more use of the school bus (an increase from 1.4% in 1991 towards 2.2% in 2000 and 3.9% in 2010) but no substantial change in use of public transport by ARUBUS. Still noteworthy, in 2010, the percentage of transport of children to school by ARUBUS is roughly twice as high as by private school bus.

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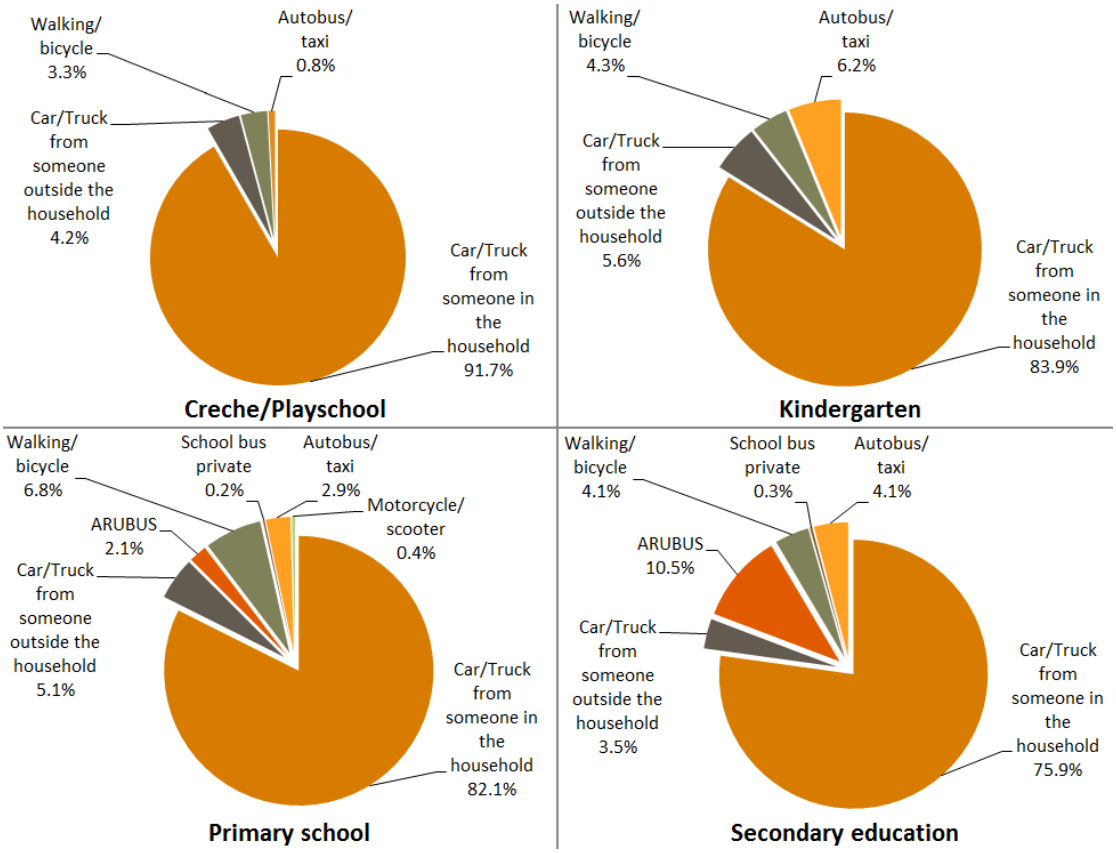
5 The data from 2010 is based on a controlled Census sample (Sample size n=6,471 respondents). In a selected subset of randomly sampled enumeration areas additional questions were asked with a Census long-form questionnaire'. In contrast to the 2010 Census, in 2000 and 1991, all Census questions were directed to the whole population.

6 This percentage is based on an estimate. As some subcategories in mode of transport were clustered differently between consecutive Censuses, we had to make an inference about the values in these subcategories. For instance, we estimated the percentages of 'Motorcycle/Scooter' use in 2000 on the basic assumption that the relative percentage of transport to school by 'Motorcycle/Scooter' will not have changed dramatically over these years and must have remained relatively small (between 0.1% in 1991 and 0.3% in 2010). Accordingly, in 2000 the value is estimated at an intermediate value of 0.2%. By further inference we were able to estimate another subcategory. For instance, in 2000, transport by 'Motorcycle or Scooter' was collected together with the category 'Bicycle'. It follows that the percentage of transport by 'Bicycle' in 2000 would have been about 1.3%, and 'Walking and Bicycle' combined at about 11.9%.

In summary, over the years we see a clear shift that children arrive at school by car by someone from within the household (an increase from 55.9% in 1991 to 76.1% in 2010) or by organized transport (private school bus). We see less transport by car by someone from outside the household (a decrease from 10.4% to 4.9% in 2010). These observations are in line with the general trend that households own several cars (Derix, 2013), and obviously, most households decide to bring their children to school themselves. Relatively few children are taken along by someone from outside the household.

We expect an influence by age and availability of nearby education on the mode of transport to school and studied the data correspondingly (figure 1). Children in Aruba have the option to follow pre-primary education at a crèche or playschool up to 4 years of age and continue to Kindergarten at the age of 4 or 5 years. Then, they follow primary education from about 6 to 12 years of age and continue secondary education when they are about 12 up to at least 16 years of age, and, perhaps, with tertiary education thereafter. The categories of education are compliant with the general ISCED system of categorization (UNESCO, 1997)[7].

Figure 1 Mode of transport to school at different levels of education.



Source: Census 2010, Aruba.

Figure 1 compares levels of education and illustrates that there is a much variation in how children are brought to school. Most children (91.7%) that visit pre-primary education are brought by car by someone from within the household. As children grow up and continue their educational program, the likelihood to be brought by a car decreases to 75.9% at secondary education (which is still very high

7 ISCED level 0 corresponds with Crèche or Playschool and Kindergarten.
ISCED level 1 corresponds with the primary and special education school programs.
ISCED level 2 corresponds with (CB) Ciclo Basico level (first two years) MAVO, HAVO/VWO and EPB.
ISCED level 3 corresponds with (CA) Cyclo Avanza level (3+ years) MAVO, HAVO /VWO and EPB
ISCED level 5 corresponds with tertiary education programs.
ISCED level 6 corresponds with University and PhD programs

when compared to the 14% in the Netherlands (CBS, 2010)). When at primary school 2.1% of children use public transport (ARUBUS) and at secondary level this is 10.5%. Notably, the percentage of children that walk or cycle to school is higher at primary level than at secondary school. This will be due to the fact primary schools are more abundant and more often located near home. The percentage of children that arrive at school by motorcycle or scooter is negligible.
Interesting too is the relative high percentage of children that arrive at Kindergarten by autobus or taxi (6.2%), whereas at primary school only 2.9% arrive by private autobus or taxi. However, at primary level 2.1% arrive by public bus transport and none when in Kindergarten. Clearly, the variation in mode of transport to school is influenced by a variety of factors. Age of the child (level of education) appears to be an important variable, but also the nearby presence of schools and the accessibility by public transport.
We observe a much higher dependency of children on their parents for their travel to school, compared to children abroad, where opportunities to use an own mode of transport are more available (such as in The Netherlands and Belgium).

Distance to school

A description of the frequency distribution of all measured distances to school, split by level of education, is presented in table 3. The distribution of distances is presented in figure 2.

Table 3 Key parameters that describe the distribution of distance to school per level of education program

2010	% of all school attenders	MEDIAN (km)	MODAL (km)	Interquartile range (km)
Crèche/playschool	*8.8*	2.1	1	2.9
Kindergarten	*10.5*	1.5	1	2.0
Special education (Emma school)	*2.3*	3.7	3	4.4
Primary school (Basis school)	*33.5*	1.6	1	2.1
Ciclo Basico (CB)	*9.5*	3.1	2	3.4
MAVO (CA)	*8.3*	3.2	2	4.0
HAVO (CA)	*6.4*	4.5	3	4.2
VWO (CA)	*1.9*	4.8	5	3.9
All other type of education	*18.9*	3.8	3	6.1
Total	*100%*			

Source: Census 2010, Aruba.
Note: The data include school attenders from all ages. We have to stress, that the measured distances refer to the distances measured in straight line between school and home.

The analyses show that the median distance[8] to school for children that go to a crèche or playschool is 2.1 km... Interestingly, the average 2.1 km. median distance to a pre-school is somewhat larger than the 1.5 km to a Kindergarten or 1.6 km to a primary school. The interquartile ranges[9] also reflect this difference between pre-scholars (2.9 km) and children that go to Kindergarten (2.0 km) and primary school (2.1 km). Thus, in general parents with very young children tend to drive a little farther to have their child at a 'preferred' school. Based on the data from the Census in 2010 we were able to distinguish 136 Crèches and Playschool, 24 Kindergarten and 36 primary school locations. Thus, crèches or playschools are widely available, more so than Kindergarten and primary schools. Special education is available in only a few locations and this explains the longer average distance to school for children that follow special education.
Children at secondary level of education, obligatorily have to travel farther as these schools are less abundant. The children in HAVO or VWO that follow secondary level education 'Ciclo Avanza' travel farthest (median distance is respectively 4.5 and 4.8 km). Only a few such schools exist on Aruba.

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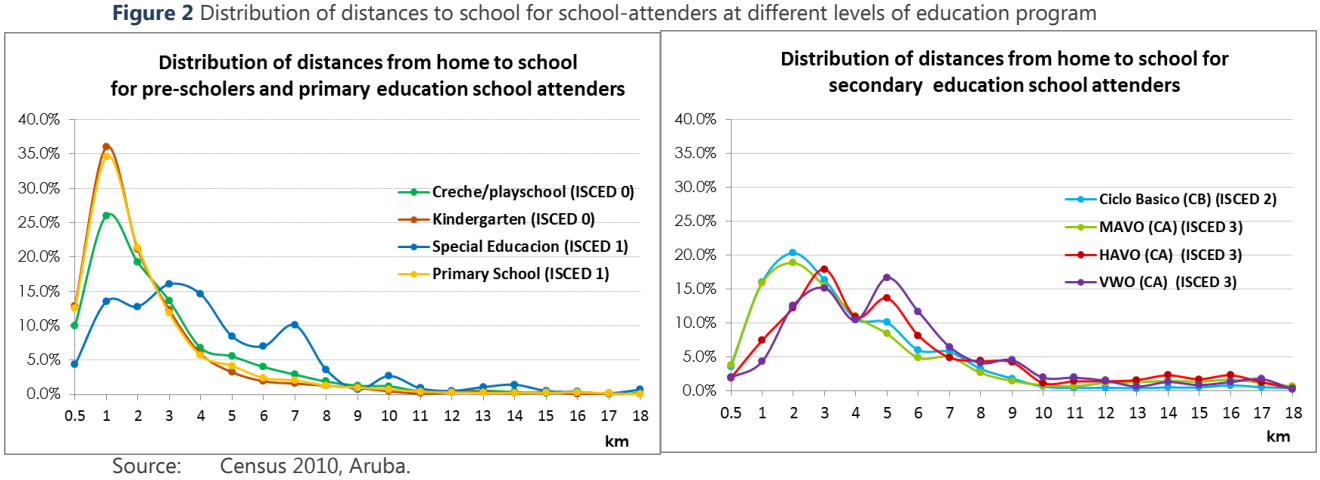
8 The median is the distance when 50% of all measured distances is smaller and 50% is larger.

9 The interquartile range is a measure (in km) that describes the difference between the 25th and 75th percentile of all recorded (sorted) distances. The measure is used as an indication of the shape of the frequency distribution.

Figure 2 presents the distances to school in more detail. Most children that visit a crèche or playschool live at a distance approximately near 1 km from school (note the steep distribution). Similar is the situation for children that visit the Kindergarten or primary school. For a large proportion of secondary level education in Ciclo Basico the distance to school is between approximately 1 and 3 km from home (note the wide distribution of distances). The majority of children that follow Ciclo Avanza level HAVO or VWO have to cover between 3 and respectively 5 km to school.
The frequency of school visitors at approximately 4 km distance from HAVO and VWO appears to be somewhat less. This dip in the distribution of distances coincides with the less densely inhabited areas at about this distance from these schools and may be emphasized by the fact that there are only two such schools in Aruba with a relatively low frequency of school visitors compared to other schools..

Figure 2 Distribution of distances to school for school-attenders at different levels of education program



Source: Census 2010, Aruba.
Note: Category values are smoothed with a line for better readability.

The information above is interesting as, obviously, a large number of children at preschool and primary school (below 12 years of age) live relatively near their school, i.e. within only a few km. So, particularly for children at primary school age, we can conclude that the distance to school will not be the reason why the majority of these children are still brought to school by car.

Where to stay after school

During the 2010 Census, information is collected for all school-attending children (age 17 or less) where they would stay in the afternoon after regular school hours (table 4). The graph in figure 3 summarizes the results.

Table 4 ISCEDlevel of education and where children (17 years or younger) stay after school.

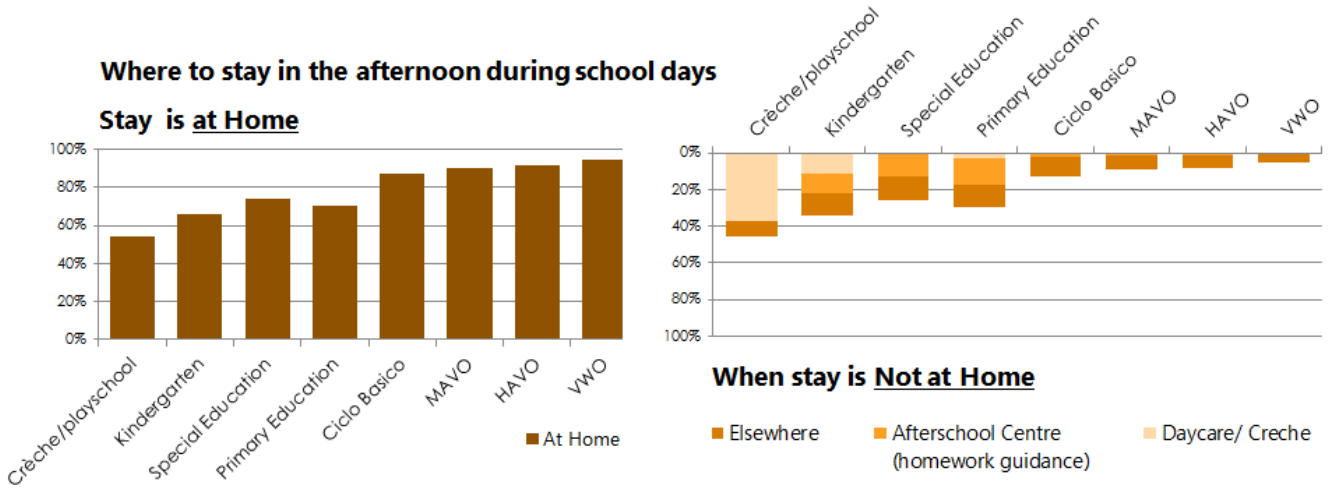
2010	Home	NOT at Home			
		Afterschool Centre	*Daycare/ Crèche*	*elsewhere*
Crèche/playschool	*54.3*	*45.7*	*0.0*	*36.9*	*8.8*
Kindergarten	*65.8*	*34.2*	*10.3*	*11.3*	*12.6*
Special education	*73.9*	*26.1*	*12.1*	*1.0*	*13.0*
Primary education	*70.6*	*29.4*	*14.1*	*3.0*	*12.3*
Ciclo Basico (CB)	*87.0*	*13.0*	*2.2*	*0.2*	*10.7*
MAVO (CA)	*90.6*	*9.4*	*1.5*	*0.1*	*7.8*
HAVO (CA)	*91.5*	*8.5*	*1.5*	*0.0*	*7.0*
VWO (CA)	*94.8*	*5.2*	*0.6*	*0.0*	*4.6*
Other education	*92.8*	*7.2*	*0.4*	*0.0*	*6.7*
In Total	*75.2 %*	*24.8 %*	*7.7 %*	*6.5 %*	*10.6 %*

Source: Census 2010, Aruba.
Note: The category 'not at home' is split into 'Afterschool Centre', 'Daycare Centre/ Crèche' and 'other location elsewhere'. Only a small percentage (0.7%) of the children did not respond to the respective question.

Overall, three-quarter (74.7%) of school-attenders appear to stay at home in the afternoon.

- The percentage that stays at home is lowest (53.5%) when at pre-school level (crèche and playschool) and highest for those that visit Ciclo Avanza (between 90.1 and 94.2%). One-third (36.6%) of preschool children remain at a Daycare Centre or Crèche in the afternoon. Assumingly, most of these children will have full-day working parents.
- At pre-school level few children (8.7%) have indicated to stay elsewhere, as for instance with family or friends, and not at a Daycare or Crèche (36.3%).
- At Kindergarten level, two-third (65.3%) stays at home after school. Equal percentages of children stay at either an after-school center (for instance 'Traemerdia' Center) or at a daycare/crèche (respectively 10.2% and 11.2%).
- Also at primary school, the majority (70.3%) indicate to go home after school. A small number of children remain at a daycare center (2.9%). Respectively 14.0% stay at an afterschool center and 12.3% elsewhere (probably with friends or family).
- At secondary level of education, (MAVO, HAVO and VWO) most stay at home and the few remaining children indicate to stay at a location 'elsewhere' (friends or family, public library, etc.).

Figure 3 Where to stay in the afternoon after school (children below 18 years of age) for subsequent level of education programs (ISCED).



Source: Census Aruba 2010

Regional coverage by schools

Classification of school-attending children per GAC region[10] on the basis of where they live (next called '*residents*'[11]) and where they visit a school (next called '*attenders*') is presented in figure 4.

The analyses provides insight in the origin of school-related traffic between the regions in Aruba, either because children do not find a matching school in the region where they live or for any other reason prefer to go to school elsewhere. Consequently, there is an *efflux* of children, leaving to go to school in another zone (referred to as '*movers*'), and, there is an *influx* of children per zone that arrive from elsewhere (referred to as '*arrivers*'). And of course, there are also '*stayers*', i.e. school-attending children that visit a school in the same zone as where they live. We define the parameter '*school coverage*' to express the number of 'stayers' as a percentage of the number of 'residents'. Coverage reveals information about the percentage of children that find a school in the region they live.

For instance, Oranjestad-East provides school seats for many children ('attenders'). Several schools situate in Oranjestad-East and these attract children from all over Aruba. Over a quarter (26.4%) of all Aruban children go to Oranjestad East ('Influx') to visit school. This is more than twice as much (216%)

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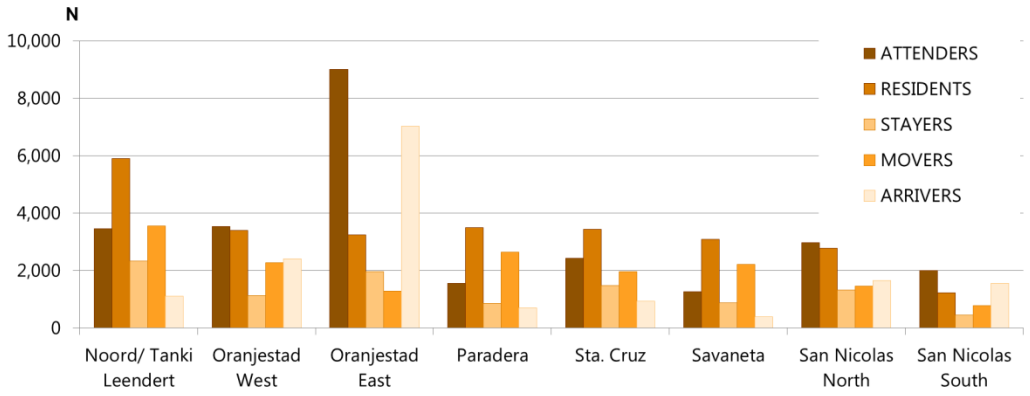
10 See the Methods section for an explanation of the Geographical Address Classification system (GAC).

11 Important note! In order to abbreviate the long definitions, and prevent long sentences in the heading of the table, we use a few shortcuts to categorize school attending children (age 17 or less). For instance, in this paragraph we refer to all school attenders that live in a zone or region as '*residents*'.

children than actually live in Oranjestad East, but also, two-third (60.5% 'coverage') of those that actually live in Oranjestad East also visits a school in the region. Thus, Oranjestad East is a strong hotspot for school-attenders as it has many schools available. Noord/Tanki Leendert is a region where many school-visiting children live ('residents') but also harbors many to visit school elsewhere ('movers').
On a national scale, in total, 60.8% of all school attenders travel to another region for school and only 39.2% of school-attenders in Aruba visit school in their own region. On a daily basis this means that there is quite some movement between regions that can be related to school attendance.

Figure 4 Geography of school-attending children in Aruba in 2010.



National parameters : as a percentage of ALL school-attenders in Aruba:									**Total**
INFLUX	4.2%	9.1%	26.4%	2.6%	3.5%	1.5%	6.2%	5.9%	**60.8%**
EFFLUX	13.4%	8.5%	4.8%	9.9%	7.4%	8.3%	5.5%	2.9%	**60.8%**
COVERAGE	8.8%	4.2%	7.4%	3.3%	5.6%	3.3%	5.0%	1.7%	**39.2%**

Regional parameters: as a percentage of school-attending residents in the region:									**Average**
INFLUX	19.0%	71.1%	216.4%	19.9%	27.4%	12.8%	59.4%	126.4%	**60.8%**
EFFLUX	60.4%	66.9%	39.5%	75.3%	56.9%	71.5%	52.5%	63.4%	**60.8%**
COVERAGE	39.6%	33.1%	60.5%	24.7%	43.1%	28.5%	47.5%	36.6%	**39.2%**

Source: Census 2010, Aruba.
Note: Influx expresses the number of 'arrivers' as a percentage of the 'attenders' or the 'residents'
Efflux expresses the number of 'movers' as a percentage of the 'attenders' or the 'residents'
Coverage expresses the number of 'stayers' as a percentage of 'residents'.

Figure 4 emphasizes the discrepancy that exists between school and home locations as a percentage of children that travel in and out of the region. As argued before, most school seats are in Oranjestad East as this region not only attracts large numbers of school attenders but also the 'coverage' in this region is high. At a national level, the least 'Influx' arrives in Paradera (2.6%) and Savaneta (1.5%). The highest efflux of children is from 'Savaneta' (8.3%), 'Paradera' (9.9%) as well, and Santa Cruz' (7.4%) and 'Noord/Tanki Leendert' (13.4%). The regions Oranjestad West as well as San Nicolas North and South receive only moderate numbers of school attenders from outside their own region (respectively, 9.1%, 6.2% and 5.9%). San Nicolas South plays the minor role at the national level with regard to 'coverage' of school-attendance (1.7%) and the influx (126.4%) is double the efflux (63.4%) considered at a regional level.

We highlighted the *school hotspots* and listed their locations at the level of GAC zones in table 5. The table lists the number of school '*attenders*' respectively school '*residents*' per GAC zone. Zones *11-Palmbeach/Malmok*, *12-Washington*, *13-Alto Vista*, *14-Moko/Tanki Flip* and *15-Tanki Leendert* as well as *41-Siribana*, *43-Ayo* and *61-Pos Chiquito* are all home to more than 1000 school-attending children. With the exception of zone *12-Washington*, these 'residential' zones differ from the typical zones where children go to school. We will discuss the number of children in the major school zones in more detail, next.
In general, the number of schools per zone is often not more than just a few, but zones *32-Klip/Mon Plaisir* and *33-Sividivi (and a small part of neighboring 34-SeroeBlanco* and *28-Companashi/Solito)* characterize two major hotspots and deserve to be mentioned in particular. They provide school to respectively 4,232 and 3,840 school-attenders (see figure 5).

In the small area of only about 1 km^2 in Zone *33-Sividivi* and overlapping zone *28-Companashi/Solito* situate nine major schools (i.e. the University and a number of large primary and middle level education schools (MAVO). More to the east, overlapping with zone *34-Sero Blanco/Cumana* situates the EPI ('*Educacion Professional Intermedio*'). This is the single largest school for tertiary level education. Both education hotspots are accessible by only a few roads and are only a mile apart. Moreover, just over a mile to the south, in zone *32 Klip/Mon Plaisir* situate another preschool, primary and some secondary schools (amongst which HAVO and VWO, Aruba's main high school). These schools all locate close to each other. In these areas much school-related traffic comes together, twice or three times a day and in a relatively short timeframe during rush hours.

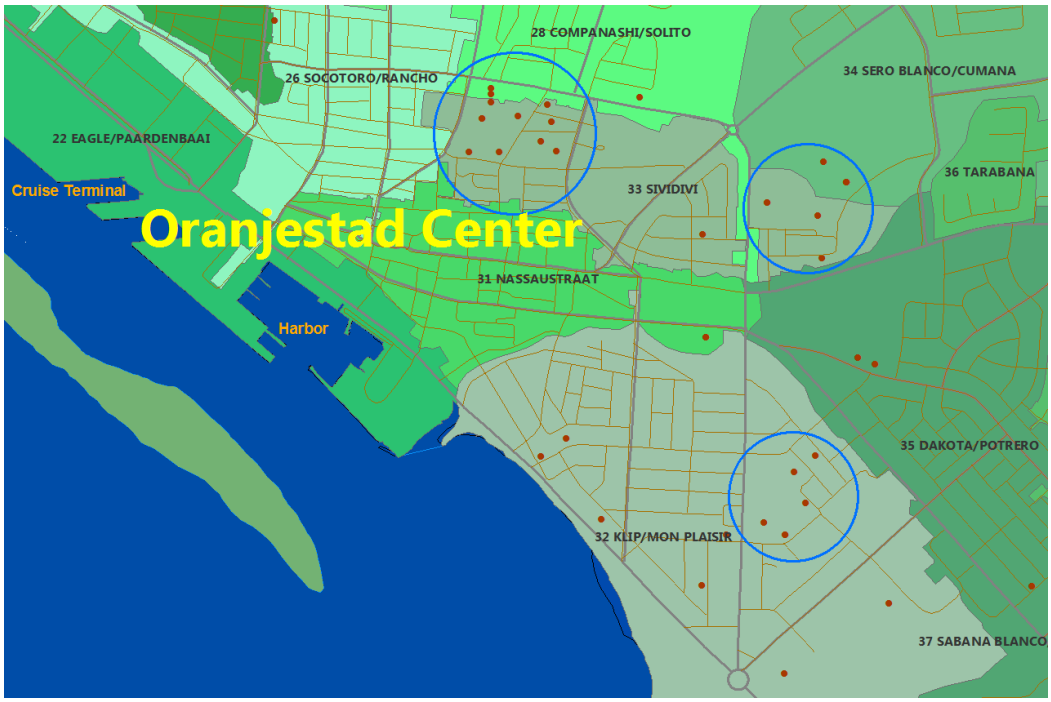
Table 5 Zones with the major concentrations of school attending children.

GAC	ZONES with over 1,000 *attenders*	N	GAC	ZONES with over 1,000 school-attending *residents*	N
12	Washington	1,183	11	Palmbeach/Malmok	1,398
27	Ponton	1,496	12	Washington	1,010
31	Companashi/Solito	1,190	13	Alto Vista	1,325
32	Klip/Mon Plaisir	4,232	14	Moko/Tanki Flip	1,094
33	Sividivi	1,776	15	Tanki Leendert	1,077
34	Seroe Blanco/Cumana	2,064	41	Siribana	1,158
52	Papilon	1,218	43	Ayo	1,012
73	Watapana Gezaag	1,074	61	Pos Chiquito	1,566
85	Essoville	1,010			

Source: Census Aruba 2010.

Other school areas exist with similar traffic congestion during rush hour but on a smaller scale. Zone *12-Washington* harbors large primary schools in a small area and at some distance to Kindergarten and the Aureus University of Medicine, but over a larger extent. In these areas, even though the number of school attending children is high, the concentration of traffic is expected to be less. Next, the EPB Oranjestad (Educacion Professional Basico) situates in zone *27-Ponton*. This large school is for vocational education but is much better situated to prevent serious congestion of school-related traffic. Also in San Nicolas situate a number of schools at a relatively small distance from each other, but the total number of school attending children in San Nicolas is not as high and the road access seems better as well.

Figure 5 East part of Oranjestad with its harbor, cruise ship terminal and some school 'hotspots'.



Source: Census Aruba 2010.

Note: The map (3x2 km) shows the location of schools in the city center of Oranjestad East, Schools are indicated by dots, roads are indicated by lines and background colors depict the different geographical zones. Small residential roads are indicated in brown color.

Location of home versus school in more detail

In this section, we review at a more detailed level of GAC zones (and GAC regions) where the children live that visit a school in a specific region or zone (Appendix B, C, D and E respectively table 6). The tables present the daily destination of school attending children at four different levels of education (ISCED), i.e. preschool, primary school (including special education), secondary school and tertiary level of education program. An explanation of how to read the tabular matrix representations is given below.

Note to the tables and Appendices B, C, D and E.

The representation of the information as a tabular matrix may be unfamiliar and that requires further explanation. The tables show the number of school attenders that live in one place (presented in rows at the GAC Zone level) and go to school in another location (also presented at the GAC zone level but in the columns). GAC zones are listed by their GAC zone number ID. To simplify the readability of the tables, the name of the GAC zone is written in full text only next to the table rows. The GAC regions are named below and to the left of the table. Zone 61-Pos Chiquito is specified by vertical and horizontal cross lines as a separate row and column, although Zone 61-Pos Chiquito is administratively part of Region 'Savaneta' that situates in the Northeast of Aruba. Zone-61 is located exactly halfway in between the city centers Oranjestad and San Nicolas and houses many residents. All locations in zone-11 up to and including zone-56 are part of the larger area 'Pabou di Brug', i.e. the local synonym to 'West of the 'bridge'. The zones-61 up to and including zone-87 are part of 'Pariba di Brug', i.e. 'situate at the Southeast of the 'bridge'. The bridge historically connects between the Northwest and Southeast and situates about halfway in Aruba, along the flat southeast coast. It spans an open water inlet that connects a mangrove area with the Caribbean Sea.

An example of how to interpret the results in the tables

For instance, from the table in Appendix B, we can read that 19 children that follow preschool education, live in GAC zone-15 *Tanki Leendert*, in the region 'Noord/Tanki Leendert', but go to school in zone-12 *Washington*. Another way to read this information is to say that from the children that live in GAC zone-15 Tanki Leendert, 19 children follow preschool education in zone-12 *Washington*. Similarly, 6 children that live in GAC zone-15 Tanki Leendert go to a school in Zone-32 *Klip/MonPlaisir* and 3 children go to Zone-61 *Pos Chiquito*, etc.

To ease the interpretation of the results, the information in the tables can be summarized percentagewise, and split into the eight regions along the rows and columns (Table 6), or into four quadrants, separating Pariba and Pabou (Table 7). In the latter, a separate row and column portrays Zone 61-Pos Chiquito, as it is interesting to discuss this zone in separate. In all tabular matrix representations, the cells with a *blue border* show a frequency of school attenders above the *table average*.

Table 6 Percentage school attenders per GAC home region (rows) versus GAC region of school location (columns).

Pre-Primary School

Home Region	Noord/ Tanki L	Oranjestad West	Oranjestad East	Paradera	Sta. Cruz	avaneta	San Nicolas North	San Nicolas South	N	
Noord Tanki- Leendert	**14.1**	4.9	2.1	1.6	0.6	0.1	0.1	0.0	1,174	23.4%
Oranjestad West	2.2	**7.9**	1.9	0.4	0.2	0.1	0.0	0.0	641	12.8%
Oranjestad East	0.8	2.6	5.5	1.0	1.2	0.2	0.1	0.0	572	11.4%
Paradera	2.4	2.0	2.1	**6.3**	1.6	0.2	0.1	0.0	730	14.5%
Sta. Cruz	0.6	1.1	1.7	1.3	**6.8**	0.4	0.1	0.0	599	11.9%
Savaneta	0.2	0.6	1.1	0.3	0.6	**6.2**	2.2	0.7	593	11.8%
San Nicolas North	0.1	0.2	0.2	0.2	0.2	0.6	**5.8**	2.8	500	10.0%
San Nicolas South	0.1	0.1	0.0	0.0	0.0	0.3	1.9	1.7	207	4.1%
N	1,022	961	736	555	567	398	512	263	**5,015**	
	20.4%	**19.2%**	14.7%	11.1%	11.3%	7.9%	10.2%	5.2%		100%

Primary School

Home Region	Noord/ Tanki L	Oranjestad West	Oranjestad East	Paradera	Sta. Cruz	Savaneta	San Nicolas North	San Nicolas South	N	
Noord Tanki- Leendert	**15.7**	0.6	3.6	1.4	0.5	0.3	0.0	0.0	2,115	**22.2%**
Oranjestad West	2.9	3.2	**5.7**	0.9	0.4	0.1	0.0	0.0	1,242	13.1%
Oranjestad East	0.8	0.6	**7.7**	0.8	1.8	0.4	0.1	0.0	1,158	12.2%
Paradera	2.0	0.4	2.7	**5.8**	1.9	0.3	0.1	0.1	1,256	13.2%
Sta. Cruz	0.4	0.3	1.8	1.1	**8.5**	0.3	0.1	0.1	1,207	12.7%
Savaneta	0.3	0.2	1.0	0.3	0.8	**6.0**	1.9	0.9	1,080	11.4%
San Nicolas North	0.1	0.1	0.2	0.1	0.1	1.3	5.5	3.2	1,012	10.6%
San Nicolas South	0.0	0.0	0.2	0.1	0.0	0.5	2.0	1.9	443	4.7%
N	2,106	518	2,167	1,000	1,334	878	927	582	**9,512**	
	22.1%	5.5%	**22.8%**	10.5%	14.0%	9.2%	9.7%	6.1%		100%

Secondary School

Home Region	Noord/ Tanki L	Oranjestad West	Oranjestad East	Paradera	Sta. Cruz	avaneta	San Nicolas North	San Nicolas South	N	
Noord Tanki- Leendert	1.3	**7.2**	**11.4**	0.0	0.2	0.0	0.3	0.7	1,932	**21.0%**
Oranjestad West	0.4	4.5	**6.5**	0.0	0.1	0.0	0.3	0.5	1,121	12.3%
Oranjestad East	0.4	3.3	**7.7**	0.0	0.4	0.0	0.5	0.7	1,185	13.0%
Paradera	0.9	3.7	**5.9**	0.0	0.9	0.0	0.5	0.6	1,141	12.5%
Sta. Cruz	0.3	1.8	**5.4**	0.0	3.6	0.0	1.7	0.6	1,220	13.3%
Savaneta	0.1	0.6	3.0	0.0	0.4	0.0	4.4	3.3	1,087	11.9%
San Nicolas North	0.0	0.4	1.3	0.0	0.0	0.0	5.4	3.8	996	10.9%
San Nicolas South	0.0	0.2	0.7	0.0	0.0	0.0	2.1	2.0	460	5.0%
N	313	1,981	3,829	0	528	0	1,377	1,115	**9,142**	
	3.4%	**21.7%**	**41.9%**	0.0%	5.8%	0.0%	15.1%	12.2%		100%

Tertiary School

Home Region	Noord/ Tanki L	Oranjestad West	Oranjestad East	Paradera	Sta. Cruz	Savaneta	San Nicolas North	San Nicolas South	N	
Noord Tanki- Leendert	0.8	1.8	**19.3**	0.0	0.0	0.0	1.3	0.3	610	**23.6%**
Oranjestad West	0.0	0.5	**11.5**	0.0	0.0	0.0	0.5	0.4	337	13.0%
Oranjestad East	0.0	0.1	**9.9**	0.0	0.0	0.0	0.9	0.2	288	11.1%
Paradera	0.0	0.1	**12.2**	0.0	0.0	0.0	0.5	0.2	336	13.0%
Sta. Cruz	0.0	0.0	**12.9**	0.0	0.0	0.0	1.1	0.4	375	14.5%
Savaneta	0.0	0.1	**10.1**	0.0	0.0	0.0	1.1	0.3	298	11.5%
San Nicolas North	0.0	0.1	8.2	0.0	0.0	0.0	0.6	0.4	244	9.4%
San Nicolas South	0.0	0.1	3.6	0.0	0.0	0.0	0.2	0.1	104	4.0%
N	22	76	2,269	5	0	0	165	54	**2,590**	
	0.8%	2.9%	**87.6%**	0.2%	0.0%	0.0%	6.4%	2.1%		100%

Source: Census Aruba 2010.

Note: The upper 10% of values is highlighted by bold. Values above table average are indicated by a blue square. Combinations where children attend school and live in the same region (diagonal) are highlighted in green. Percentages are expressed as percentage of table total. Row and column totals express the total frequencies (N) of school attenders.

Some specific zone and/or region combinations show particularly high frequencies (or percentages). We will discuss these next.

First, as expected and shown in table 6 (see also the Appendices), children in pre-school and primary school preferably tend to go to a school in the same region (and zone) as where they live (we refer to the diagonals of the tables). The diagonals describe region (and zone) combinations that are spatially near to each other. These findings emphasize the importance of distance to school is a primary determiner for the selection of pre-primary and primary school. But the data reveal other patterns as well.
Some schools are favored by children from all over the country. For instance, at preschool level (Appendix B) children from all three zones 11, 12 and 13 most frequently attend a school in zone 12. This preference is similar at preschool and primary level of education (compare Appendix B and C). We note that some of these schools are large and receive much interest from outside their zone. The reason for this may be that the quality of education at these schools is expected to be high, or because there is a preference for education in the own religion (for instance catholic or evangelic, or other type of school, versus public school), but it may also be that these school locate well relative to the parents' location of work (see also the next section).

At secondary, respectively tertiary level of education (tables in Appendix D and E and table 6 and 7), we observe even more that specific zones have a high concentration of school attending children that arrive from all over Aruba. The major tertiary schools situate in or near Oranjestad, so it is obvious that the vast majority of the children have to travel quite a distance to go to these schools. The consequent concentration of traffic at such school hotspots during rush hour seems straightforward, but this school-related traffic is likely to have an impact on the traffic flow beyond the actual location of the schools, since there is a limited amount of roads that lead to these areas. For instance, in order to get to the EPI (MBO education) in zone-33 *Sividivi* and zone-34 *Sero Blanco/Cumana*, traffic has to go into the center of Oranjestad and comes together with traffic from the south of Oranjestad that has to enter or pass to the north and vice versa, adding to the traffic queues.

In the presentations of table 6 one may consider in separate the regions Noord/Tanki Leendert and Oranjestad West on one side and the other six regions on the other side, in order to get an impression of the school-related traffic that has to visit or cross Oranjestad (from south to north and vice versa).
Interestingly, reading the tables in this manner, from all children that visit secondary school, as much as 41.9% go to Oranjestad East of which 17.9% arrive from the north and thus have to cross the city center. An even larger percentage (87.6%) visits a tertiary school in Oranjestad East, of which 30.8% arrive from the North. In the opposite direction, the amount of children that live south of Oranjestad (for instance in Oranjestad East or even more to the south) but visit a school in Oranjestad West or Noord/Tanki Leendert is relatively small.

Similarly, we may compare the traffic between Pariba and Pabou. The majority of children, with the exception in Tertiary school, that live in the Northwest (Pabou di Brug) also go to school Pabou, whereas, the majority that live in the Southeast (Pariba di Brug) also go to school Pariba (table 7). Of preschool children that live Pabou the vast majority (98.2%) visits a school Pabou. However, from preschool and primary school children that live Pariba di brug close to one in eight children (15% and 13%) still travels to a school north. So, proximity to home clearly is not the only reason for the selection of school. In the opposite direction, as noted already, from those that live Pabou only a fraction parts to go to school Pariba (respectively 1.8% and 2.6% for pre-primary and primary school attenders).

At secondary level, from the children that live Pariba close to one out of every four children (24.5%) travel to a school Pabou di Brug. The majority remains South of Oranjestad, in zone 32 *-Klip/Mon Plaisir,* and a smaller proportion visits a school in zone *27-Ponton (EPB)* that situates northwest of Oranjestad.
In the opposite direction, however, more traffic through town can be expected on the basis of school destinations. Over all, in opposite direction, 8.7% from children that live in the Northwest attend a secondary school in the Southeast. Although numbers are low, it is interesting to note that most of these children attend a secondary school in Zone *85-Essoville* (in either the Ibero-American High school or another school for general secondary education, MAVO). A small proportion of these children go to

zone *72-Rooi Congo* where the first and second stage technical and vocational education is situated (EPB San Nicolas).

Table 7 Percentage school attenders that live (rows) or visit a school (columns) in the different parts in Aruba.

Pre-Primary School

	Pabou	PosChiquito	Pariba	N	%
Pabou	***98.2***	*0.8*	*1.8*	3,715	*100*
PosChiquito	*33.5*	*43.6*	*66.5*	288	*100*
Pariba	*15.0*	*13.9*	***85.0***	1,012	*100*
N	3,842	212	1,173	5,015	

Primary School

	Pabou	PosChiquito	Pariba	N	%
Pabou	***97.4***	*1.1*	*2.6*	6,977	*100*
PosChiquito	*32.1*	*30.3*	*67.9*	564	*100*
Pariba	*13.0*	*7.4*	***87.0***	2,535	*100*
N	7,126	*268*	2,387	9,512	

Secondary School

	Pabou	PosChiquito	Pariba	Total	%
Pabou	***91.3***	*0.0*	*8.7*	6,600	*100*
PosChiquito	*42.8*	*0.0*	*57.2*	559	*100*
Pariba	*24.5*	*0.0*	***75.5***	1,984	*100*
Total	6,650	*0*	2,492	9,142	

Tertiary School

	Pabou	PosChiquito	Pariba	Total	%
Pabou	***92.3***	*7.7*	*7.7*	1,945	*100*
PosChiquito	***91.8***	*8.2*	*8.2*	132	*100*
Pariba	***89.3***	*10.7*	*10.7*	513	*100*
Total	2,372	*219*	219	2,590	

Source: Census Aruba 2010.
Note: Zone-61 Pos Chiquito is part of the Southeast 'Pariba di Brug' and included in the respective percentages, even though the zone is also highlighted as a separate category.

For children at preschool that live in Pos Chiquito, the tendency to travel northwest is somewhat larger than to go to a school southeast (33.5% versus 22.9%). A majority, however, 43.6% of the preschool children that live in zone *61-Pos Chiquito* stay in Pos Chiquito. For children from zone *61-Pos Chiquito* at primary school level, the tendency to visit a school in the Northwestern is equally likely as in the Southeastern part of Aruba (respectively 32.1% and 37.6%). Interestingly, at secondary school level, however, a slight majority prefers a school in the Southeast (42.8% against 57.2%). There are no secondary schools in Pos Chiquito, so none of the children stay in this zone for secondary school. Thus, at preschool, the trend is to stay in Pos Chiquito or go to a school north, at primary school, there is equal likelihood to go south or to go north for school, but at secondary school, a majority goes to school southwards.

As said before, at tertiary level of education only a few schools exist in Aruba and most locate in Oranjestad East. It is clear that these schools attract students from all over the island (see Appendix E).

Transport to work

At the time of the Census in 2010, *46,526* individuals of age 14 years and above (45.8% of the population) indicate to be employed in Aruba. Employment is defined as having a job for which one had (or should have had) worked for at least 4 hours in the week prior to the Census[12]. At the time of the Census in 2000 the number of employed persons was 41,918 (46.3% of the population) and in 1991 it was 29,220 (43.8%). Thus, over the two recent decennia, the labor force increased with 12,698 individuals between 1991 and 2000 (43.5% increase) and 3,955 individuals between 2000 and 2010 (9.4% increase). The new workforce is likely to travel by private car as well (see table 8), but it seems unlikely that this increase in traffic flow is to be blamed for the incidence in traffic jams that we see in recent years. To gain better insight, we present the analyses of where employees live and work in more detail, below.

Type of transport to work

The long-form questionnaire provides information about the mode of transport that employees commonly use to go to work (table 8).

In 2010, 80.6% of employees travel to work by car of which 68.5% as the driver and 12.1% as a passenger, likely from the same household as the driver (parents, partner, etc.). Another 8.9% arrive by public or organized transport (ARUBUS, private taxi/bus or personnel transport) and 0.9% by motorcycle or scooter. So, 90.4% of all workers use motorized transport to work (car/truck, bus, etc.). Compared to the situation in previous censuses, we can observe a steady percentage increase in the use of motorized transport (from 84.1% in 1991 and 86.8% in 2000 up to 90.4 in 2010).

Table 8 Prevalence of different means of transport to work in 1991, 2000 and 2010 (Census results).

Transport to work	**2010**		**2000**		**1991***	
	N	%	N	%	N	%
Car, as driver		*68.5*		*61.3*		*53.6*
Car, as passenger		*12.1*		*11.9*		*15.7*
ARUBUS		*5.3*		*6.6*		*7.7*
Employee transport		*1.9*		*3.2*		*4.3*
Private bus/taxi		*1.7*		*3.2*		*2.5*
Motorcycle/scooter/bicycle				*1.3*		
Motorcycle/scooter		*0.9*		*0.6* [13]		*0.3*
Bicycle/ on foot / lives at job site		*8.2*		*12.9* [13]		*14.1*
Bicycle/ on foot		*4.2*		*7.0* [13]		
On foot				*6.3*		
Lives at job site		*4.0*		*5.9*		
Other		*0.9*				
Not reported		*0.5*		*0.3*		*1.9*
Total employed persons in sample	2,996	*100*				
Total employed persons in population (14+)	46,526		41,918	*100*	29,220	*100*
Total population	101,484		90,506		66,687	

Source: Census Aruba 2010, 2000 and 1991.

Interestingly, the percentage of organized employee transport dropped from 4.3% in 1991 to 3.2% in 2000 and 1.9% in 2010, and public transport of employees by ARUBUS also went down from 7.7% in 1991 towards 6.6% in 2000 and 5.3% in 2010. Furthermore, between 2000 and 2010, the percentage of employees that arrived at their work site on foot dropped from 6.3% in 2000 to less than 4.2% in 2010 (i.e. the percentage of 'transport on foot even including 'transport by bike' in 2010).

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12 An additional 63 persons indicated to work abroad and were left out from our analyses

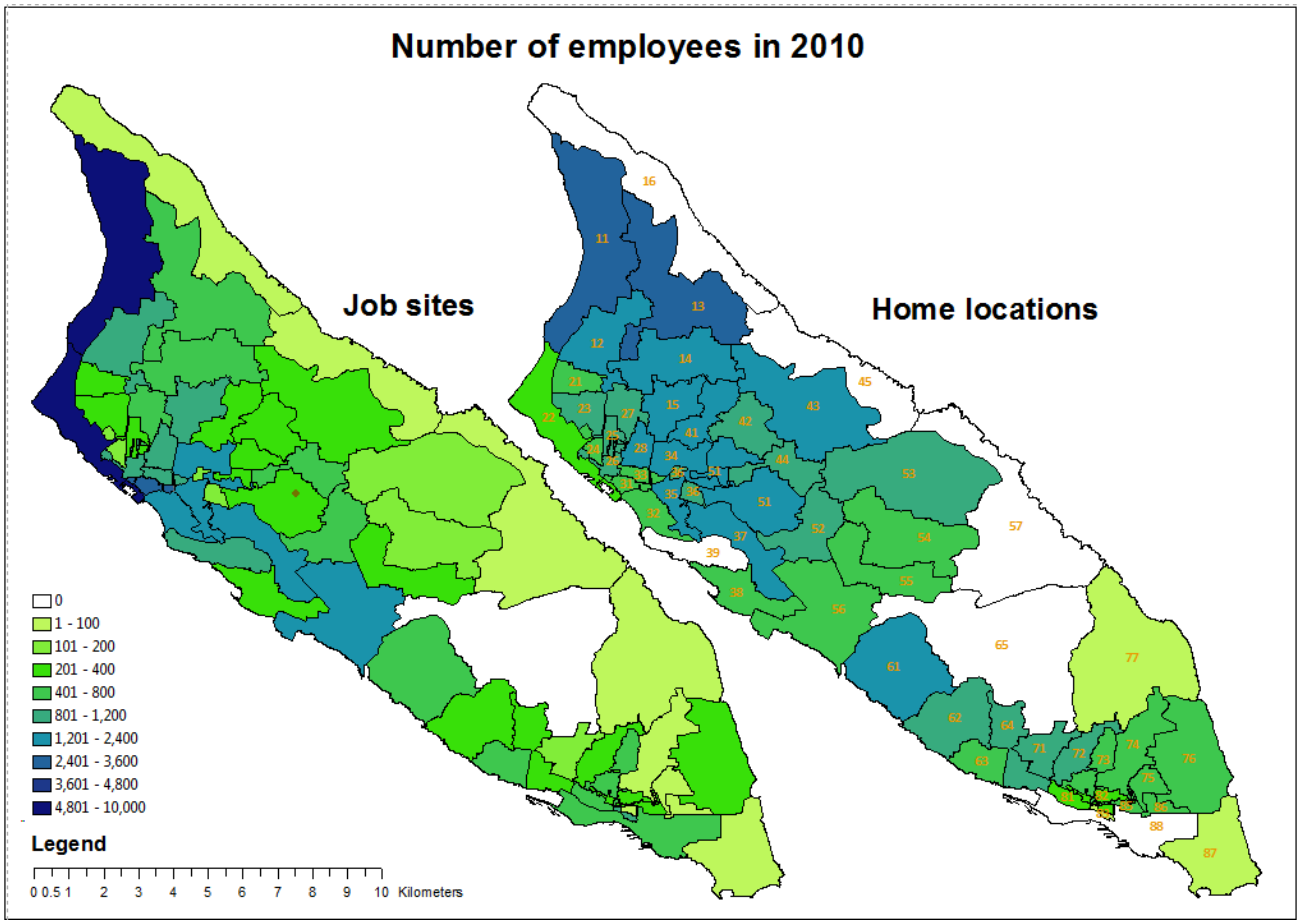
13 This percentage is based on an estimate following the assumption that 'transport by motorcycle/scooter' in 2000 is at an intermediate value in between the percentages in 1991 and 2010. A comparison between Census results for transport 'on foot' or 'by bike' cannot be made conclusively as these categories shifted over the years. In 2000, 'transport by bike' was included in the category 'transport by motorcycle', whereas in 1991 'transport by bike' was recorded together with 'transport on foot or lives at job site'.

The only increase we observe between 1991 and 2010, besides the increase in persons using a car as mode of transport, is the slight increase in the percentage of employees that arrive per motorcycle or scooter at work (from 0.3% in 1991 to 0.9% in 2010).

Where do most employees live and work

In Appendix G we list a number of indicators that are used internationally with regard to job intensity. The table presents information about the number and percentage of the employee population that lives or works in a GAC zone, as well as the home and job density per GAC zone (N per km^2) and the ratio of job locations over employee home locations per GAC zone. Table 9 presents a listing of 'hot' job and 'hot' employee residential zones. The data are compared between the Census results in 2000 and 2010. The results are represented in two maps, figure 6 (employees' job and home locations in 2010 in Aruba) and figure 8 (change in employees' job and home locations between 2000 and 2010). Figure 8 will be discussed hereafter. In addition to the general information in figure 6, we present in Appendix F[14] even more detail as a tabular matrix and reveal where employees live that work in a particular zone. The same data we present in table 10, but then at the regional level and as a percentage of employees that live and go to work in subsequent regions.

Figure 6. Spatial distribution in GAC zones of employee job and home locations in 2010.



Source: Census Aruba 2010.
Note: The map to the right also shows the GAC zone ID numbers (indicated inside subsequent zones),

14 Similar to the presentation of children that visit a school in a specific zone, we present the distributions of zones where employees work per zone of residence (Appendix F). In addition to the distribution of employees' home location and employees' work location at the level of zones (main upper table), the row and column totals summarize the results for respectively 'Pabou di Brug' and 'Pariba di Brug' as well as a percentagewise representation of both areas at the regional level.

Clearly, two areas along the Northeast coastline are characterized by a high concentration of job sites. These zones, like in the tourism area zone *11-Palm Beach/Malmok* and zone *22-Eagle/Paardenbaai* provide jobs to many and make up for 35.8% of the total worker population (respectively 14.3% and 21.5% of all Aruban workers). Zone 11 is the major Hotel area but also has two large shopping malls as well as an exclusive restaurant area. Zone 22 characterizes by the tourist area and Cruise Terminal in Oranjestad, a number of administrative buildings as well as commercial activity close to the Container harbor. Additionally, in the center of Oranjestad, the historical shopping area named zone *31-Nassaustraat*, provides job opportunity to many. Compared to most other zones Zone 31 is relatively small (0.4 km^2) but the density of job sites is very high (8,221 per km^2) and a 7% of all employed find a job in this zone. Further to mention are zone *32-Klip/Mon Plaisir*, i.e. the area with schools, administration and government offices, and zone *37-Sabana Blanco/Mahuma,* historically characterized by commercial activity, and finally, zone *56-Balashi/Barcadera,* i.e. the zone with a relatively new shipping and container terminal that attracts many businesses. A high density of job sites does exist in the city center of San Nicolas, in zone *83-Van de Veen Zeppenfeldstraat* (with 8,457 workers per km^2) but only 2.3% of the total work force in Aruba finds employment in this zone (the area is very small).

Many employees (22.7%) live in the region 'Noord/Tanki Leendert', i.e. zones 11 up to 15, and in zone *61-Pos Chiquito* (5.1%). Also, a large number of workers live directly around Oranjestad, i.e. in zone *28-Companashi/Solito* (2.7%), zone 34-*Seroe Blanco/Cumana* (2.8%), zone 35-*Dakota/Potrero* (2.7%), zone 37-*Sabana Blanco/Mahuma* (3.1%), zone *41-Shiribana* (3.7%), zone *43-Ayo* 43 (3.3%) and in zone *51-Hooiberg* (2.7%). In San Nicolas, zone *84-Village* and *85-Essovile* characterize by a historically high density of homes, but these zones are relatively small and thus add little to the total number of employees' homes in Aruba.
Zone 34-*Seroe Blanco/Cumana*, 35-*Dakota/Potrero* and 37 *Sabana Blanco/Mahuma* also provide a significant number of jobs, but as Appendix F reveals, only about 15% of those who live in these zones also find a job in the zone. These hot working zones are visited by employees from the wider region and most of those who live in the zone leave for work elsewhere (to zone 11, zone 22 or zone 31). In contrast, in zone *11-Palm Beach/Malmok*, nearly 33% of those who live also have a job in this zone.

Table 9 Zones with the major concentrations of jobs and employees' home locations.

GAC	ZONES with over 3,000 *employed jobs*	N	GAC	ZONES where over 1,300 *employees* live	N
11	*Palm Beach/Malmok*	6,645	**11**	Palmbeach/Malmok	2,480
22	*Eagle/Paardenbaai*	9,985	**12**	Washington	1,953
31	Nassaustraat	3,260	**13**	Alto Vista	2,425
			14	Moko/Tanki Flip	1,833
GAC	ZONES with over 1,300 *employed jobs*		**15**	Tanki Leendert	1,852
32	Klip/Mon Plaisir	1,987	**34**	Seroe Blanco/ Cumana	1,313
34	Seroe Blanco/ Cumana	1,275	**37**	Sabana Blanco/Mahuma	1,450
35	Dakota/Potrero	1,350	**41**	Shiribana	1,698
37	Sabana Blanco/Mahuma	1,986	**43**	Ayo	1,544
56	Balashi/Barcadera	1,498	**61**	Pos Chiquito	2,350

Source: Census Aruba 2010.

The ratio of the *number of jobs per number of employee residence locations* is often seen as an index for how well some areas can provide a home residence relative to the number of persons that find employment in these areas. However, workers not necessarily can or want to live in the zone of work for a number of reasons. Appendix F clearly reveals this phenomenon. Two main principles seem to structure the distribution of home versus job sites. First, a significant amount of people live in the zone where they work (diagonals show above average frequencies), and two, a few zones attract employees from a wider region (zone 11, 22, and 31 in particular).
For wherever one lives in Aruba, there appears no dominant relationship between the home and work location other than that a preference exists to work near home but that such most often cannot be realized. With the exception of the two regions 'Tanki Leendert/Noord' and 'San Nicolas South' the majority of employees always work in 'Oranjestad'. Table 10 shows that also at the regional level, a major proportion works in the region where they live, but, the majority of the employees in for instance, 'Paradera', 'St. Cruz', 'Savaneta' and 'San Nicolas North' still work in either 'Oranjestad East' (respectively 3.5%, 3.8%, 2.6% and 1.8% of all employees in Aruba) or in 'Oranjestad West' (respectively 3.3%, 3.0%

2.5% and 2.0%). From the employees that live in 'San Nicolas North' a major proportion (1.8%) also works in 'San Nicolas South'. As indicated already, those who live in the region 'San Nicolas South' in majority also work in 'San Nicolas South' (1.3% of all employees in Aruba in 2010), and those who live in 'Tanki Leendert/Noord' in majority also work in 'Tanki Leendert/Noord' (i.e. 9.1%).

Table 10 Percentage of the employed population per region of work and region of residence.

Percentage of employees per region of home and work

Home Region	Work Region Noord/ Tanki Leendert	Oranjestad West	Oranjestad East	Paradera	Sta. Cruz	Savaneta	San Nicolas North	San Nicolas South	*Total*
Noord Tanki- Leendert	**9.1%**	**6.5%**	**5.1%**	0.4%	0.9%	0.3%	0.2%	0.4%	10,431
Oranjestad West	3.3%	**6.7%**	3.4%	0.2%	0.5%	0.3%	0.1%	0.3%	6,752
Oranjestad East	2.5%	**4.2%**	**6.0%**	0.2%	0.8%	0.3%	0.1%	0.4%	6,669
Paradera	1.9%	3.3%	3.5%	**1.7%**	0.8%	0.2%	0.2%	0.2%	5,432
Sta. Cruz	1.6%	3.0%	3.8%	0.3%	**2.7%**	0.3%	0.2%	0.4%	5,655
Savaneta	1.5%	2.5%	2.6%	0.1%	0.8%	**1.7%**	0.5%	1.1%	4,944
San Nicolas North	1.3%	2.0%	1.8%	0.1%	0.5%	0.4%	**1.1%**	1.8%	4,116
San Nicolas South	0.6%	0.8%	0.7%	0.0%	0.2%	0.2%	0.2%	**1.3%**	1,874
	10,016	13,250	12,291	1,402	3,269	1,608	1,184	48,518	100%

Source: Census Aruba 2010.

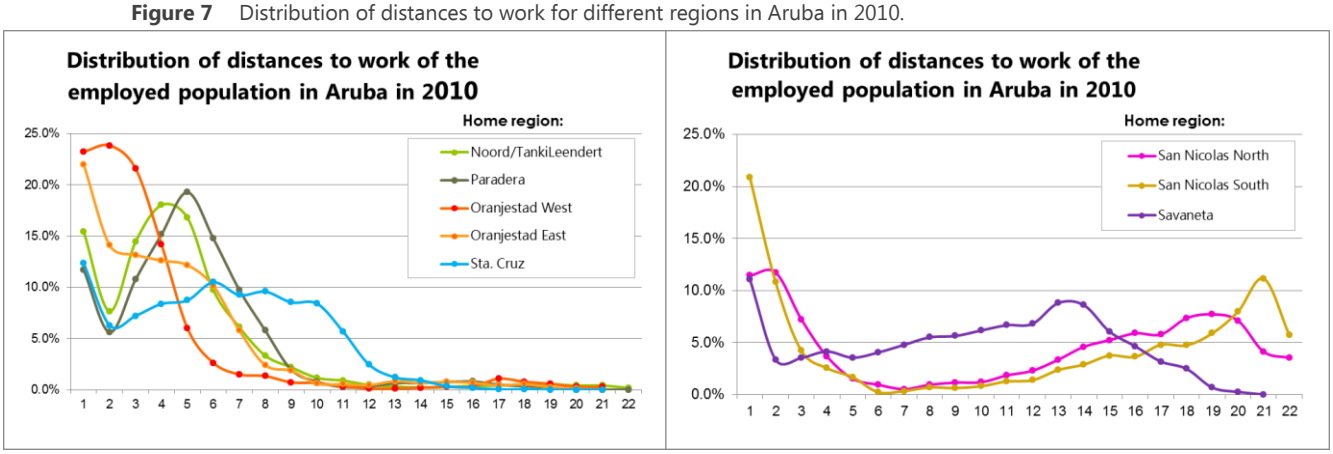
Note: The upper 10% of values is highlighted by bold and blue. Values above average are indicated by a blue square. Combinations where employees work and live in the same region (diagonal) are highlighted with a green background. Percentages are expressed as a total of the table.

Distance to work

We evaluated the distributions of all travel distances between employee home and work locations in more detail. Differences exist between the employees that live in different regions (figure 7).

From the employees that live 'Pabou di brug' (Southeast) a major proportion travels only a short distance to work (less than 2-3 km), although a significant proportion commonly travels maximal distances to work. The shape of the distance distribution suggests that the latter concerns those that work in the Hotel region (distances for San Nicolas South are such that they cross all the way from San Nicolas South to the Hotel area[15]). Analogously, parts of the employees from San Nicolas North and the region Savaneta travel short distances to work and part travel a distance as far as to the Hotel area. The shape of the distance distribution from St. Cruz, and even Paradera and Noord/Tanki Leendert suggest a similar pattern. Only for the employee populations that live in Oranjestad West itself and in San Nicolas North we observe a peak in the distribution of distances of up to 2 km from work, but this is probably due to their more central location.

Figure 7 Distribution of distances to work for different regions in Aruba in 2010.



Source: Census 2010, Aruba.

Note: Category values are smoothed with a line for better readability.

When we evaluate where the employees live, reading Appendix F row-wise, we observe, in contrast to the distribution of school attenders, that employees from *61-Pos Chiquito* have a job clearly more likely

15 At the time of the Census in 2010, the oil refinery was temporarily partially closed, so a number of workers will have indicated to be unemployed.

Pabou di Brug (n=1,703) than Pariba di Brug (n=375). It is not surprising though; that many people went to live in *61-Pos Chiquito* as *61-Pos Chiquito* is still strategically situated towards the north. Except for the zone *83-Van De Veen Zeppenfeldstraat* and *87-Seroe Colorado*, in general, more employees travel north for a job Pabou di Brug than that stay Pariba di Brug. A comparison between Pabou and Pariba reveals that 94.9% of employees who live Pabou di Brug also work Pabou and only 5.1% of those who live Pabou do work Pariba. In contrast only 34.4% of employees that live Pariba di Brug also work Pariba, whereas the majority of those who live Pariba (65.6%) still go to work Pabou.

In summary, the distributions of job locations over home zones reveal that arriving from all zones in Aruba a significant proportion of employees have to travel relatively large distances. Some zones in Aruba provide most of the jobs; zone *22-Eagle/Paardenbaaistraat* even more so than zone *11-PalmBeach/Malmok*. Despite these specific work hotspots, the number of employees that find employment in the home zone is still high, and in fact, it seems that from all GAC zones there are always employees that go to a job site in any of the other GAC zones. In other words, except some preference, there is considerable spread of job-related traffic all over Aruba.

Economic development in the North

The spatial dynamics in where employees work and live during the last ten years in Aruba are represented in figure 8 (see also Appendix F).

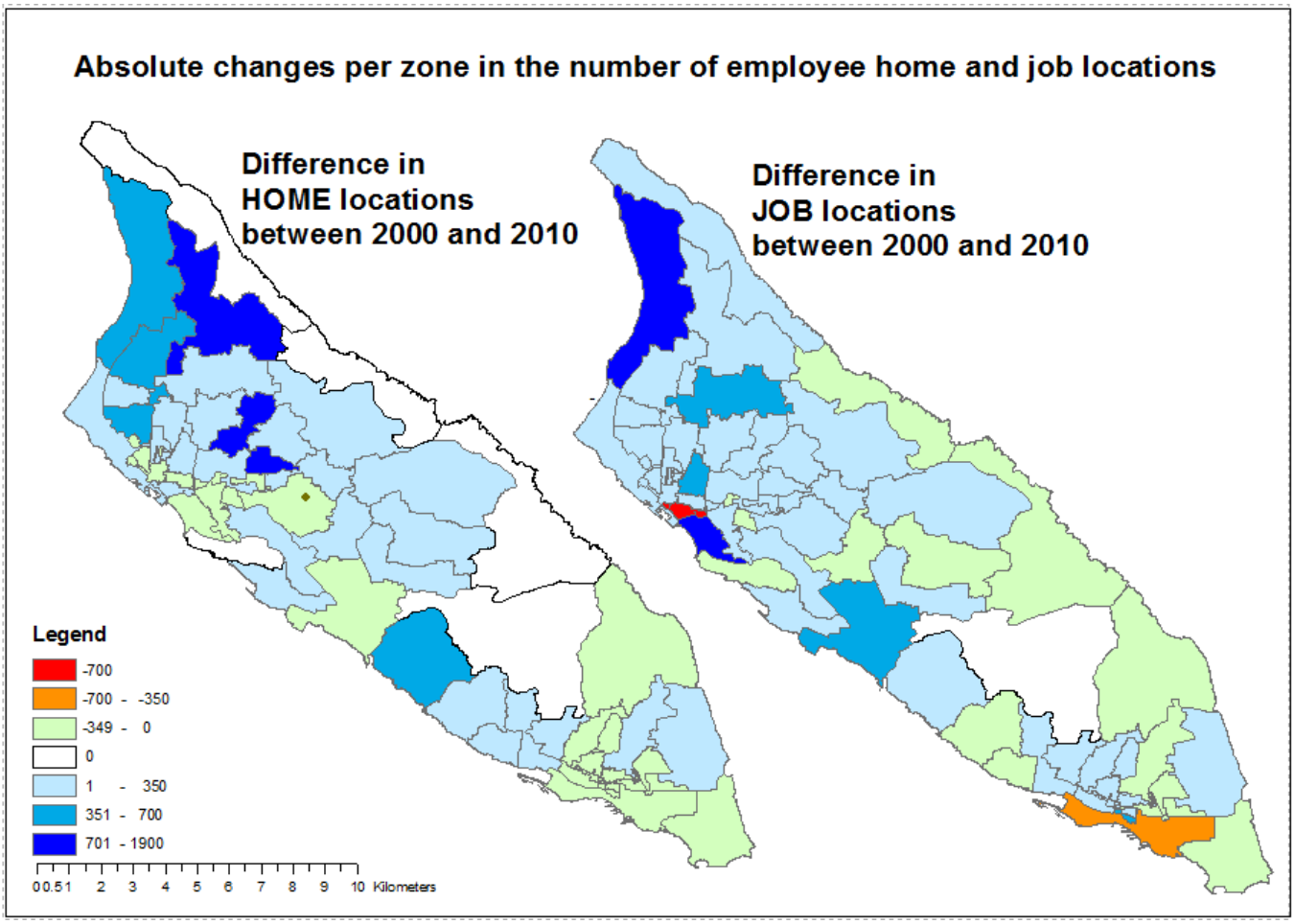


Figure 8 Change in number of employee work and home locations per GAC zone in Aruba in 2010.
Source: Census 2010, Aruba.

At the regional level, except in 'San Nicolas South' there was an overall increase in employment in Aruba. The strongest growth of jobs[16] took place in the region 'Noord/ Tanki Leendert' (zones 11 to 16) with a regional increase of 42.7% (3005 employees). Most new employees went to work, probably in the 'hotel sector', in zone *11-Palm Beach/Malmok* (1,887 persons). But in some other regions as well, there are zones with a considerable growth in the number of employees, i.e. zone 32-Klip/Mon Plaisir (775 persons), zone 56-Balashi/Barcadera (556 persons) and zone *83-Van De Veen Zeppenfeldstraat* (477 persons).
The strongest decrease took place in the Southeast, in particular the zones *87-Seroe Colorado* (126 employees) and in zone *88-San Nicolas South* other[17] (514 employees). Also in the Northwest, in zone *31-Nassaustraat*, situated in Oranjestad East, we observe a strong decrease in employment during last ten years (686 persons).
The data show that in the Northwest part of Aruba the employment opportunities have increased in 28 zones against a decrease in 7 zones with, whereas in the Southeast we see an increase in 11 zones against a decrease in 9 zones. Net, the number of jobs in the Northwest increased by 5,602 employees and in the Southeast by 264 employees.

A similar pattern emerges from the changes[18] in employee residence locations between 2000 and 2010. Particularly in zone *11-Palm Beach/Malmok* (ΔN= 518 persons or 0.6%), zone *13-Alto Vista* (ΔN= 759 persons or 1.2%), zone *23-MadikiKavel* (ΔN= 394 or 0.7%) and in zone *41-Shiribana* (ΔN= 711 or 1.3%) we observe a considerable growth in home locations, whereas a decrease in employee home locations is most eminent in most zones of Oranjestad East and in San Nicolas North and South. In the Southeast, zone *61-Pos Chiquito* (ΔN= 507 or 0.7%) and zone *76-Juana Morto* (ΔN= 84 or 0.1%) are the only zones with a percentagewise increase in employee home locations. All other zones in the Southeast show a percentagewise decrease in employees living in that zone.
In the region Oranjestad East, the decrease is strongest in zone *32-Klip/Mon Plaisir* (ΔN= -162 or -0.5%), in zone *35-Dakota/Potrero* by (ΔN= -79 or -0.4%), and in zone *36-Tarabana* (ΔN= -87 or -0.4%). The only exception in Oranjestad East with an increase in employee home locations is zone *37-Sabana Blanca/Mahuma* (ΔN= 213 or 0.1%).

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16 by workers of age 14 and above

17 The oil refinery is located in 'San Nicolas South other' and partly in 'Seroe Colorado' and at that time of the Census in 2010 many of its workers had recently become jobless.

18 The change difference between 2000 and 2010 is expressed as a change in numbers (ΔN) or in percentage (%) from total employee population.

The geography of vulnerable households

We have learned that transportation is primarily by private car. Active transportation is not completely absent, but the situation in daily traffic seems such that a majority of traffic users prefers the car above for instance the bicycle (even for the very short trips). We have also learned that many travel considerable distances to work or school. Thus far, the car has always been available to ensure easy mobility, but there is a chance that future financial pressures force traffic users to refrain from using a motorized vehicle. Today, mobility and particularly the costs of motorized transport already form an intrinsic part of daily budget for most inhabitants and is getting more and more expensive. Given the conditions right, i.e. good accessibility to public transport for school and work, the minimal cost for transport at the household poverty line, is still an estimated 6% of the household budget or at a third place in the total costs of living, after housing and food (Commissie Bestaansminimum Aruba, 2013). So, the more vulnerable households[19] in our society are likely to suffer directly from for instance an increase in the costs of transport (gasoline, vehicle tax or mileage toll, etc.). Traffic users, in an attempt to keep their privilege of motorized transport and try to prevent isolation, may opt for a financial tradeoff and spend less on other and more elementary needs. This may be particularly so in the regions in Aruba when alternative (public) transportation is sparse or irregular and dependency on own transportation is high. The risk that some of the more vulnerable groups in Aruba may even become socially excluded exists. Therefore, insight in the location, level of car ownership and accessibility to the public transportation network[20] of the more vulnerable households in our society is relevant and is evaluated in more detail, in the upcoming paragraphs.

Categories of vulnerable household in Aruba

First, we categorize and quantify individuals and households on the basis of vulnerability. A household is named a vulnerable household when at least one person in the household is considered vulnerable. Ideally we require detailed knowledge about the social network that individuals may rely upon to secure their needs, but the Census doesn't provide such specific information. We follow the general terminology for vulnerable groups (Mander, 2012) but decided also to narrow down and combine some of the definitions of vulnerability in order to limit the size of groups and still attain sufficient foothold to perform the analyses.

Household income[21] is a good indicator for level of (economic) vulnerability, but such 'personal' information collected during a Census should be interpreted in perspective. On top of that, in order to use income to categorize the economic status of households it would require adjustment for attributing factors that may influence individual or household economics. The use of an income equivalence scale (OECD, 2011) as for instance the *market basket measure* might be appropriate. This measure is used in poverty studies and takes into account many meaningful factors, such as the costs of living, family type, urban or rural locality, number and age of household members, etc. For our analysis, a more simple scale, the '*square root scale*'[22], will suffice to categorize households in terms of vulnerability. We correct for the number of household members, since household members influence household income as well at the cost side as at the benefit side of the household budget. We define a vulnerable household as a household with a '*square root scale' household income* that falls in the lowest 10% category.

Vulnerability can be defined at other levels of categorization as well, such as at the level of employment, health, and education or family status. In table 11, we show the results of such analyses. In some cases

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19 A vulnerable household runs the constant risk of being confronted with insufficient means to attain an acceptable standard of living and lacks a buffer or possibility to secure financial balance. Vulnerable households can be trapped in the process of marginalization when faced with additional economic hardship. The prevalence of vulnerable groups in Aruba is described by Maduro and Eelens (Eelens, 2012).

20 Public transportation in Aruba is available through regular line and school busses, run by a semi-governmental transportation company (ARUBUS N.V.) and a number of private owned small autobus licensees. Whereas the schedules of line buses leave some areas uncovered, both, in time as in space, the small auto-busses crisscross the island and show more flexibility on their routes. The auto-busses cover a particular area each, and are prohibited to take passengers near the (Hotel) tourism spots in order to limit competition with taxis.

21 Household income is calculated as the sum of all individual incomes in a household and from all sources.

22 A household income corrected by the square root scale is the total household income divided by the square root of the number of household members.

we have narrowed down the definitions even more. For instance, we use, next to a more general definition of vulnerability by age (aged 60+), also a more strict interpretation of what vulnerability may encompass, and analyzed the situations when an elderly (aged 60+) has to pay rent (whatever the income) or has an income that falls within the lowest income decile (10%) of income categories.

Table 11 The distribution of vulnerable households (individuals) with and without a car in Aruba, in 2010.

	Vulnerable Persons [23]	Vulnerable Households		>1 vulnerable person in HH		no car in Household		1 single car in Household	
	N	N	*% of total*	N	*% of HH*	N	*% of HH*	N	*% of HH*
Vulnerable - main category									
All vulnerable categories together	21,117	18,942	*54.4*	2,001	*10.6*	4730	*25.0*	8570	*45.2*
All but without the elderly	12,034	11,114	*31.9*	864	*7.8*	3,613	*32.5*	5,051	*45.4*
Employment									
Young unemployed persons (age 15 – 24)	1,332	1,225	*3.5*	97	*8.0*	234	*19.1*	508	*41.4*
Young unemployed persons (age 15 – 24) that live as a nuclear household	725	679	*1.9*	42	*6.2*	126	*18.5*	300	*44.2*
Household income									
Individuals aged 14+ from a household with a household income in the lowest 10% of 'scaled' household incomes[22]	7,482	4,149	*11.9*	2,142	*51.6*	1,921	*46.3*	1,805	*43.5*
Family situation									
Single mothers with child underage (age<18)	5,184	4,932	*14.2*	240	*4.9*	910	*18.5*	2,544	*51.6*
Single mothers with child underage (age<18) that live as a nuclear household	2,549	2,549	*7.3*	0	*0*	583	*22.9*	1,652	*64.8*
Single mothers with child underage (age<18) that live as a nuclear household and with a household income in the lowest 10% of 'scaled' household incomes	655	655	*1.9*	0	*0*	311	*47.4*	312	*47.6*
Teenage mothers (age of mother 14-19)	219	219	*0.6*	0	*0*	45	*20.8*	78	*35.6*
Teenage mothers (age of mother 14-19) that live as a nuclear household	16	16	*0.05*	0	*0*	3	*20.0*	11	*66.7*
Teenage mothers (age of mother 14-19) that live as a nuclear household and with a household income in the lowest 10% of 'scaled' household incomes	9	9	*0.03*	0	*0*	2	*25.0*	5	*62.5*
The elderly (age 60+)[24]	15,658	11,291	*32.4*	3,790	*33.6*	2,497	*22.2*	4,802	*42.6*
The elderly (age 60+) that have to pay rent	2,425	2,049	*5.9*	352	*17.2*	930	*45.4*	845	*41.3*
The elderly (age 60+) with a household income in the lowest 10% of 'scaled' household incomes	1,553	1,350	*3.9*	198	*14.7*	724	*53.6*	504	*37.4*
Health status									
Sub(adults) with disability (age 15-24)	244	237	*0.7*	5	*2.3*	45	*19.3*	90	*38.1*
Education development									
Children (age 4-17) who do not go to school[25]	533	487	*1.4*	41	*8.4*	107	*22.0*	200	*41.2*

Source: Census 2010, Aruba.
Note: The percentage of 'Vulnerable Persons' and 'Vulnerable Households' is expressed, respectively as a percentage of the total population (N= 100.696) or total number of households (N=34,845).

In table 11, we show the frequencies of different categories of vulnerable households in Aruba in 2010. The table describes several levels of intensity of what we may consider a more vulnerable situation, i.e. by a combination of categories of vulnerability as well as by the number of vulnerable household

23 In a number of cases individual vulnerable persons are part of the same household. Hence we present both, the frequencies of vulnerable persons (PP) as a total and as part of households (HH).
24 Outside of the scope in this study fall the homeless[24] and those that live in a collective household (prison, elderly home, etc.). Some elderly live together in a non-institutional collective household.
25 Compulsory education until the age of 16 is introduced in Aruba after the Census in 2010.

members. Those that have a double 'vulnerable' status are only counted once. For the purpose of this study we listed the number of vulnerable households that have none or a single car in ownership.
We find that a large number of households (54.4%) can be linked directly to a vulnerable household member. Even with the group of elderly excluded, still 31.9% of households in Aruba at the time of the 2010 Census can be linked to a vulnerable situation, i.e. at least one of the family members is unemployed, is a single mother, a teenage mother, is disabled or has a child that does not go to school. Also, we observe an obviously strong dependency on the car, i.e. even in the most narrowed down definition of vulnerable household (with a combination of low income and vulnerable status) between 40% to nearly 70% of households still possess a car. We will describe some categories in more detail, next.

Employment: In 3.5% of households in Aruba a young unemployed household member is present, and in 8.0% of these households there is even more than one young unemployed present. From the young unemployed that live as a nuclear household (in 679 from a total of 1,225 cases), we observe that in 18.5% of these cases there is no car in the household, but in 44.2% of nuclear households with unemployed the nuclear households does possess a single car.

Household income: From all households 11.9% (n=7,482) is considered vulnerable based on low income. In 51.6% of these cases there is more than one vulnerable person present in the household. This means that 48.4% of households with a low household income are one-person households[26]. In 46.3% (n=1,921) of the low income households there is *no* car present and in 43.5% the household possesses a single car.

Family situation: In 14.2% of Aruban households we observe a single mother with a child underage. In 0.6% of Aruban households this single mother is a teenage mother, and in 7.3% of households, this single mother lives with her child(ren) as a nuclear household (n=2,549). Interestingly, still in 64.8% of these cases, the mother owns a car. Even more interesting, in 47.6% of cases where there is a nuclear household of a single mother with child, the household income falls inside the lowest income docile and there is still a single car present in the household (n= 655).
During the Census, 219 (in 0.6% of households) teenage mothers have been recorded, 16 live in a nuclear household situation with their child and 9 live as a nuclear household but have an income that falls inside the lowest 10% category. Of those that live in a nuclear household situation, still a majority (66.7%) own a single car.
An elderly household member (aged 60+) is present in 32.4% of Aruban household and in 22.2% of these cases there is no car in the household. In 5.9% of Aruban households with an elderly household member, a monthly rent is to be paid (total n=2,049) and in this situation 45.4% (n=930) is without a car. In 3.9% of Aruba households (n=1,553) with an elderly, the household income falls inside the lowest 10% category and 53.6% (n=724) is without a car.

Disability: In 237 households a young disabled individual is present, and in 19.3% of these cases, the household is without a car.

Education: In 487 households, a total of 533 children do not go to school. We have no information about their reason, but in 41.2% of these cases a single car is present in the household (and in 22% the household does not own a car).

Easy access to the public transport network is relevant for vulnerable households, particularly in those cases when there is no car present. We present our analyses in the next section.

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[26] Note that the measure is based on a scaled household income that is equal for all household members.

Transport by public means (busses)

Because of the high car dependency of even the most vulnerable households, we have made an attempt to analyze accessibility to public transport. We use geographical information system software (ESRI, 2010) to analyze the location of the public line bus network[27] and the location of vulnerable households at the time of the Census. Busses may halt in between stops in the less traffic intense zones to take passengers. For the ease of this study we assumed that everywhere along the bus route it would be possible to take a bus (see discussion). Distances are calculated as nearest Euclidean distances between the household location and the bus route.

Line bus transport along the West coast, between San Nicolas, Oranjestad and the Hotel area is very regular and scheduled all day. At the time of the Census, in 2010, buses between the Hotel area and Oranjestad run every 10 minutes and between Oranjestad and San Nicolas about once an hour. Similar is the schedule between Oranjestad and San Nicolas via Santa Cruz. Also, other regions in Aruba are covered by public busses, but their schedule is infrequent and mostly only twice a day, i.e. once in the morning and once in the late afternoon (see Appendix C).

In addition to the line buses, a fleet of 93 small private-owned buses (vans) cover most of the island (Department of Public Transportation, 2012). Each of these busses runs in a dedicated area (see Appendix C) and outside the hotel zone, but they have no strict time schedule. These busses are more flexible in their routes and some can even be called for pick-up or delivery. On many occasions, the private owned autobuses fill the gaps that are left by the network of line buses. They tend to follow similar routes but keep a different time schedule and also visit areas where line connections are infrequent or not present at all.

Proximity to public transport

Table 12 presents a listing of vulnerable households that respectively have a location within 100m, 200m 300m 400m or 500 meter proximity of the ARUBUS line network.

Table 12 Straight distance to nearest public bus network for some groups of vulnerable households

Proximity to the Line bus network (meters):	**0-100**		**100-200**		**200-300**		**300-400**		**400- 500**		**500 +**		**Row Total**	
Households with:	N	*%*	N	*%*	N	*%*	N	*%*	N	*%*	N	*%*	N	*%*
Children (age 4-17) who do not attend school	145	*29.8*	93	*19.1*	60	*12.3*	54	*11.1*	30	*6.2*	105	*21.6*	487	*100%*
Young unemployed persons (age 15 – 24) that live as a nuclear household	206	*30.3*	130	*19.1*	97	*14.4*	61	*8.9*	45	*6.7*	95	*14.0*	679	*100%*
Individuals aged 14+ from a household with a household income in the lowest 10% of 'scaled' household incomes	1,392	*33.6*	882	*21.3*	634	*15.3*	349	*8.4*	231	*5.6*	661	*15.9*	4,149	*100%*
Single mothers with a child underage (age<18) that live as a nuclear household and with a household income in the lowest 10% of 'scaled' household incomes	175	*26.8*	159	*24.3*	109	*16.7*	53	*8.1*	30	*4.6*	128	*19.5*	655	*100%*
The elderly (age 60+) with a household income in the lowest 10% of 'scaled' household incomes	542	*40.2*	286	*21.2*	185	*13.7*	102	*7.5*	73	*5.4*	162	*12.0*	1,350	*100%*

Source: Census 2010, Aruba.

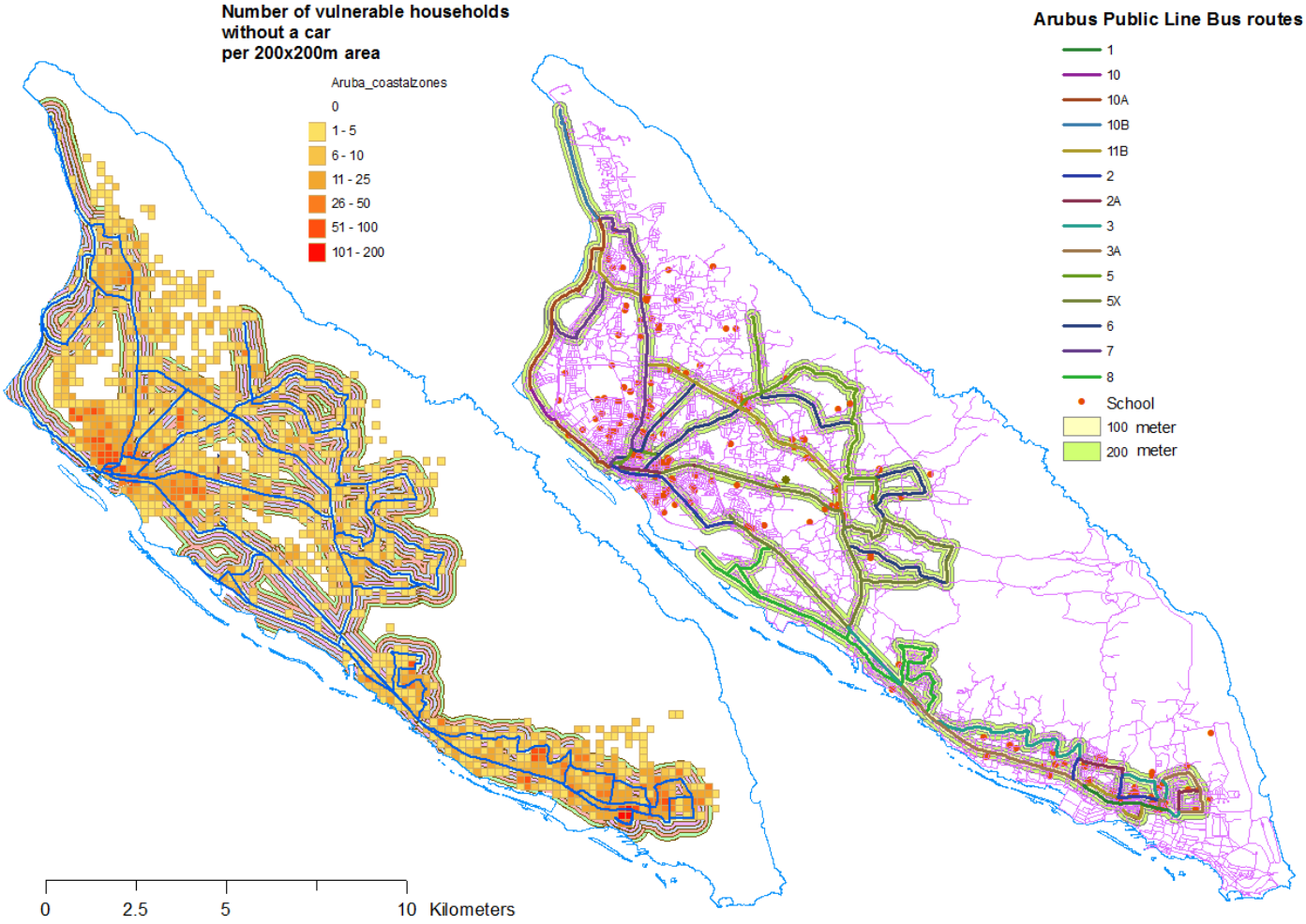
About half of children that do not attend school live within a range of 200 meters from a bus line (table 12). But also, 21.6% of the children that do not attend school have to travel farther than 500 meters to get to a bus line. For other categories, such as the 'young unemployed persons that live in a nuclear household', the 'low income households', and 'single mothers with a child underage that have a low income', similarly about 50% of households live within a 200 meter distance from a line bus. From the

[27] For Information about the time schedule we refer to the webpage of ARUBUS (Arubus route time schedule, 2010).

'elderly with a low income' even more, 61.4% live within a distance of 200 meters from the bus (40.2% live within a 100 distance).
So it appears that measured in straight line, distances as such, to the nearest public bus line generally is not so bad and the majority of households even live within walking distance.

A map of the line bus network and the corresponding 100 meter ranges alongside the bus network is presented in figure 9. The left map shows the geographical distribution of vulnerable households without a car (density per 200x200 meter square area) and the 100 and 200 meter ranges alongside the bus lines. The right map shows the network of roads, the location of schools, the line bus network and ranges alongside, up to 500 meter distance. The maps are meant, primarily to indicate the scale of accessibility to public transport in relation to the location of vulnerable households and the location of schools.

Figure 9 Map representation of the public line bus network in Aruba in 2010.



Source: Census 2010, Aruba.
Note: The maps show the complete road network in 2010 (purple lines), the different line bus routes at the time of the Census (indicated by a range of colors but not all routes are recognizable because at part of the routes there is an overlap in line busses), the distribution of vulnerable households without a car (see categories in table 12) , and the location of schools (all types). The right map also shows the 100m and 200m distance ranges alongside the bus lines. The left map shows similar distance bands but up to 500 meter.

So, even though a majority of households are not too far situated from a public line bus network, some dense areas with vulnerable households (Oranjestad West) have no coverage of public transport at the time of the Census.

Summary and Discussion

The dependency on motorized transport is high in Aruba (over 90% of households use motorized transport to school and /or work, the majority by private car). Most households own at least one car and often there is more than one car per household. In many cases both partners work and probably both travel by own car because it will save them time and effort. Daily traffic congestions have become a common phenomenon and raise the question how mobility can be improved. Already, the government has put efforts to improve the local infrastructure and there may come other measures that aim to decrease the stagnation on the roads and lessen the environmental and health hazards that come along. The current paper aims to shed some light on a number of aspects that influence mobility, in particular the geography of household destinations, the level of household participation and different modes of transport and also the type and location of the vulnerable groups in our society.

The Census offers opportunities to gain relevant knowledge. The data collected during the Census in 2010 are used to analyze patterns in daily transportation between home, work and school. School-related traffic is thought to be a major factor that causes road congestion. We know this, because when schools are closed it is relatively 'quiet' on the road. School- and work-related traffic is particularly high during a short time frame in early morning, noon and late afternoon.
The results are presented at the level of *administrative zones* to provide an optimal understanding of the daily movements of children or employees in Aruba. It is brought forward that we might link the information of individual destinations to the major road network and study the potential of traffic flow patterns in Aruba. We may create models and evaluate the potential effect of changes in the road network. However, even though such approach in principle is feasible and even very tempting, it would be limited by the various assumptions and fair guesses about for instance the sequence of events in between destinations, the number of persons that travel together, etc. Still, as a model such exercise could help to understand the different scenarios and traffic flow patterns but unfortunately, at the moment we do not have the appropriate software (ArcGIS extension). So, we decided to keep to the information that we got and analyze the characteristics and geographical relationships between home, work and school events.

An employee is defined as "a person 14 years of age or older that had a job for which he/she worked 4 hours or more during the week prior to the Census moment". Thus, the definition of 'employees' includes workers who have regular employment but not necessarily on a daily basis. Employees also include unpaid working members of a family business or apprentices or trainees who receive pay in cash or kind, as well as students that have a formal employment with the Government as government officials, or even volunteers that produce goods or services for an enterprise'. Thus, an employee not necessarily works on a daily basis and consequentially, we may have a small bias in the results, as part of traffic from home to work will not be on a daily basis.

Car ownership in Aruba is grown in recent years (Derix, 2013) and on some days it seems that everyone has gone by car. Minor events may have a big impact on stagnation in a wider area. This is particularly so on the roads that access the city center of Oranjestad. The data show, that in a very small area in Oranjestad, we find a high density of schools and jobs and many have to transit the area for work or school. The proximity of schools near job locations can be efficient. In cases like these, workers have the advantage, during lunch break, to collect their children more easily. But, on the other hand, children grow fast and when they leave for another school elsewhere the advantage becomes a disadvantage and limited access, transit traffic, and occasional tourist activity (cruise terminal) makes the city a bottle neck for traffic in all directions.

In the Northern part of Aruba the population and number of new jobs has increased more than average in the last ten years (9.4%). New shopping malls, supermarkets, restaurants and recreational hotspots emerged near the main hotel and tourist area. At the time of the Census, 14.3% of the total work force had employment in just a single zone in this area, zone *11-Palm Beach/Malmok*. We observe 35.8% of all jobs to be situated in the wider region '*Noord/Tanki Leendert'* in 2010. Given an increase in jobs and residential areas, it is not surprising that the local infrastructure fall behind. Our results show that many that work in the tourist business arrive from the far South in Aruba (area San Nicolas).

We like to summarize the results in more detail next, and discuss the constraints we had to make. An overview of major household destinations in 2010 is presented in the maps below (figure 10).

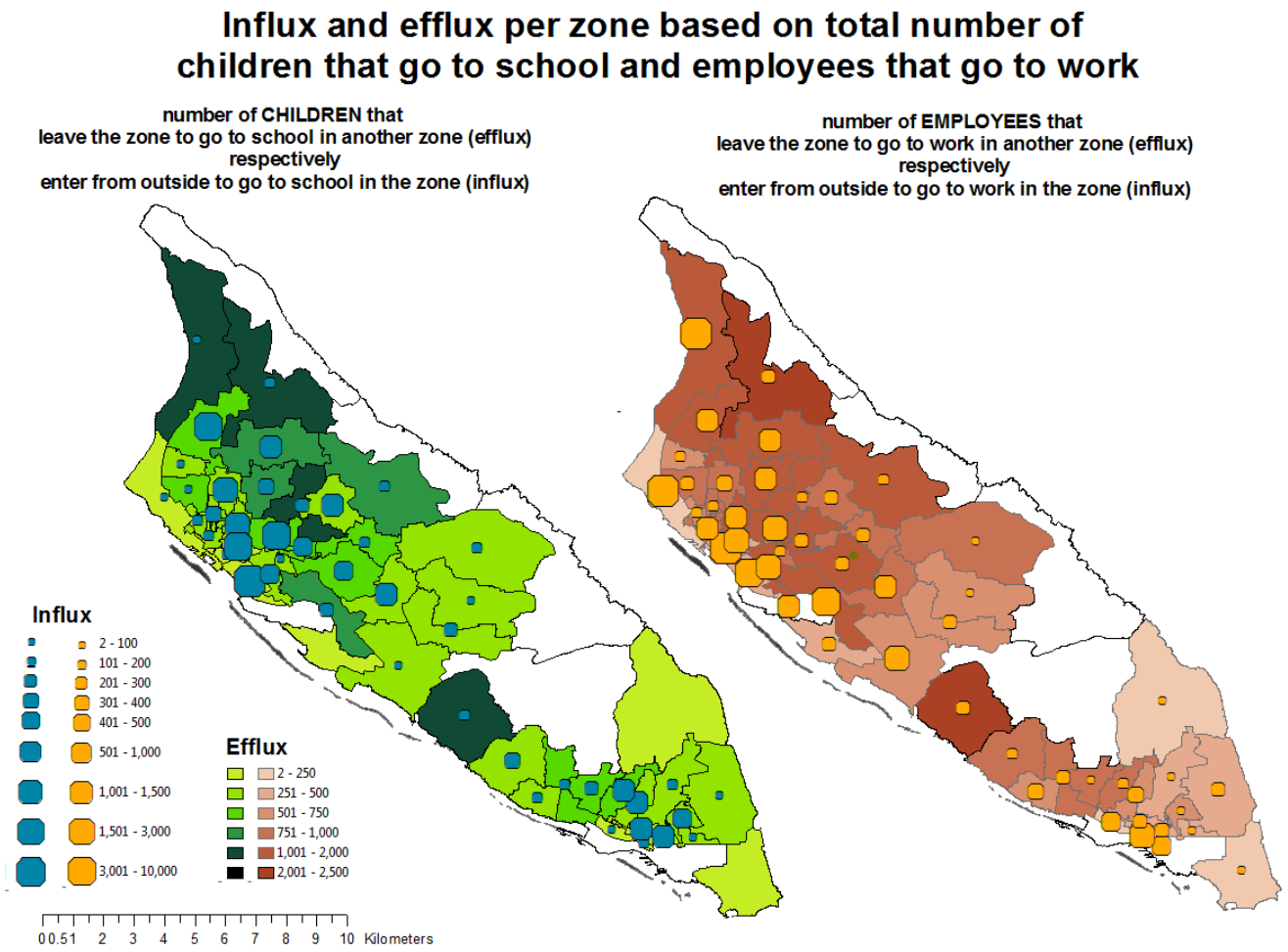


Figure 10 Departing and arriving traffic from home, work and school in Aruba in 2010.

The aforementioned zones with large residential, school-attending and working population have been translated into characteristics of a traffic ***efflux*** (the green and brown colored backgrounds in figure 10) and a traffic ***influx*** (the blue and orange bubbles in the figure). Zones where many children go to school or many employees find a job but few of these have their home are characterized by a high influx whereas typical residential zones commonly show a high efflux of school- and work related traffic. The results take into account that some stay for school or work in their zone of residence.
The combined maps present a comprised overview of the main traffic flows in Aruba *(departing from the zones with colored background* and *arriving at the zones with bubbles).* All this traffic will take place in just a small timeframe in early morning, at noon and at late afternoon. The direction of influx and efflux is reversed in late afternoon (when employees travel back home) and is both ways at noon (when parents take their children from school, continue to a daycare or home and drive back to work again). This may explain why, in particular during lunchtime, roads in and around Oranjestad become cluttered so heavily. The maps illustrate the pressure and traffic intensity in the center of Oranjestad and San Nicolas.

Attempts to reduce traffic congestion generally follow different scenarios, ranging from a raise of the costs of transportation (with the risk of social exclusion of the more vulnerable groups in our society) to measures such as improvements of the road infrastructure. Alternatively, an incentive to use more active

means of transport would benefit the physical condition of children and reduce environmental pollution along the way[28]. Urban planning sometimes goes as far as direct road pricing or access regulation for specific corridors or specific time of the day (Rijkswaterstaat, 2012). In the Netherlands, telecommuting[29] and the implementation of flexible working hours has rapidly become popular. Many measures can help solve traffic congestion (Muhammad, Ottens, Ettema, & Jong, 2007). The situation in Aruba is not essentially different from abroad.

This study shows that 94% of children are brought to school by motorized transport. At pre- and primary school most children are brought by one of the household members. At the pre-school level 53.5% of children remain at a daycare center or elsewhere afterschool; thus not at home, and at the age of primary school, 70.3% is found to stay at an afterschool center. In contrast, at secondary level and up children tend to stay preferably at home afterschool (80% and more). These children also travel more by school bus or public transport.

With regard to active transport to school, however, at present only 5.4% of children go to school by bicycle or on foot whereas twenty years ago a percentage as high as 21.7% went to school at a more active manner! The present study shows that the actual distance to school is still not so far, at least from an aerial point of view. Most primary school (and pre-school) children live at a mere 1-2 km from home. For the vast majority of the children at secondary level of education the distance is up to 4-5 km, but still few use a bike or go on foot. So, the distance to school obviously is not the primary factor why children do not go to school at bike or on foot. A study in Belgium explains (Kinderbijslagfonds - HDP, 2006) that according to almost one-third of parents, the criterion to choose a school is based by the fact that the school is on the road to work. For one-third of parents safety was a major reason why their children were brought by car and not otherwise, even though the distance to school may have been relatively short. But, in Belgium, at an older age children favored the bicycle as a means of own transport to school. The trend in Belgium is similar to what we see in Aruba. As children become older they are less likely to be brought to school by car. However, the percentage of children that are brought to school by their parents is clearly higher in Aruba (83.9% for children at Kindergarten, 82.3% for primary and 69.8% for secondary level at school in Aruba against respectively 49.6%, 43.8% and 13.9% in Belgium). Similar also is the trend for active transport. At young age, in Belgium, about 20% of parents accompany their children on foot and 3.9% by bicycle. At the age of secondary education, these percentages are reversed, 21.4%of children go by bicycle and 7.8% go on foot to school. In Aruba the situation is comparable, be it that the majority of parents do not go on foot and take the car and that children at secondary level do not take the bike but take public transport. The circumstances, we imagine, in Aruba are such that the bicycle to school and work is not really considered as an option, neither at a young age nor at an older age even though distances may be relatively short. Our primary concern may be to have our children safe on the road but road users often show little respect for slow-moving traffic and the roads are not apt for travel on foot or at bike. So, we choose the safety of the car.

However, the many relatively short distances suggest that there may still be opportunities to encourage active transport to school and work, at least when adequate measures are taken. The improvement of traffic safety, such as by construction of separate bicycle paths, separated from the main traffic, and the safeguarding from stray dogs along the roads or even more trees with a shadow rich canopy may certainly stimulate the use of active transport. At the writing of this report, the government is very much involved with efforts to improve the road infrastructure and attempts to improve the general health

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28 Aruba is fortunate to have a constant Northeast Passat wind and most exhaust pollution is blown towards the sea. Nevertheless, the Census results show much inconvenience by traffic in the vicinity of homes along many parts of the major roads (Derix, 2012). Inconveniences may be the result of unsafe traffic situations, but also caused by traffic noise and pollution. Dark clouds of car diesel exhaust can be observed far too often in Aruba. These exhausts cause high levels of PM^{10} and $PM^{2.5}$ particle matter concentrations in the air (Krämer, 2010)[28]. The fine airborne particles, less than 10 respectively 2.5 microns in size, are known to be a severe threat to public health and are internationally used as determinant for air quality (World Development Indicators, 2006).

29 Telecommuting is defined as working in the home environment by access of internet to the data at work.

condition of children and adults. Already, a number of bicycle paths have been constructed, be it at locations that favor recreational efforts in first place.

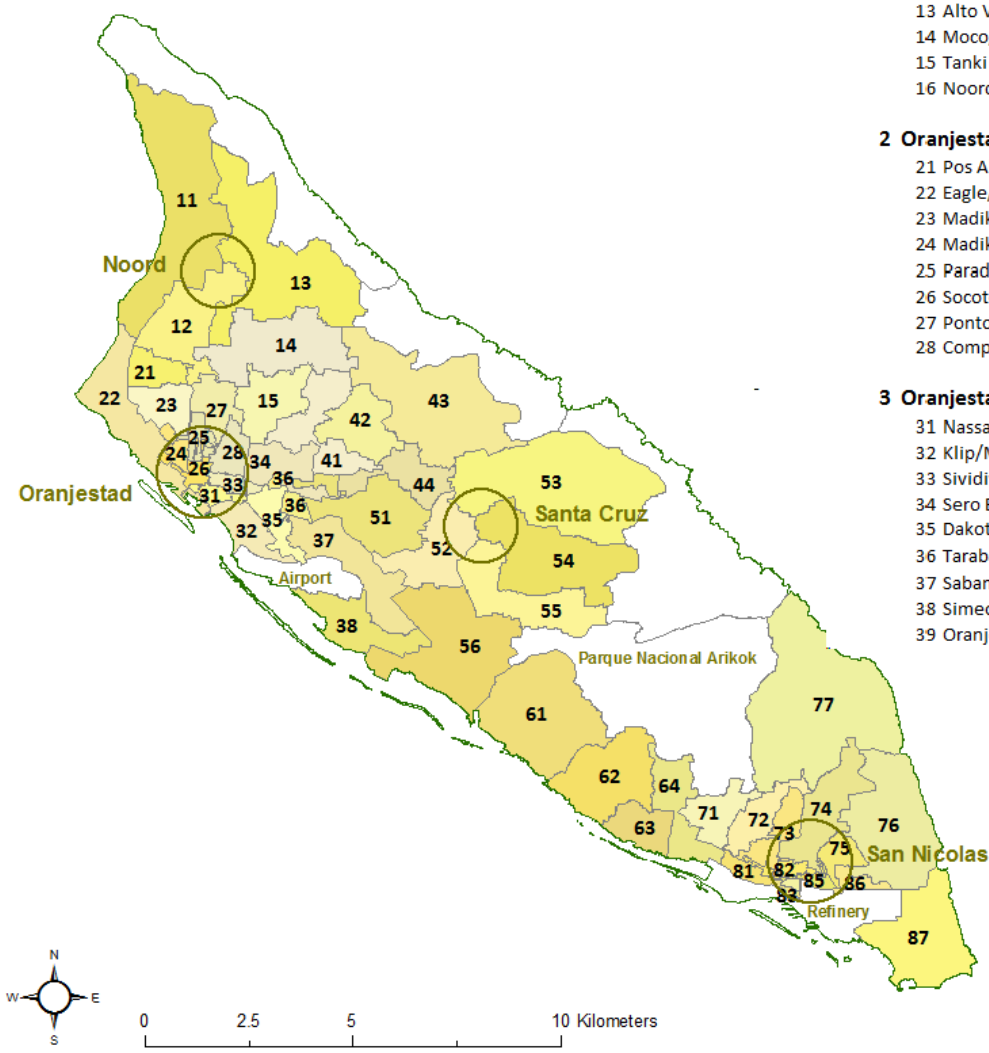
Other developments, for instance with regard to the improvement of public or organized transport, are taken as well (introduction of small ARUBUS mini-busses). Today, most employees and children arrive by motorized private transport to work and school, but this was different in the past. During the last two decennia, the proportion of public and organized employee transport steadily decreased from 14.5% in 1991 and 13% in 2000 to 8.9% in 2010.
Public transportation in Aruba is organized by the ARUBUS line bus company and a number of small private-owned mini-vans. We were unable to retrieve information about public participation and the accessibility to bus transport. Bus stops are often at request or unregistered. In general, line busses follow the main roads and offers special services to schools and companies. The use of smaller busses is a recent development and enables more flexibility, cost efficiency and better regional coverage. The special services were limited at the time of the Census in 2010, and we have not included these in our analyses. Only descriptive information was available about the small mini-busses (see Appendix C) and no one really seems to have the complete overview of where and when private transport is available and how many passengers are transported.

When access to public transportation is difficult and social support not present, the most vulnerable groups in our society are expected to hold onto a car, even at the expense of other basic needs (or refrain from recreational activities and sport). The distance between the home location and public bus line is considered a measure that links to social exclusion and poverty.
Our study reveals that in general the bus line network does cover the locations of (vulnerable) households reasonably well, with the exception of some areas north and west of Oranjestad. A percentage of the children that do not go to school (21.6%) and a percentage of households with a low household income (15.9%) do locate farther than 500 meter from the nearest line bus, however. Also, 19.5% of the group of mothers that live on their own and have an underage child and a low income live at some distance from the nearest bus line.

We used the direct Euclidean distance as a measure to the nearest public line bus but in reality this is not always an appropriate measure. 500 meter does not seem much, but it can be a long and indirect walk in harsh climate conditions, unsafe traffic situations and free ranging dogs. Also, line busses often follow the main roads where traffic is intense and along these parts the bus driver is less likely to stop at request. For those with difficulty in walking the access to public transport can still be hard, particularly so, as many busses are scheduled only a few times a day on the route.

In conclusion, recent changes in the home and work locations together with improved economic circumstances have strained the traffic infrastructure in Aruba. The geography of home, school and work locations suggest however that other factors then distance alone play a role in why most transport is done by car. This study reveals the geography of daily destinations in high detail and provides the basic information that helps to understand why traffic congestion occurs and may help to minimize negative effects on the more vulnerable groups in our society of appropriate measures to organize private and public road use.

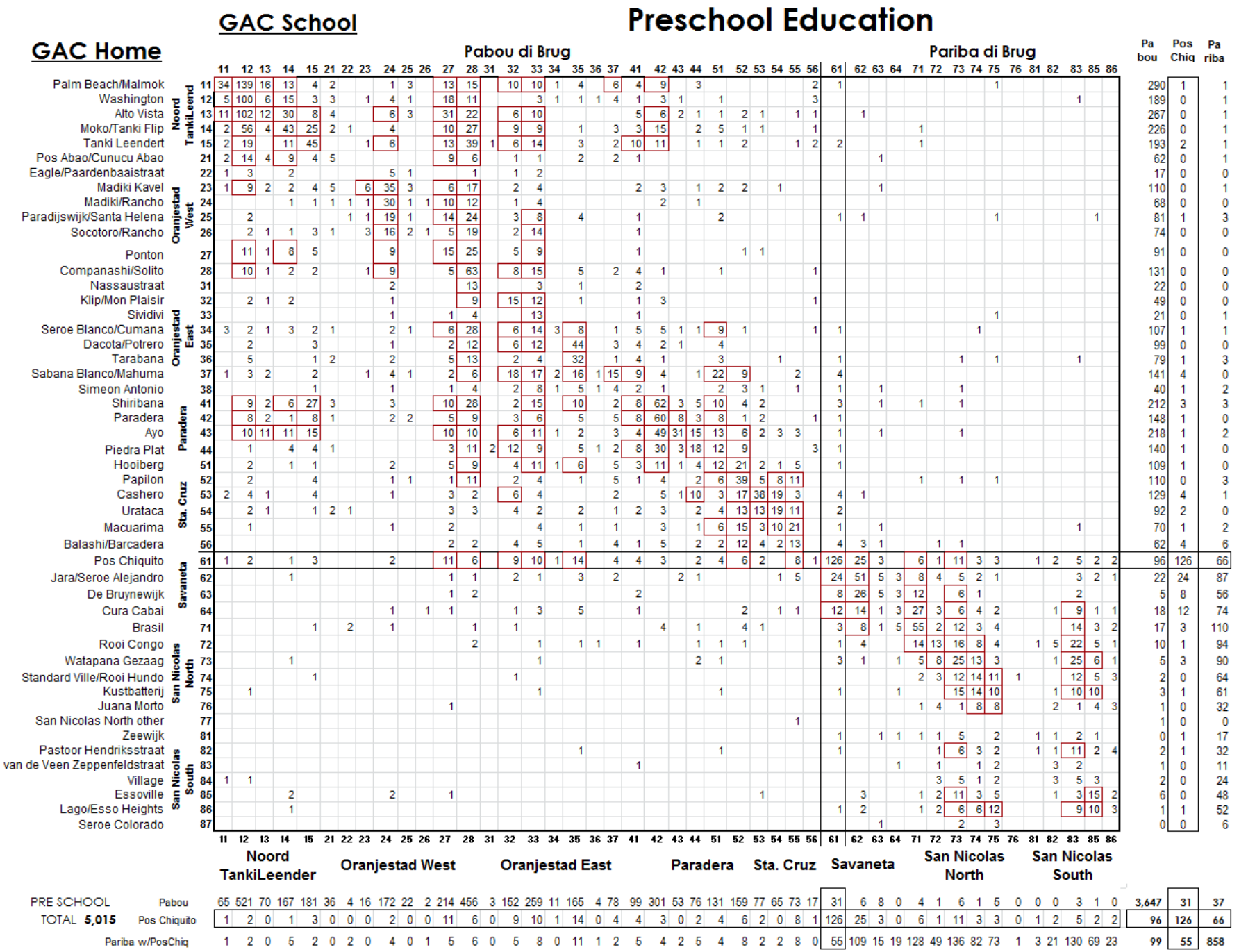
Appendix A: GAC classification of regions and zones in Aruba



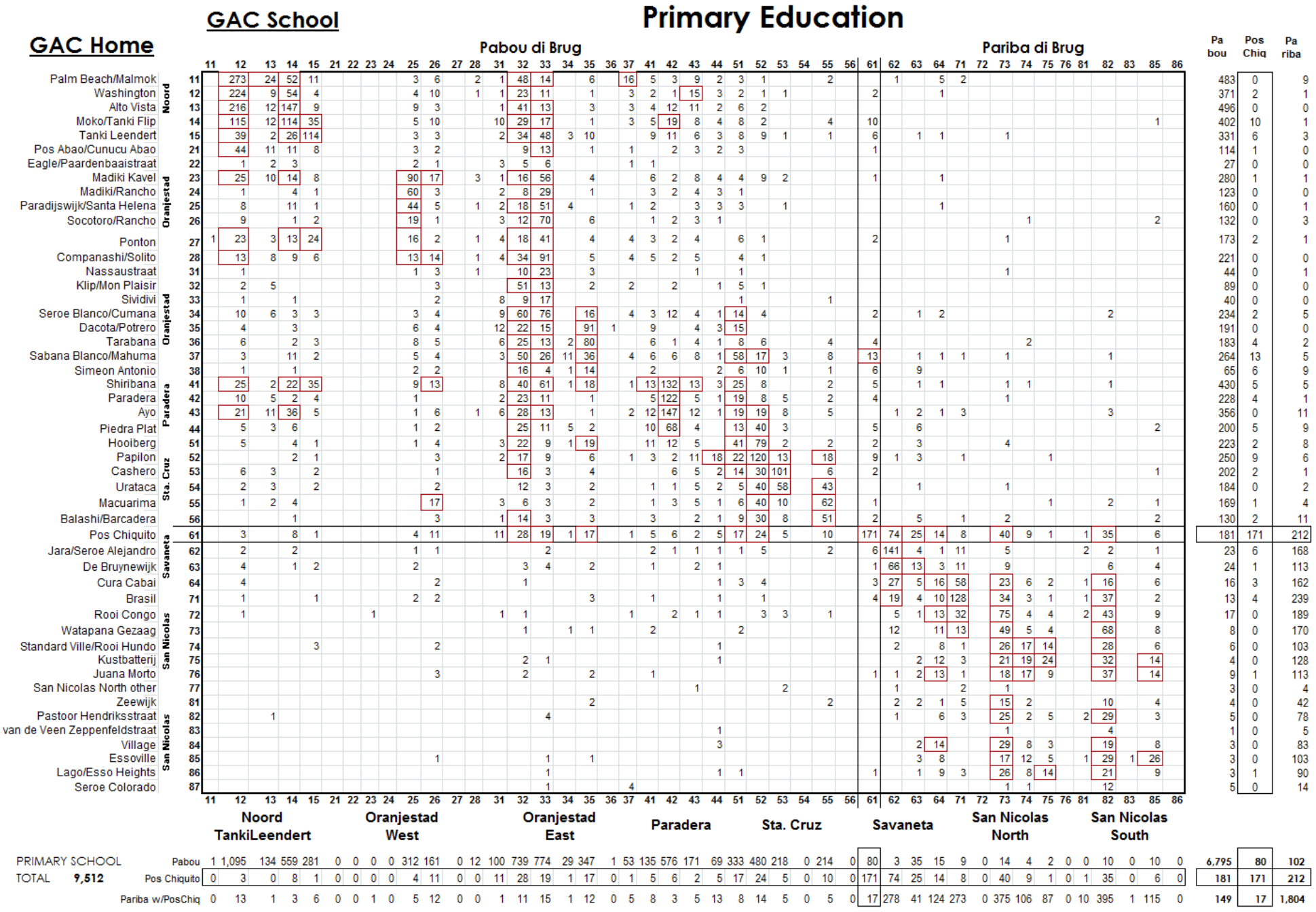
Region	Zone		
1	**Noord/Tanki Leendert**	**34.55**	**km²**
11	Palm Beach/Malmok	8.30	km²
12	Washington	3.40	km²
13	Alto Vista	7.83	km²
14	Moco/Tanki Flip	4.29	km²
15	Tanki Leendert	2.15	km²
16	Noord overig	8.58	km²
2	**Oranjestad West**	**9.37**	**km²**
21	Pos Abou/Cunucu Abc	1.04	km²
22	Eagle/Paardenbaai	3.38	km²
23	Madiki Kavel	1.35	km²
24	Madiki/Rancho	0.42	km²
25	Paradijswijk/Santa He	0.52	km²
26	Socotoro/Rancho	0.50	km²
27	Ponton	1.26	km²
28	Companashi/Solito	0.89	km²
3	**Oranjestad Oost**	**12.47**	**km²**
31	Nassaustraat	0.40	km²
32	Klip/Mon Plaisir	1.31	km²
33	Sividivi	0.41	km²
34	Sero Blanco/Cumana	1.66	km²
35	Dakota/Potrero	1.06	km²
36	Tarabana	0.45	km²
37	Sabana Blanco/Mahur	2.99	km²
38	Simeon Antonio	2.28	km²
39	Oranjestad Oost overi	1.93	km²

Region	Zone		
4	**Paradera**	**20.46**	**km²**
41	Shiribana	2.72	km²
42	Paradera	2.19	km²
43	Ayo	7.42	km²
44	Piedra Plat	1.86	km²
45	Paradera overig	6.28	km²
5	**Santa Cruz**	**40.83**	**km²**
51	Hooiberg	3.57	km²
52	Papilon	2.79	km²
53	Cashero	8.90	km²
54	Urataca	5.18	km²
55	Macuarima	3.46	km²
56	Balashi/Barcadera	6.15	km²
57	Santa Cruz overig	11.41	km²
6	**Savaneta**	**27.58**	**km²**
61	Pos Chikito	5.93	km²
62	Jara/Sero Alejandro	3.67	km²
63	De Bruynewijk	1.40	km²
64	Cura Cabai	2.14	km²
65	Savaneta overig	14.44	km²
7	**San Nicolas Noord**	**23.41**	**km²**
71	Brasil	1.49	km²
72	Rooi Congo	1.41	km²
73	Watapana Gezaag	1.20	km²
74	Standard Ville/Rooi Hu	2.69	km²
75	Kustbatterij	0.76	km²
76	Juwana Morto	5.38	km²
77	San Nicolas Noord ove	10.47	km²
8	**San Nicolas Zuid**	**9.61**	**km²**
81	Zeewijk	0.46	km²
82	Pastoor Hendriksstraat	0.40	km²
83	van de Veen Zeppenfe	0.13	km²
84	Village	0.10	km²
85	Essoville	0.28	km²
86	Lago/Esso Heights	0.44	km²
87	Sero Colorado	4.39	km²
88	San Nicolas Zuid overig	3.41	km²

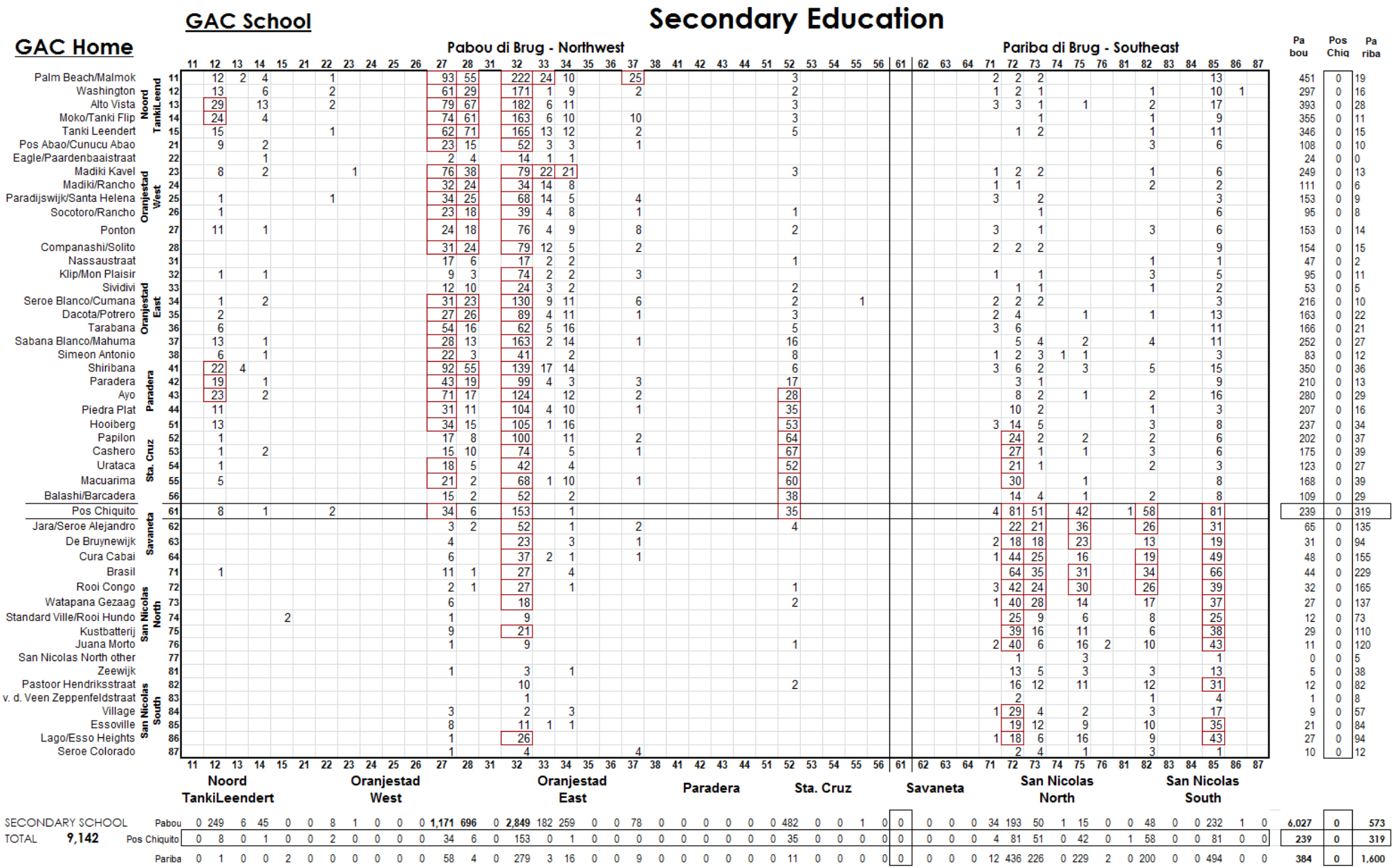
Appendix B: Preschool education, ISCED 0



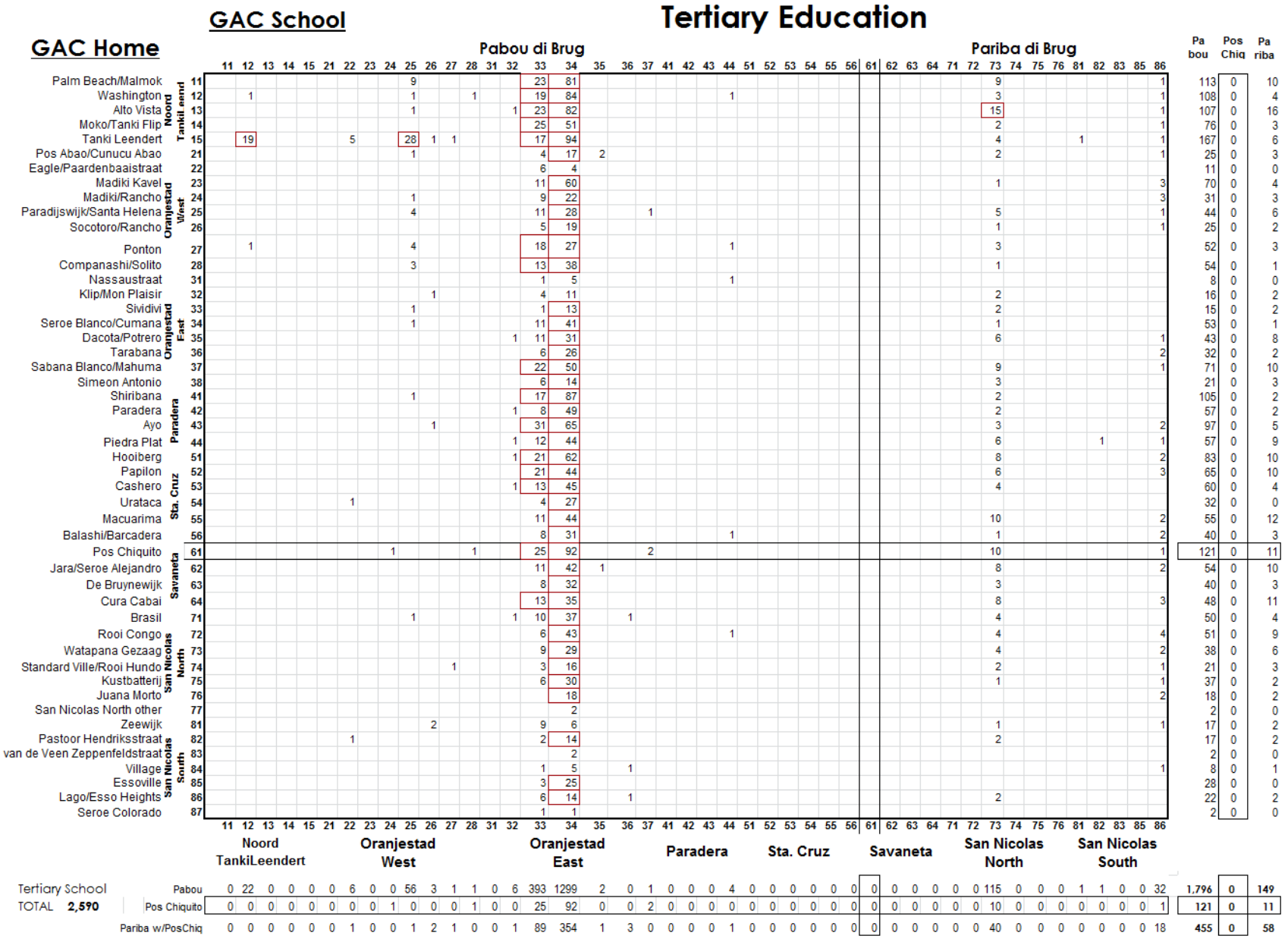
Appendix C: Primary level of education program, ISCED 1



Appendix D: Secondary level of education program, ISCED 2 and 3



Appendix E: Tertiary level of education program, ISCED 5



The tables from **Appendices B, C, D** and **E.** show **residential zones** (horizontal) versus **school zones** (vertical) for all school attenders (children below 18 years of age) in Aruba, for each of the four levels of education program, respectively:

a. Pre-school
b. Primary school
c. Secondary school
d. Tertiary school

Source: Census Aruba 2010.

Appendix F: Distribution of employed population per residential and working GAC zone.

Source: Census Aruba 2010.

Note: The upper 10% of values are highlighted with a blue square. The table is divided in four sections, based on the division of Aruba in a geographical northern part (Pabou) and a southern part (Pariba). The lower right corner shows the percentage of employees that work Pabou and Pariba. The table underneath provides the percentages of where employees live (column total =100%) per region of work. Highlighted in green is the percentage of those that live and work in the same region.

Work GAC Location

Home GAC Location			Noord Tanki Leendert						Oranjestad West							Oranjestad East								Paradera						Sta. Cruz						Savaneta					San Nicolas North						San Nicolas South										
			11	12	13	14	15	21	22	23	24	25	26	27	28	31	32	33	34	35	36	37	38	39	41	42	43	44	51	52	53	54	55	56	61	62	63	64	71	72	73	74	75	76	77	81	82	83	84	85	86	87	88	Total	Pabou	Pariba
Noord Tanki-Leendert	Palm Beach/Malmok	11	839	113	27	40	15	14	549	17	2	9	40	23	39	144	87	48	60	57	4	90	12	30	11	11	8	11	11	21	2	2	4	52	2	5	10	6	2	1	5	2		4		2	1	11		2		1	2	2,463	2,390	58
	Washington	12	446	281	23	37	23	16	411	12	3	14	22	23	22	137	80	34	32	31	9	80	6	27	5	16	1	9	3	13	1	3	1	45	5	2	10		3	1	5			4			1	16		3	2		5	1,934	1,868	60
	Alto Vista	13	516	114	281	52	27	14	565	17	5	14	28	13	31	131	92	49	39	54	6	89	13	24	6	17	10	8	9	18	1	4	6	39	6	3	15	2	1	5	13		1	5		4	3	23		3	3	4	3	2,396	2,295	97
	Moko/Tanki Flip	14	331	77	25	210	34	6	407	10	1	12	29	28	14	127	66	50	48	52	2	74	5	17	3	6	1	6	9	16		2	1	54	10	3	11	9		2	10	2		1		6	1	19		2			2	1,808	1,724	79
	Tanki Leendert	15	261	25	13	35	332	8	416	14	6	5	31	17	45	113	68	41	53	42	4	68	2	17	6	17	5	17	10	25	2		5	35	11	1	9	5	2	5	5	1		4		8	3	16		2		2	5	1,830	1,742	81
Oranjestad West	Pos Abao/Cunucu Abao	21	97	21	2	14	6	49	178	5	2	3	8	4	6	34	26	9	16	14	1	21		5	1	1	1	2		3	1		1	14	3	2	17	1	1	1	1							1					1	578	547	29
	Eagle/Paardenbaaistraat	22	34	2	2	2	1		113	2		2	2		1	18	17	4	2	1		1		1			1	1					1			2			1		2						1	3						222	210	10
	Madiki Kavel	23	195	30	4	11	11	2	321	99		4	26	6	21	91	42	13	21	19	4	26	9	13	6	2	1	5	5	10	1	1		22	3	2	24	2	3	1	4	1		1		2	3	10			1			1,082	1,023	58
	Madiki/Rancho	24	157	13		11	21	3	195	9	58	6	30	5	15	48	18	10	10	11	2	22	4	10		5		1	1	4				15		2	3	1	1		1					6	1	9			1		2	714	685	28
	Paradijswijk/Santa Helena	25	131	19	3	19	17	5	250	5	3	121	29	18	19	71	42	31	21	32	3	29	1	11	4	4	2	3	2	10			3	27	2	2	3	3		1	1			3		2	2	5		2	1	2	5	983	942	37
	Socotoro/Rancho	26	161	25	3	9	17	6	212	11	6	2	168	16	14	63	21	23	18	23	1	31	2	11		5	2	3	1	10		1		29	2	2	3	4	3		1	1		1		4	1	5		1			3	935	896	34
	Ponton	27	137	32	6	12	19	6	220	2	2	17	16	160	14	92	38	22	24	28	1	31	4	11	5	4	4	1	8	8	2		2	21	4	1	1	4			4	2		4		3	3	10		2				995	953	40
	Companashi/Solito	28	198	28	8	19	24	8	267	10	6	12	31	13	193	120	44	26	22	28	4	47	8	10	9	8	4	2	3	11	2		2	24	12	3	2			1	1			3		5	5	5		1		1	9	1,243	1,191	50
Oranjestad East	Nassaustraat	31	74	4	1	4	15	2	86	1	2	1	9	3	5	102	4	5	5	15	1	10	1	1	2	1	2	1		2	1			12	2	4		1										3				1	2	389	375	14
	Klip/Mon Plaisir	32	65	5		5	4	3	160	1		1	18	6	5	81	172	11	13	22		21	2	12	11	2		1	3	6			3	10	1	1	2	2					1	1		1	3	1		1	1		4	669	646	21
	Sividivi	33	50	8	2	6	10		77	3	3	2	13	4	8	40	15	95	6	9		5		3		2		1	3	3		1	1	5	1		2	2			2	1		1		1		3					2	394	378	16
	Seroe Blanco/Cumana	34	137	28	9	15	31		305	4	2	2	26	10	22	134	71	19	196	38	6	48	6	16	3	12		5	13	9	1	3	4	28	12	4	10	4	1	1	3			4	1	8	5	9		2	1	4	6	1,285	1,207	77
	Dacota/Potrero	35	171	22	4	18	15	6	274	10	5	8	21	15	29	107	45	29	34	176	9	44	5	19	3	2	10	4	5	9		1	4	42	16	2	2	3	2	6	3		2			2	1	6		3			17	1,218	1,150	68
	Tarabana	36	109	14	4	6	16	2	211	2	6	2	22	13	9	61	31	25	18	53	62	36	5	12		4	1	2	2	12	1	1	3	34	4	2	4	1			3			3		3	4	9		4		1	8	831	782	48
	Sabana Blanco/Mahuma	37	160	18	4	14	8	1	319	5	2	8	18	13	21	111	77	41	45	48	6	205	3	58	3	12	3	5	11	24	1	1	14	41	11	3	28	2	2	6	13			1		4	5	18	1	6	3	6	14	1,432	1,303	127
	Simeon Antonio	38	38	10	2	9	5	2	100	4		1	9		5	26	17	13	15	15	4	22	55	18	1	1	4		2	2		2	1	26	3	3	4	1			3	1				3	3	10		1			6	451	411	40
Paradera	Shiribana	41	245	36	14	26	32	6	400	4	5	6	19	23	36	120	70	42	45	44	5	60	15	27	167	30	8	18	5	27	1	2	5	57	10	4	9	2	2	2	4		1	1	1	4	1	9		6			13	1,679	1,605	70
	Paradera	42	131	19	4	19	10	4	232	5	8	1	15	9	22	101	58	21	42	30	3	70	5	21	4	134	5	19	4	18	4	1	12	29	5	4	4		1	6	9			5		6	3	11				1	5	1,131	1,064	63
	Ayo	43	146	30	5	22	17	9	354	9	1	4	25	15	24	118	87	43	44	36	6	81	8	36	6	16	137	30	9	28	3	1	12	52	11	4	9	3	3	1	21	1	2	6		10	2	8		2	1		13	1,519	1,416	97
	Piedra Plat	44	94	13	3	16	8	1	221	8	2	3	29	8	23	80	67	31	44	39		45	2	29	6	18	6	159	16	25	3	2	13	37	5	2	5	3		2	6			5		1	2	2		2	1		9	1,103	1,054	48
	Hooiberg	51	115	18	4	12	14	8	262	4	5	3	11	11	31	118	65	31	40	39	3	60	12	34	3	2	2	15	170	25	2	5	4	36	6	6	8	6	1	3	5			8		4	11	17		2			6	1,252	1,166	86
Sta. Cruz	Papilon	52	93	17	4	23	18	1	222		1	2	14	9	17	71	67	27	40	37	2	78	9	36	2	3	3	9	13	179	1	8	11	54	6	4	5	4	1	3	6	1		8		5	2	13		1	1	1	10	1,146	1,072	74
	Cashero	53	70	13	6	10	14	1	198	5	1	4	5	5	13	56	52	36	40	22		63	6	16	2	9	6	18	6	42	80	12	12	38	6	4	14	2	5	5	13			4		5	2	11		1		2	9	953	865	86
	Urataca	54	52	12	5	12	6	2	133	1	1	3	9	4	8	51	47	29	18	28	2	48	5	17	4	6	2	9	8	31	3	87	17	40	6	4	10	1	5		10			4		2	3	10		4			2	769	702	63
	Macuarima	55	62	11	4	9	9	2	136	11	3	3	11	5	13	54	36	23	22	28	2	45	1	15	3	3	5	14	4	40	1	13	97	41	3	5	2	1	1	2	5		1	6		8	1	10		3	2		9	791	728	61
	Balashi/Barcadera	56	66	14	4	9	9		152	1	1	4	11	8	6	58	35	16	23	22	3	48	1	19	4	2	3	12	4	18	1	2	13	106	4	5	1	6	2	2	3			2		6	5	12		4			12	744	677	67
Savaneta	Pos Chiquito	61	289	26	12	17	24	6	463	12	2	5	34	12	30	154	87	55	50	58	2	90	12	43	2	9	5	15	12	45	1	4	10	115	254	26	34	19	8	12	31	3	2	19	1	43	22	63	2	16	1	4	67	2,335	1,703	629
	Jara/Seroe Alejandro	62	87	11	2	9	9	3	194	1	1	2	5	8	14	73	36	22	28	23		41	8	36	1	9	3	2	3	15		1	10	48	12	120	31	18	2	9	15	2	1	13		12	13	43	2	5		1	24	1,028	702	325
	De Bruynewijk	63	61	10	2	6	10		133	5	1		13	4	8	47	32	21	8	14		31	5	14	2	4	2	1	3	9	3		5	37	6	14	91	5	4	10	23	2		6		14	6	37	1	8	3	2	6	733	493	240
	Cura Cabai	64	103	10		6	12	2	143	1	2	3	9	5	9	57	26	26	17	14	1	31	6	21	1	1		2		6			5	37	8	6	25	89	9	11	18	4	2	3		21	14	51		12	1	6	9	849	559	289
	Brasil	71	113	5	2	5	8	3	209	3	3	2	10	5	9	53	24	28	22	36	2	41	9	27	2	2	3	8	6	9	1	1	4	47	4	9	14	25	52	6	30	2	2	14		34	21	74	1	13	1	4	13	1,026	702	319
San Nicolas North	Rooi Congo	72	99	3	2	5	2	3	166	1	1	1	10	3	11	51	30	21	15	30		34	9	15		2	2	2	1	6	2		3	23	5	10	8	14	11	84	22	5	2	10		45	24	73	2	14	3	1	38	925	554	371
	Watapana Gezaag	73	86	9	2	6	3	3	128	5	1	2	6	3	5	36	16	8	16	16		25	2	14	4			1	4	10			2	27	3	6	5	12	1	21	63	3	1	9		35	9	52	3	8	5	8	34	723	443	277
	Standard Ville/Rooi Hundo	74	47	5	4	4	5	2	88		2	1	2	2	8	13	8	5	11	6		14		10		1	1	3	3	1			1	21	2	4	9	12		6	17	26	1	5		19	14	52	1	5	2	4	13	464	270	195
	Kustbatterij	75	89	1	1		2		101			2	6	3	5	19	17	13	13	11	1	13	1	17	1		3		1	9	2		3	8	2	2	9	9	2	4	14		40	9		21	13	56		17	2	2	9	556	344	211
	Juana Morto	76	56	9			6		84	1	1	3	3	4	5	18	9	5	9	12	1	12	1	18	1		1	2	1		2	1	2	12	1	2	1	10		2	8		4	21		14	5	37		8	1	5	8	410	283	127
	San Nicolas North other	77							2									2				1	1											2							1						1							11	9	2
San Nicolas South	Zeewijk	81	29	5	2	1	10		41			1		1	1	9	8	1	4	1	1	4	2	3	1		1		1	6			1	19	3	2	1	3	2	3	4	1		1		41	8	18		3	1		5	254	156	99
	Pastoor Hendriksstraat	82	49	3		3	1		67				2		3	14	10	2	10	8		15	2	16		2		1	1		2		2	8	3	5	4	4	1		8	1	1	3		26	45	42		3	2		12	384	222	162
	v.d. Veen Zeppenfeldstraat	83	11		1			1	12							4					1	1		3						1						4		1						1		1	3	34		1				81	36	45
	Village	84	40			1	2		48			3	1		5	5	1	2	1	3	1	4	2	6				1		2				10		2	4	2		1	1			3		11	4	17	14	3	2		6	213	141	73
	Essoville	85	51	5	2	4	4	1	79	1		1		2	2	15	8	5	3	8		11		10		1	1	2	3	5			2	8	3	4	4	9	1	4	4	2		5		30	13	52	1	41		3	3	418	236	182
	Lago/Esso Heights	86	51	6	1	3		1	75	1	2	1	1	1	1	11	14	9	10	14	1	14	5	24	2		2	1	1	3	1			10	3	1	2	6	2	2	11	2	3	6		11	15	50		25	14	1	8	431	267	163
	Seroe Colorado	87	5			2			9		1					2	3	1	1	1		8	1	2		1			2					4	2		1	1		1						3	1	24		5		9		92	44	48
			6,645	1,183	516	783	889	218	9,985	326	167	313	849	544	849	3,260	1,987	1,124	1,275	1,350	172	1,986	278	858	304	393	267	437	386	778	133	165	308	1,498	491	318	472	327	142	239	437	69	69	224	3	501	315	1,069	29	253	60	80	442	45,873		
	Pabou		5,382	1,074	482	707	790	191	7,945	293	148	284	746	489	732	2,679	1,659	897	1,058	1,094	160	1,595	211	578	286	360	241	395	342	649	118	157	257	1,065	178	99	228	87	47	62	167	14	9	94	2	120	83	296	1	65	19	28	187		94.9%	5.1%
	Pariba		1,263	109	35	76	99	27	2,040	32	18	29	103	55	117	581	328	226	218	255	12	391	67	280	18	32	26	42	44	129	15	8	52	433	314	220	244	240	95	178	271	55	61	130	1	381	232	774	28	188	40	52	254		65.6%	34.4%

Appendix G: Population employed in 2000 and 2010 per zone of work and zone of residence

Source: Census Aruba 2010 and 2000.

Note: For those that are less familiar with the names in Aruba, the naming of regions and zones is sometimes confusing. For example, zone-31 named Nassaustraat is not a street but a reference to 33 different streets whereas for instance, the zone-27 named Ponton includes the street named Ponton and a larger area that includes 18 more streets.

			2010							2000							Between 2000 and 2010			
			employees work location			employees home location			ratio work/home	employees work location			employees home location			ratio work/home	Difference (N)		shift in total population of employees	
GAC Zone	**Zone ID**	area (km^2)	N	%	density	N	%	density		N	%	density	N	%	density		work	home	work	home
Palm Beach/Malmok	11	8.30	6,645	*14.3*	800	2,480	*5.3*	299	**2.7**	4,758	*11.4*	573	1,962	*4.7*	236	**2.4**	1,887	518	*2.9*	*0.6*
Washington	12	3.40	1,183	*2.5*	348	1,953	*4.2*	575	**0.6**	880	*2.1*	259	1,579	*3.8*	465	**0.6**	303	374	*0.4*	*0.4*
Alto Vista	13	7.83	516	*1.1*	66	2,425	*5.2*	310	**0.2**	307	*0.7*	39	1,666	*4.0*	213	**0.2**	209	759	*0.4*	*1.2*
Moko/Tanki Flip	14	4.29	783	*1.7*	182	1,833	*3.9*	427	**0.4**	383	*0.9*	89	1,603	*3.8*	374	**0.2**	400	230	*0.8*	*0.1*
Tanki Leendert	15	2.15	889	*1.9*	414	1,852	*4.0*	863	**0.5**	699	*1.7*	326	1,636	*3.9*	762	**0.4**	190	216	*0.2*	*0.1*
Noord other	16	8.58	31	*0.1*	4	0	*0.0*	0	**0.0**	16	*0.0*	2	0	*0.0*	0	**0.0**	15	0	*0.1*	*0.0*
Region Noord/Tanki L.		34.55	10,047	*21.6*	291	10,542	*22.7*	305	**1.0**	7,042	*16.8*	204	8,447	*20.2*	245	**0.8**	3,005	2,095	*4.8*	*2.5*
Pos Abao/Cunucu Abao	21	1.04	218	*0.5*	210	583	*1.3*	562	**0.4**	149	*0.4*	144	469	*1.1*	452	**0.3**	69	114	*0.1*	*0.2*
Eagle/Paardenbaaistraat	22	3.38	9,985	*21.5*	2,955	226	*0.5*	67	**44.1**	9,846	*23.5*	2,913	201	*0.5*	59	**49.0**	139	25	*-2.0*	*0.0*
Madiki Kavel	23	1.35	326	*0.7*	242	1,096	*2.4*	813	**0.3**	183	*0.4*	135	702	*1.7*	520	**0.3**	143	394	*0.3*	*0.7*
Madiki/Rancho	24	0.42	167	*0.4*	395	735	*1.6*	1,740	**0.2**	142	*0.3*	336	803	*1.9*	1,901	**0.2**	25	-68	*0.1*	*-0.3*
Paradijswijk/SantaHelena	25	0.52	313	*0.7*	598	999	*2.1*	1,911	**0.3**	271	*0.6*	518	873	*2.1*	1,670	**0.3**	42	126	*0.1*	*0.0*
Socotoro/Rancho	26	0.50	849	*1.8*	1,690	961	*2.1*	1,914	**0.9**	836	*2.0*	1,665	1,023	*2.4*	2,038	**0.8**	13	-62	*-0.2*	*-0.3*
Ponton	27	1.26	544	*1.2*	431	1,016	*2.2*	805	**0.5**	425	*1.0*	337	929	*2.2*	736	**0.5**	119	87	*0.2*	*0.0*
Companashi/Solito	28	0.89	849	*1.8*	952	1,266	*2.7*	1,421	**0.7**	477	*1.1*	535	1,070	*2.6*	1,200	**0.4**	372	196	*0.7*	*0.1*
Region Oranjestad West		9.37	13,250	*28.5*	1,414	6,884	*14.8*	735	**1.9**	12,328	*29.4*	1,316	6,070	*14.5*	648	**2.0**	922	814	*-0.9*	*0.3*
Nassaustraat	31	0.40	3,260	*7.0*	8,221	407	*0.9*	1,026	**8.0**	3,946	*9.4*	9,951	400	*1.0*	1,009	**9.9**	-686	7	*-2.4*	*-0.1*
Klip/Mon Plaisir	32	1.31	1,987	*4.3*	1,515	682	*1.5*	520	**2.9**	1,212	*2.9*	924	844	*2.0*	644	**1.4**	775	-162	*1.4*	*-0.5*
Sividivi	33	0.41	1,124	*2.4*	2,744	402	*0.9*	981	**2.8**	1,066	*2.5*	2,603	442	*1.1*	1,080	**2.4**	58	-40	*-0.1*	*-0.2*
Seroe Blanco/Cumana	34	1.66	1,275	*2.7*	769	1,313	*2.8*	792	**1.0**	991	*2.4*	598	1,251	*3.0*	754	**0.8**	284	62	*0.3*	*-0.2*
Dacota/Potrero	35	1.06	1,350	*2.9*	1,269	1,239	*2.7*	1,165	**1.1**	1,332	*3.2*	1,252	1,318	*3.1*	1,239	**1.0**	18	-79	*-0.3*	*-0.4*
Tarabana	36	0.45	172	*0.4*	381	845	*1.8*	1,872	**0.2**	186	*0.4*	412	932	*2.2*	2,064	**0.2**	-14	-87	*0.0*	*-0.4*
Sabana Blanco/Mahuma	37	2.99	1,986	*4.3*	665	1,450	*3.1*	486	**1.4**	1,790	*4.3*	600	1,237	*3.0*	414	**1.4**	196	213	*0.0*	*0.1*
Simeon Antonio	38	2.28	278	*0.6*	122	457	*1.0*	200	**0.6**	254	*0.6*	112	444	*1.1*	195	**0.6**	24	13	*0.0*	*-0.1*
Oranjestad East Other	39	1.93	858	*1.8*	445	0	*0.0*	0	**0.0**	935	*2.2*	484		*0.0*	0	**0.0**	-77	0	*-0.4*	*0.0*
Region Oranjestad East		12.49	12,291	*26.4*	984	6,795	*14.6*	544	**1.8**	11,712	*27.9*	938	6,868	*16.4*	550	**1.7**	579	-73	*-1.5*	*-1.8*
Shiribana	41	2.72	304	*0.7*	112	1,698	*3.7*	625	**0.2**	204	*0.5*	75	987	*2.4*	363	**0.2**	100	711	*0.2*	*1.3*
Paradera	42	2.19	393	*0.8*	179	1,143	*2.5*	522	**0.3**	284	*0.7*	129	1,005	*2.4*	459	**0.3**	109	138	*0.1*	*0.1*
Ayo	43	7.42	267	*0.6*	36	1,544	*3.3*	208	**0.2**	165	*0.4*	22	1,212	*2.9*	163	**0.1**	102	332	*0.2*	*0.4*
Piedra Plat	44	1.86	437	*0.9*	236	1,122	*2.4*	605	**0.4**	311	*0.7*	167	964	*2.3*	519	**0.3**	126	158	*0.2*	*0.1*
Paradera other	45	6.28	3	*0.0*	1	0	*0.0*	0	**0.0**	6	*0.0*	1	0	*0.0*	0	**0.0**	-3	0	*0.0*	*0.0*
Region Paradera		20.46	1,405	*3.0*	69	5,507	*11.8*	269	**0.3**	969	*2.3*	47	4,167	*9.9*	204	**0.2**	436	1,340	*0.7*	*1.9*

			2010							2000							Between 2000 and 2010			
			employees work location			employees home location			ratio work/home	employees work location			employees home location			ratio work/home	Difference (N)		shift in total population of employees	
GAC Zone	Zone ID	area (km²)	N	%	density	N	%	density		N	%	density	N	%	density		work	home	work	home
Hooiberg	51	3.57	386	0.8	108	1,269	2.7	356	0.3	348	0.8	97	1,349	3.2	378	0.3	38	-80	0.0	-0.5
Papilon	52	2.79	778	1.7	279	1,158	2.5	416	0.7	873	2.1	313	1,136	2.7	408	0.8	-95	22	-0.4	-0.2
Cashero	53	8.90	133	0.3	15	960	2.1	108	0.1	119	0.3	13	850	2.0	96	0.1	14	110	0.0	0.1
Hooiberg	51	3.57	386	0.8	108	1,269	2.7	356	0.3	348	0.8	97	1,349	3.2	378	0.3	38	-80	0.0	-0.5
Papilon	52	2.79	778	1.7	279	1,158	2.5	416	0.7	873	2.1	313	1,136	2.7	408	0.8	-95	22	-0.4	-0.2
Cashero	53	8.90	133	0.3	15	960	2.1	108	0.1	119	0.3	13	850	2.0	96	0.1	14	110	0.0	0.1
Urataca	54	5.18	165	0.4	32	779	1.7	150	0.2	186	0.4	36	663	1.6	128	0.3	-21	116	0.0	0.1
Macuarima	55	3.46	308	0.7	89	799	1.7	231	0.4	135	0.3	39	781	1.9	226	0.2	173	18	0.4	-0.2
Balashi/Barcadera	56	6.15	1,498	3.2	244	762	1.6	124	2.0	942	2.2	153	799	1.9	130	1.2	556	-37	1.0	-0.3
Santa Cruz overig	57	11.41	6	0.0	1	0	0.0	0	0.0	7	0.0	1	0	0.0	0	0.0	-1	0	0.0	0.0
Region Sta. Cruz		41.45	3,275	7.0	79	5,727	12.3	138	0.6	2,609	6.2	63	5,579	13.3	135	0.5	666	148	0.8	-1.0
Pos Chiquito	61	5.93	491	1.1	83	2,350	5.1	396	0.2	331	0.8	56	1,843	4.4	311	0.2	160	507	0.3	0.7
Jara/Seroe Alejandro	62	3.67	318	0.7	87	1,036	2.2	283	0.3	389	0.9	106	980	2.3	267	0.4	-71	56	-0.2	-0.1
De Bruynewijk	63	1.40	472	1.0	337	735	1.6	524	0.6	510	1.2	364	733	1.7	523	0.7	-38	2	-0.2	-0.1
Cura Cabai	64	2.13	327	0.7	153	858	1.8	402	0.4	270	0.6	127	765	1.8	359	0.4	57	93	0.1	0.0
Savaneta overig	65	14.44	0	0.0	0	0	0.0	0	0.0	0	0.0	0	0	0.0	0	0.0	0	0	0.0	0.0
Region Savaneta		27.58	1,608	3.5	58	4,979	10.7	181	0.3	1,499	3.6	54	4,321	10.3	157	0.3	109	658	-0.1	0.4
Brasil	71	1.50	142	0.3	95	1,049	2.3	701	0.1	105	0.3	70	1,001	2.4	669	0.1	37	48	0.0	-0.1
Rooi Congo	72	1.41	239	0.5	169	938	2.0	665	0.3	217	0.5	154	1,036	2.5	734	0.2	22	-98	0.0	-0.5
Watapana Gezaag	73	1.20	437	0.9	364	734	1.6	611	0.6	301	0.7	251	787	1.9	655	0.4	136	-53	0.2	-0.3
StandardVille/RooiHundo	74	2.69	69	0.1	26	473	1.0	176	0.1	131	0.3	49	454	1.1	169	0.3	-62	19	-0.2	-0.1
Kustbatterij	75	0.76	69	0.1	91	561	1.2	734	0.1	84	0.2	110	638	1.5	835	0.1	-15	-77	-0.1	-0.3
Juana Morto	76	5.38	224	0.5	42	412	0.9	77	0.5	165	0.4	31	328	0.8	61	0.5	59	84	0.1	0.1
San Nicolas North other	77	10.47	3	0.0	0	11	0.0	1	0.3	7	0.0	1	13	0.0	1	0.6	-4	-2	0.0	0.0
Region San Nicolas North		23.41	1,184	2.5	51	4,178	9.0	178	0.3	1,011	2.4	43	4,257	10.2	182	0.2	173	-79	0.1	-1.2
Zeewijk	81	0.46	501	1.1	1,085	258	0.6	558	1.9	375	0.9	812	321	0.8	695	1.2	126	-63	0.2	-0.2
Pastoor Hendriksstraat	82	0.40	315	0.7	788	393	0.8	983	0.8	214	0.5	536	412	1.0	1,031	0.5	101	-19	0.2	-0.2
v.d. Veen Zeppenfeldstr.	83	0.13	1,069	2.3	8,457	84	0.2	668	12.7	592	1.4	4,683	111	0.3	878	5.3	477	-27	0.9	-0.1
Village	84	0.10	29	0.1	302	224	0.5	2,317	0.1	19	0.0	195	229	0.5	2,368	0.1	10	-5	0.1	0.0
Essoville	85	0.28	253	0.5	897	424	0.9	1,503	0.6	321	0.8	1,138	483	1.2	1,711	0.7	-68	-59	-0.3	-0.3
Lago/Esso Heights	86	0.44	60	0.1	136	437	0.9	998	0.1	83	0.2	189	452	1.1	1,032	0.2	-23	-15	-0.1	-0.2
Seroe Colorado	87	4.39	80	0.2	18	92	0.2	21	0.9	206	0.5	47	172	0.4	39	1.2	-126	-80	-0.3	-0.2
San Nicolas South Other	88	3.41	442	0.9	129	0	0.0	0	0.0	956	2.3	280	28	0.1	8	34.1	-514	-28	-1.4	-0.1
Region San Nicolas South		9.61	2,749	5.9	286	1,913	4.1	199	1.4	2,766	6.6	288	2,208	5.3	230	1.3	-17	-295	-0.7	-1.2
Subtotal			45,873			45,873														
Not Reported			653	1.4		0	0.0			1,981	4.7		0	0.0						
Total		179	46,526	100%	260	46,526	100%	260	1.0	41,918	100%	234	41,918	100%	234	1.0				

Appendix H: Public Transport in 2010

Public Line Buses (at the time of the Census in 2010)

Line 1, 2 and 3 Connection between the bus station in *San Nicolas* and *Oranjestad* roughly about *every hour*, from about 5 AM until late at night 11 PM. Different lines take different routes and the bus is more frequently *in the morning* and *afternoon* and less frequent the rest of the day.

Line 3A Runs similarly between *San Nicolas* and *Oranjestad* but passes via *Santa Cruz*.

Line 5 Runs twice daily at about 6 AM and at about 6 PM from *Oranjestad* via *Sero Blanco*, *Paradera*, *Piedra Plat* and *Siribana* to *Macuarima*, once in early morning and once in late afternoon: Returns via *St. Cruz*, *Ayo*, Rooi Prikichi, Jaburibari, *Paradera* and *Tanki Leendert* to *Oranjestad*.

Line 6 Connects similar to Line 5 between *Macuarima* and *Oranjestad*. but with a slightly different route: Runs four times a day, twice in early morning and twice in late afternoon.

Line 7 Connection between *Oranjestad* and the *Hotel area*, and passes a number of neighborhoods aside from the main road, *Ponton*, *Turibana*, *Bakval*, and runs roughly every two hours.

Line 7A: Similar to Line 7 but via *Ponton*, *Palmbeach*, *Keito*, and *Babuli Plas*.

Line 8 Connection between *Pos Chiquito* or *Sabana Basora* and *Oranjestad e*very one to two hours, via *Dakota*, *Simeon Antonio*, *Bucutiweg* and *Barcadera*.

Line 10 Transfers between *Oranjestad* to the *Hotel area* from about 5 AM until 11 PM every day of the week. At weekdays the schedule is about *every 10 minutes* and at Sunday it is every 20 minutes. The trip from the Hotel area to Oranjestad runs similar but starts and ends about 25 minutes later. These busses are used by the tourists as well as employees that work in the Hotel district.

Special lines A few *special (school) bus lines* run once in early morning and around noon between the schools and smaller residential areas that are not directly connected by normal line bus. *Special busses* run once in the early morning and once in the afternoon between a few neighborhoods for children that follow special education (in total 3 schools).

Private-owned Buses

According to the regions these 'autobuses' have indicated to cover, the following systematic can be discerned:

33 buses run between San Nicolas and Oranjestad center
25 buses run between San Nicolas and Oranjestad center - via Sta. Cruz
8 buses run between San Nicolas and Oranjestad southeast
2 buses run from San Nicolas up to Noord
1 bus runs in the area San Nicolas and Brazil
1 bus runs between Oranjestad and Brazil
1 bus runs in the area Oranjestad only
11 buses run between Noord and Oranjestad Southeast - via Tanki Leendert
7 buses run between Santa Cruz and Oranjestad
4 buses run northeast from Santa Cruz up to Ayo

Figures

Tables

Bibliography

Kinderbijslagfonds - HDP. (2006, Sept). Van Huis naar school in 15 minuten: http://www.hdp.be/nl/kinderbijslagfonds/nieuws-kinderbijslagfonds/persberichten-kinderbijslagfonds

UNESCO. (1997). Opgehaald van International Standard Classification of Education - ISCED97: www.unesco.org

Arubus route time schedule. (2010). Opgehaald van http://arubus.com/schedules/

CBS Aruba. (2010). *Fifth Population and Housing Census.* Aruba: Central Bureau of Statistics, CBS Aruba.

Commissie Bestaansminimum Aruba. (2013). *Rapport bestaansminimum 2010.* www.cbs.aw.

D'Haese, S. (2011). Criterion distances and environmental correlates of active commuting to school in children. *International Journal of Behavioral Nutrition and Physical Activity*.

Department of Education, A. (2010). *Ensenansa na Aruba 2010-2011.*

Department of Public Transportation. (2012). Lijst Kleine autobussen.

Derix, R. (2013). *Car ownership in Aruba.* Aruba: Census 2010 report series. Central Bureau of Statistics (CBS).

Eelens, M. a. (2012). Vulnerable groups within Aruba's Society.

ESRI. (2010). *ESRI GIS System.* www.esri.com/.

GAC. (2012). *GAC, Geographical Address Classification Aruba.* Central Bureau of Statistics - CBS Aruba.

HDP. (2006). *Op weg naar school in 15 minuten.* Opgehaald van HDP & Acta: http://www.hdp.be/nl/kinderbijslagfonds/nieuws-kinderbijslagfonds/persberichten-kinderbijslagfonds/3123-thuis_naar_school_15_minuten

IRTAD. (2010). *IRTAD annual Report.*

Krämer. (2010). Traffic-related air pollution is associated with incident type 2 diabetes among elderly women.

Mander, H. (2012). *Report of the Expert Group to recommend the detailed methodology for identification of families living below the poverty line in the urban areas.* Centre for Equity Studies New Delhi.

McCreanor. (2007). Respiratory Effects of Exposure to Diesel Traffic in Persons with Asthma.

McKenzie, B., & Rapino, M. (2011). *Commuting in the United States: 2009.* Washington, DC.: American Community Survey Reports, ACS-15. U.S. Census Bureau.

Muhammad, S., Ottens, H., Ettema, D., & Jong, T. (2007). Telecommuting and residential locational preferences: a case study of the Netherlands. *Journal of Housing and the Built Environment, Volume 22, Number 4*, 339-358.

OECD. (2011). *OECD Project on Income Distribution and Poverty: What are equivalence scales?* www.oecd.org/dataoecd/61/52/35411111.pdf: www.oecd.org/els/social/inequality

Rijkswaterstaat, M. o. (2012). *Mobiliteitsonderzoek Nederland*. http://www.rws.nl/wegen/innovatie_en_onderzoek/betere_doorstroming/mobiliteitsonderzoek_nederland/

UN, D. o. (2008). *The Principles and Recommendations for Population and Housing Censuses, 2008.*

Worldbank. (2011). *http://data.worldbank.org*.