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SURVEY OF THE OWNED DOG POPULATION IN DISTRICT II OF QUEZON CITY, PHILIPPINES

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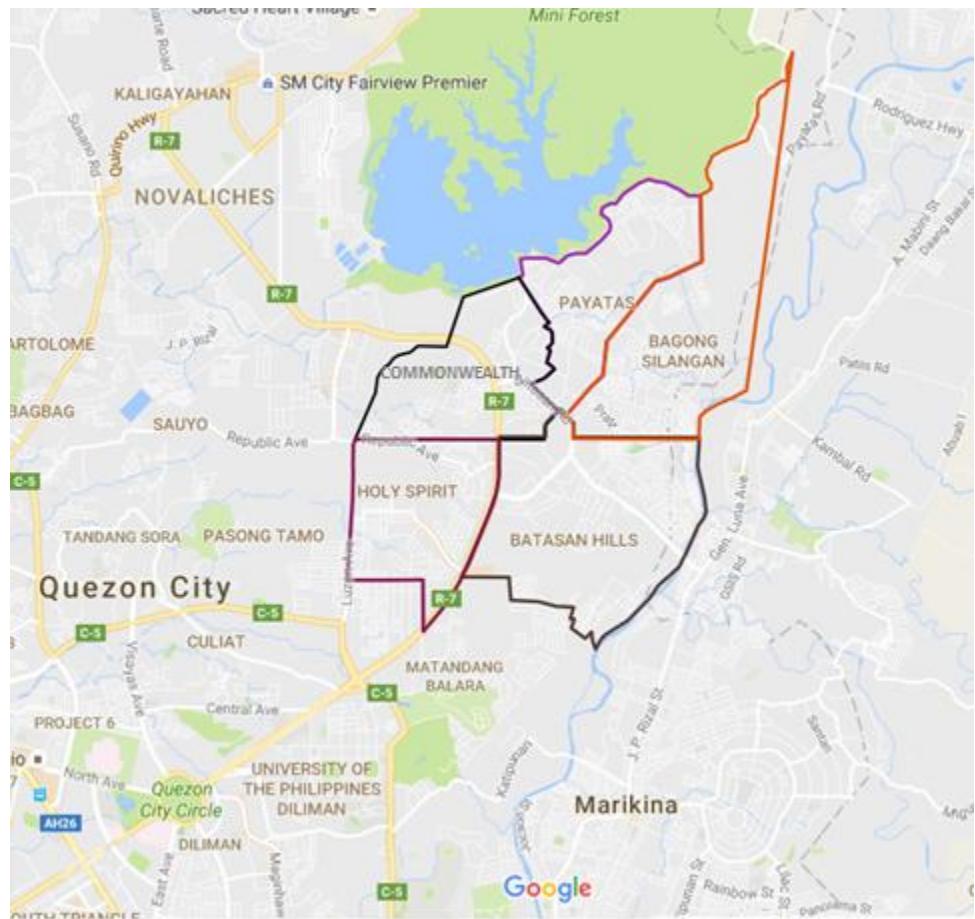
INTRODUCTION

Humane Society International (HSI) in cooperation with the Quezon City Veterinary Department (QCVD) conducted a dog population survey in District II of Quezon City, Philippines (figure 1). Quezon City accounts for 23.3% of Metro Manila's total population. It is part of the National Capital Region (NCR) and is located near the center of Metro Manila (figure 2). It has a land area of 161.126 km² (16,112.6 hectares) with a human population of 2,936,116 million (Census, 2015) with an estimated annual growth rate of 2.42%. The population density is 19,151 persons per km².

Figure 1.Quezon City, Philippines



Figure 2. Location map of the study area: District II of Quezon City, Philippines



More than 95% of human rabies cases worldwide have been reported to have domestic dogs as their sources of infection (Cleaveland, *et al.*, 2006). Dogs are by far the most significant species for viral transmission (Rupprecht, C.E., *et al.*, 2008). The World Health Organization has recommended that communities achieve at least 70% vaccination coverage of the dog population to eliminate canine rabies (WHO, 2015). A 70% coverage rate maintains population immunity above critical levels (around 40%) for at least twelve months and this interrupts the transmission of rabies (Coleman & Dye, 1996; Cleaveland, *et al.*, 2003; Hampson, *et al.*, 2009; Morters, *et al.*, 2013).

There is increasing evidence that street dogs are very dependent on human food provision rather than garbage for their nutritional needs. In at least some communities with large numbers of "street" dogs, the majority of street dogs are claimed to be "owned" by one or more residents (Butler & Bingham, 2000; Estrada, *et al.*, 2001; Morters, *et al.*, 2015). In principle, these dogs will be more accessible for vaccination (WHO, 2005; Lembo, *et al.* 2010).

The use of animal birth control (ABC) programs in concurrence with rabies vaccination has been promoted since the 1960s (apparently first suggested by Dr Chinny Krishna of the Blue Cross of India) as the method of choice for controlling dog populations and

human rabies in urban areas. The World Health Organization (WHO, 2005) has accepted this approach for at least a decade and has criticized culling alone which has been shown to be unsuccessful (Windijaningsih, *et al.*, 2004; Morters, *et al.*, 2013). In some cases (e.g. in Bali), culling is counterproductive because the sterilized and/or vaccinated dogs are killed while reproduction continues and vaccination thresholds are not maintained (WHO, 2005).

The Philippines has consistently been included among the top 10 countries with the highest number of human rabies deaths (DOH, 2011). Deray (2015) reports that there are on average 200 reported deaths annually, the vast majority caused by dog bites. In 2014 for example 96% of the 234 probable cases of human rabies were a result of a dog bite (Deray, 2015).

Achieving 70% vaccination coverage for an entire population is often difficult and it has been recommended that anti-rabies initiatives start by targeting strategic areas of higher rabies incidence to break existing transmission cycles (WHO & OIE, 2016).

Reliable information on dog population demographics as well as the total dog population size is crucial to the planning and implementation of mass dog vaccination campaigns. Baseline surveys are important to estimate program costs, inform strategies as well as to assess vaccination coverage throughout the program. Several methods to estimate dog population densities are available, often consisting of a combination of questionnaire surveys and street counts, depending on the dog populations' demographics.

Study objectives

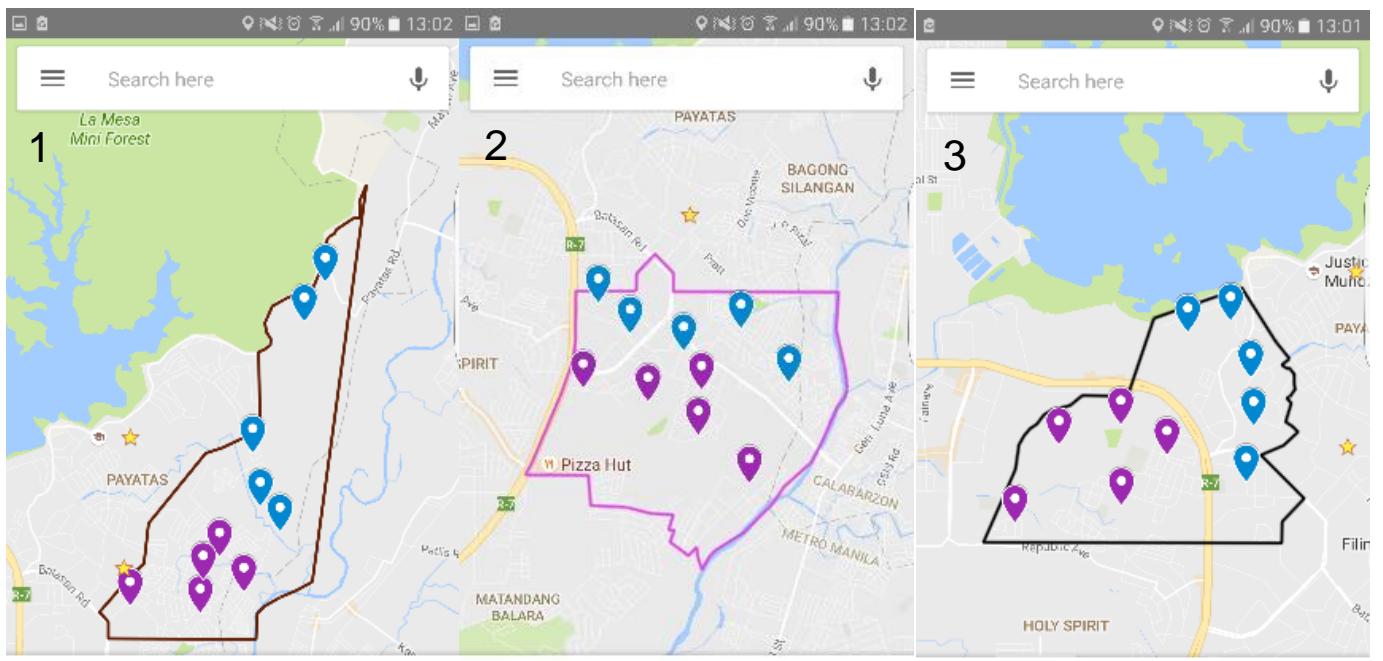
The objectives of the household survey conducted in District II of Quezon City, Philippines were:

1. Accurate estimation of the owned dog population in each of the five barangays of District II.
2. To inform the mass dog vaccination efforts against rabies in Barangay Payatas, Quezon City.
3. To create a framework for ongoing monitoring efforts throughout the vaccination program to ensure vaccination coverage of 70% of the dogs

METHODOLOGY

The dog population survey was conducted by HSI India following an established protocol. The survey focused on the owned dog population rather than the street dog population, because most, if not all, of the "street" dogs in the country are considered roaming but 'owned' dogs.

For this survey, five barangays of District II of Quezon City were chosen as the study area, with numbers assigned as followed: (1) Bagong Silangan; (2) Batasan Hills; (3) Commonwealth; (4) Holy Spirit; and (5) Payatas. Each barangay was assigned ten survey plots with their starting points as a reference (5 blues and 5 purples, shown in Figures 3-7). The blue points mark the first day of the survey while the purple points mark the consecutive day.



HH_Survey Bagong Silangan

Created: 18 September 2016

[VIEW MAP LEGEND](#)



HH survey_Batsan Hills

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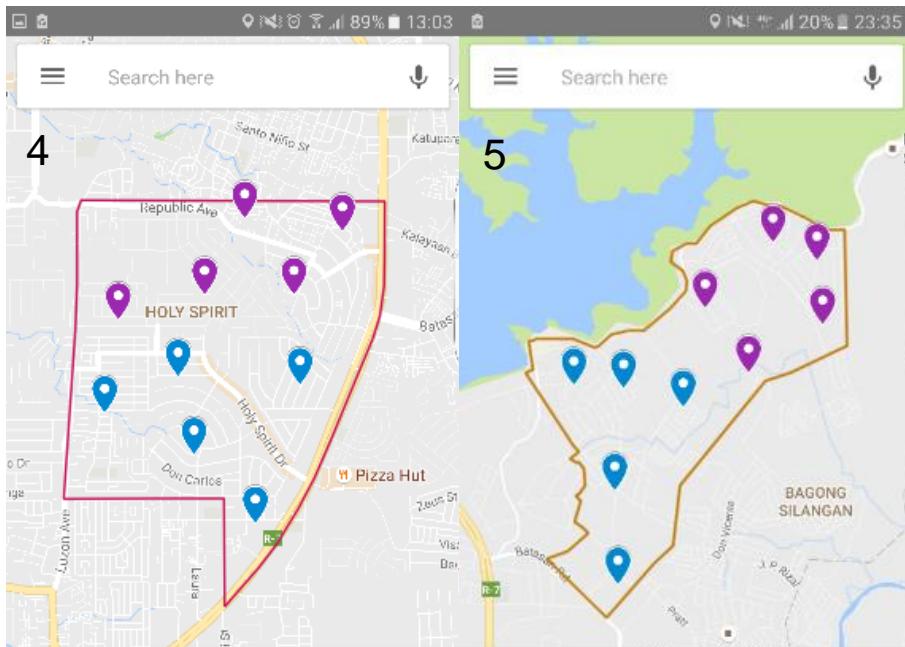
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HH survey_ Commonwealth

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HH Survey_ Holy Spirit

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HH Survey _ Payatas

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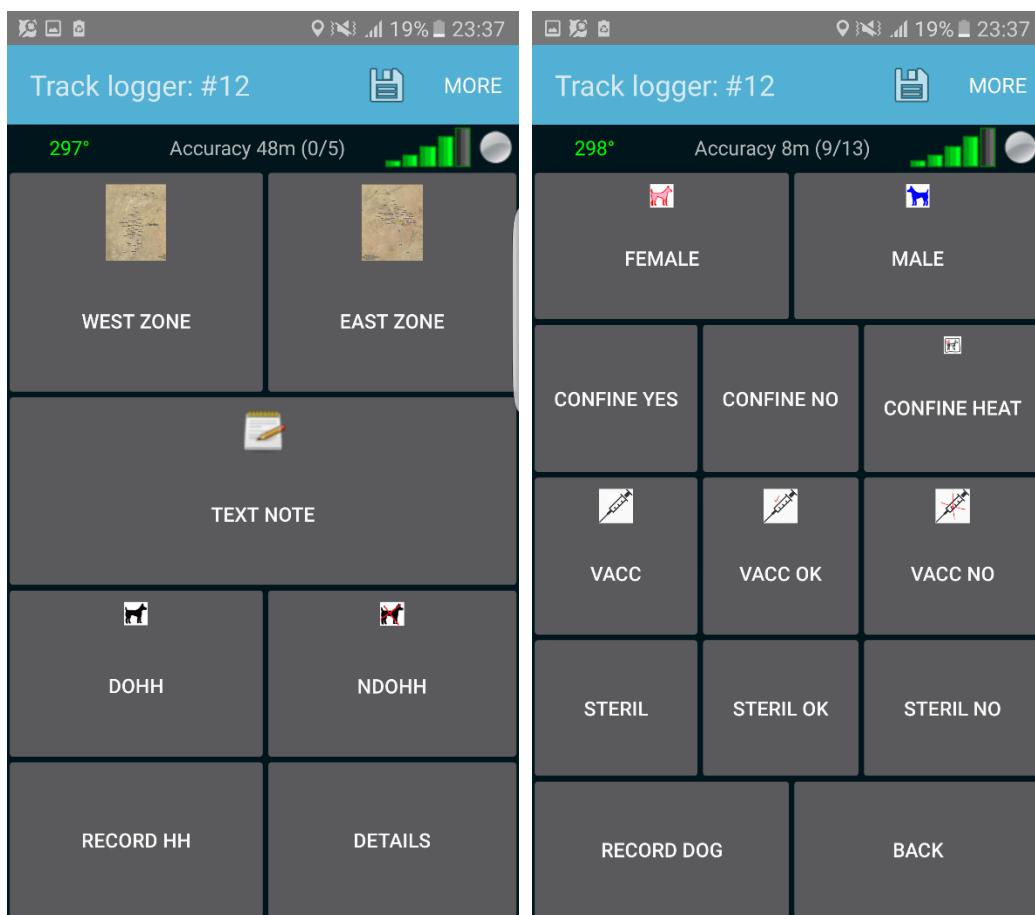
Figures 3-7. Screenshot of the guide maps of the survey areas in order of their assigned numbers: 1. Bagong Silangan; 2. Batasan Hills; 3. Commonwealth; 4. Holy Spirit; and 5. Payatas.

A combination of two smart phone applications, Google Maps and OSM Tracker, were used to accurately locate households, record GPS coordinates of survey points as well as assure the safe storage of the data collected in the questionnaires.

Google Maps is an accessible, free application developed and offered by Google Inc., which helps the surveyor to navigate the research area, while the OSMTracker application tracks the survey route and provides a layout for the questionnaire. Once a survey area is completed, the collected data are exported as a gpx file and sent to a specifically designed database tailored to the survey type and questions.

Each barangay was assigned to a team of two persons on a motorbike: one staff from the Quezon City Veterinary Department, and one veterinarian either from HSI or the QCVD. As soon as the first point for a particular barangay was reached, the previously set up OSMTracker was used to record the data gathered from interviews. Aside from counting the number of owned dogs, additional basic information about each dog was recorded. Logos for each button in OSMTracker made recording this information faster and easier (Figures 8-9).

Figures 8-9. Screenshot of the OSMTracker application.



First, the surveyor recorded whether the area was in the West Zone or the East Zone, then recorded the number assigned to the study area (1, 2, 3, 4, or 5) in the Text Note option. The household owners were asked whether they owned a dog or not, which was recorded after choosing either the DOHH (owned dogs in the household) button or the NDOHH (no owned dogs in the household) button. If the answer was yes, then the surveyor went on to ask for number of dogs in the household, then went on to the DETAILS button to record each dog's details in the next page (Figure 9). If the answer was no, then the surveyor recorded it and moved on to the next household.

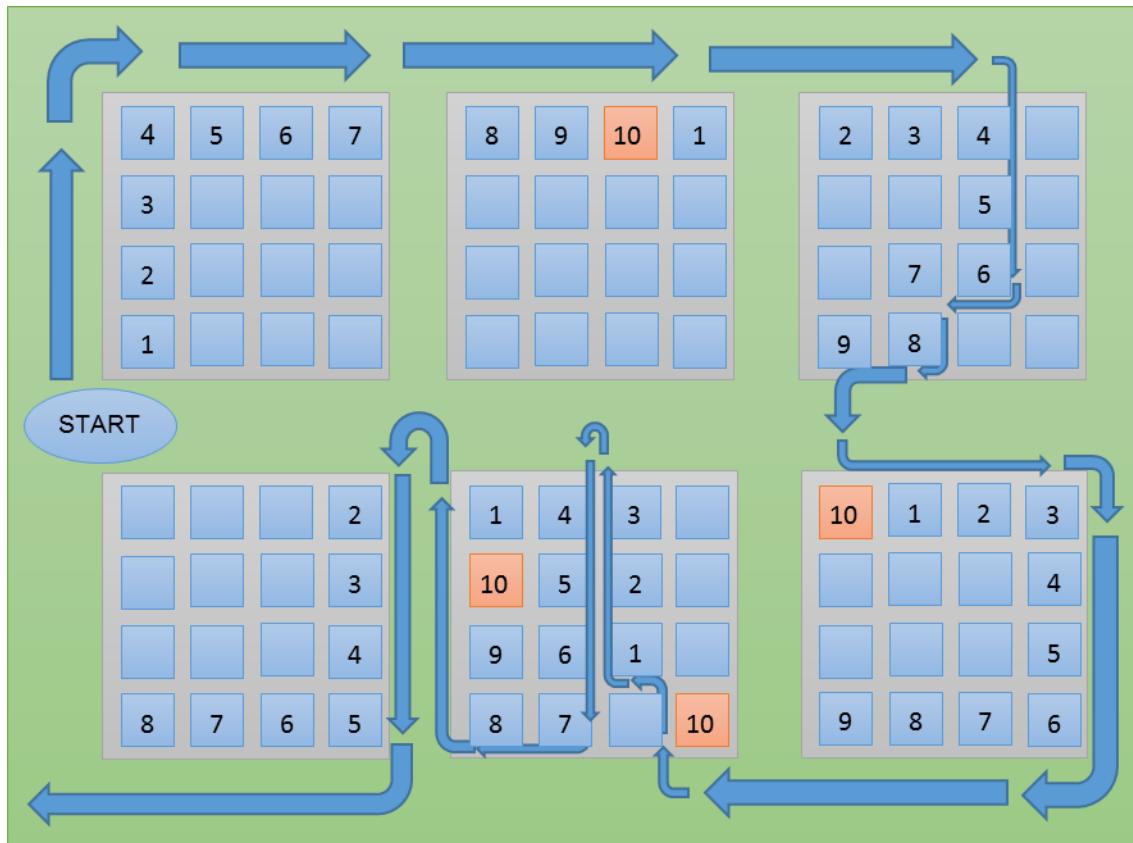
For each dog, the information gathered included:

- (1) sex of the dog (FEMALE and MALE buttons);
- (2) whether the dog was confined or not (CONFINE YES and CONFINE NO buttons);
- (3) for a female, whether they confined the dog when in heat (CONFINE HEAT button);
- (4) the rabies vaccination status of the dog (VACC button if yes);
- (5) the household willingness for the dog to be vaccinated if not yet vaccinated (VACC OK and VACC NO buttons);
- (6) whether the dog was spayed or neutered (STERIL button); and
- (7) the household willingness to spay or neuter the dog if not yet sterilized (STERIL OK and STERIL NO buttons).

Survey Design

To obtain a representative sample, households were selected randomly following a pattern of every tenth household, either by foot or on a motorbike. To remain consistent throughout the survey either the left or the right side was chosen to be the survey side. In case the owner of the tenth household was not around the owner of the ninth or the eleventh household was interviewed instead. The survey route followed a zigzag pattern (see figure 10) to minimize selection bias, and also to cover a larger part of the survey area, including the closely built houses of the lower-income communities. Surveyors were encouraged to include major streets as well as small streets to make the sample more random, and to be able to cover more diverse areas and households.

Figure 10. Sample map with sample household survey walking pattern.



Confirmation of owned dog population estimates

A follow-up survey to validate the dog population estimate was conducted after the first anti-rabies mass vaccination drive about 5 days post baseline survey. All dogs vaccinated during this period were marked with a pink dye that remains visible for up to a few weeks. With a mark-resight survey, it was possible to estimate the dog population as well as the vaccination coverage.

Follow-up estimates were conducted in the three major sections in Barangay Payatas (Payatas A, Payatas B, and Lupang Pangako). Random streets were chosen from a map prior to the mark-resight survey, with a starting point and a target end point. The streets that were chosen were the ones that had stations for the vaccination teams. All dogs that were marked and unmarked were counted and their gender noted.

RESULTS AND DISCUSSION

We estimate a total dog population of 177, 289 owned dogs in the five areas, resulting in a mean dog distribution of 25.45 dogs per 100 people across the barangays. Dog density per 100 people varied significantly between barangays, from 13.5 dogs per 100 people in Batasan Hills to 40.7 dogs per 100 people in Commonwealth. This is one of the highest recorded dog densities in East Asia (figure 11). However, another recent survey in a rural area of the Philippines also recorded very high numbers of dogs in the 35-40 dogs per 100 people range (John Boone, personal communication, 2016)

The survey encompassed fifty (50) survey plots evenly distributed over the five barangays (10 plots each). About 140-230 households were interviewed per barangay resulting in a total sample size of 950 households. The majority of households owned a dog (60%) with an average of 1.16 dogs per household for the entire District II of Quezon City, however there was significant variance between barangays. For barangay Holy Spirit the mean number of dogs per household is 1.75, while barangay Batasan Hills has the lowest mean of 0.58 dogs per household (table 1).

Figure 11. Dogs per 100 people against human density per km²

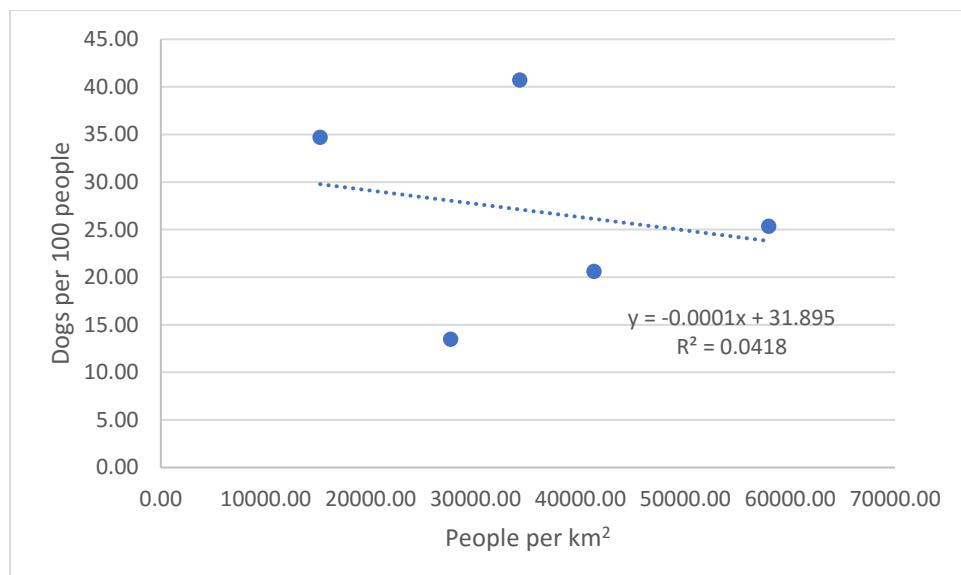


Table 1. Summary table of dog population survey in District II of Quezon City

Barangay	Human population 2016	Area size in km ²	Human density	Number of HH	Mean dogs/ HH	Total owned dog population	Dogs/100 people
Bagong Silangan	90,361	5.948	15,192	21,014	1.49	31,353	34.70
Batasan Hills	163,520	5.921	27,617	38,028	0.58	22,056	13.49
Commonwealth	200,604	3.462	57,945	46,652	1.09	50,851	25.35
Holy Spirit	112,263	3.281	34,216	26,108	1.75	45,688	40.70
Payatas	132,600	3.21	41,308	30,837	0.89	27,340	20.62
District II Total	699,348					177,289	25.35

The number of studies of dog populations in developing countries has exploded in the 21st Century. As more data becomes available, more discrepancies between the results of different surveys have become apparent. One example are the different estimates of the dog population of Lilongwe, Malawi. The Lilongwe SPCA conducted a street dog survey in 2011, following WSPA guidelines (WSPA, 2007), and estimated a street dog population of 4,500 dogs. However a follow-up survey conducted by HSI in 2013 estimated the street dog population at about 36,500. We suspect this discrepancy is attributable to the lack of correction for detectability and limited survey coverage in the earlier survey.

The current survey also has come up with very different estimates of total dog populations in Quezon City. Table 2 shows a comparison of the dog population estimates of two different surveys for the five barangays, including the current survey results. Our results are more than double the earlier estimates reported by QCVD. Accurate estimates are important because they indicate the targets needed to achieve and maintain appropriate vaccination thresholds. The comparison indicates that the earlier survey results underestimated the dog population and hence inferred higher vaccination levels in the dog population than were probably actually achieved.

Table 2. Comparison between the QCVD dog population estimate and the estimates of this survey.

District II Barangay	Dog Population Estimate	QCVD Dog Population Estimate
Bagong Silangan	31,353	9,036
Batasan Hills	22,056	16,352
Commonwealth	50,851	20,060
Holy Spirit	45,688	11,226
Payatas	27,340	13,260
Total	177,289	69,935

Rabies vaccination coverage of pet dogs was overall high (60%) across the 5 barangays. The barangay Holy Spirit had the highest proportion of vaccinated dogs at 86.9%, while barangay Bagong Silangan had the lowest, at 39.3% (table 3).

The target vaccination coverage of 70% has proven to be sufficient in long-term rabies elimination programs across the world (Hampson, et al., 2009; Lapiz, et al., 2012; Townsend, et al., 2013) and has prevented major rabies outbreaks on no less than 96.5% of occasions (Coleman & Dye, 1996; Cleaveland, et al., 2003). Results from this survey suggest that vaccination coverage of 70% has only been achieved in the barangays Batasan Hills and Holy Spirit (table 3) and further efforts are needed to reach target vaccination levels in the other barangays.

Table 3. Summary table of vaccinated dogs recorded during the survey.

Barangay	Day	Number of dogs recorded during household survey	Number of vaccinated dogs recorded during survey	% Vaccinated dogs
Bagong Silangan	Day 1	178	61	34.3%
	Day 2	122	57	46.7%
	Total	300	118	39.3%
Batasan Hills	Day 1	67	56	83.6%
	Day 2	67	41	61.2%
	Total	134	97	72.4%
Commonwealth	Day 1	99	72	72.7%
	Day 2	87	47	54.0%
	Total	186	119	64.0%
Holy Spirit	Day 1	167	141	84.4%
	Day 2	85	78	91.8%
	Total	252	219	86.9%
Payatas	Day 1	91	44	48.4%
	Day 2	89	36	40.4%
	Total	180	80	44.4%
Total	Day 1	602	374	62.126%
	Day 2	450	259	57.556%
	Total	1,052	633	60.171%

The sterilization rate was overall low with only 6.75% of the dogs being sterilized (71 dogs out of 1,052). The highest percentage by barangay was recorded in Holy Spirit (17.9%), while the barangay Bagong Silangan had the lowest percentage (1.0%) (table 4)

Table 4. Summary table of sterilized dogs recorded during the survey.

Barangay	Day	Number of dogs recorded during household survey	Number of sterilized dogs recorded during survey	% Sterilized dogs
Bagong Silangan	Day 1	178	2	1.1%

	Day 2	122	1	0.8%
	Total	300	3	1.0%
Batasan Hills	Day 1	67	5	7.5%
	Day 2	67	0	0.0%
	Total	134	5	3.7%
Commonwealth	Day 1	99	5	5.1%
	Day 2	87	8	9.2%
	Total	186	13	7.0%
Holy Spirit	Day 1	167	29	17.4%
	Day 2	85	16	18.8%
	Total	252	45	17.9%
Payatas	Day 1	91	4	4.4%
	Day 2	89	1	1.1%
	Total	180	5	2.8%
Total	Day 1	602	45	7.475%
	Day 2	450	26	5.778%
	Total	1,052	71	6.749%

There is some indication that sterilization combined with vaccination campaigns can stabilize a population and help sustain a higher level of vaccination coverage. In Jaipur, the rapidly expanding capital of Rajasthan with a population of over 2.5 million people, Help in Suffering (HIS) started a pilot ABC program in 1994. On average, HIS has sterilized between 2,000-2,500 female street dogs every year starting in the Pink city and expanding outwards (Hiby, 2007). HIS, in collaboration with the Jaipur Municipal Council, sterilized and vaccinated 70,000 dogs between 1995 and the end of 2009 (Hiby et al., 2011). Population surveys in Jaipur indicated that 65.7% of female dogs and 5.8% of males (some prepubescent males were included but the program concentrated on females) had been covered through ABC (Reece and Chawla, 2006). Vaccination coverage of the whole population was 35.5%, not including a few animals that were vaccinated only (Reece and Chawla, 2006). Biannual street counts showed a slow but steady decline in the number of dogs on the street (28% decrease overall by 2005 – Reece & Chawla, 2006) but a rapid increase in the percentage sterilized over the first few years. The sterilization rate has now stabilized at around 70% (Hiby, 2007) but the street dog population has now declined by around 50% since the start of the program.

Reece and Chawla (2006) conclude that the combined sterilization and vaccination procedure of the ABC program may be an effective and humane method for controlling rabies in endemic areas with large populations of community dogs, and may also create a more stable, smaller street dog population. Furthermore, the cases of human rabies in the main government hospital declined to zero in the program area while there was no change in human rabies cases in the non-program areas (Reece & Chawla, 2006). The benefit of combining vaccination and sterilization programs is becoming more apparent.

As a means to evaluate the new population estimate a mark-resight survey was conducted during the vaccination drive in Payatas A and Payatas B (table 5).

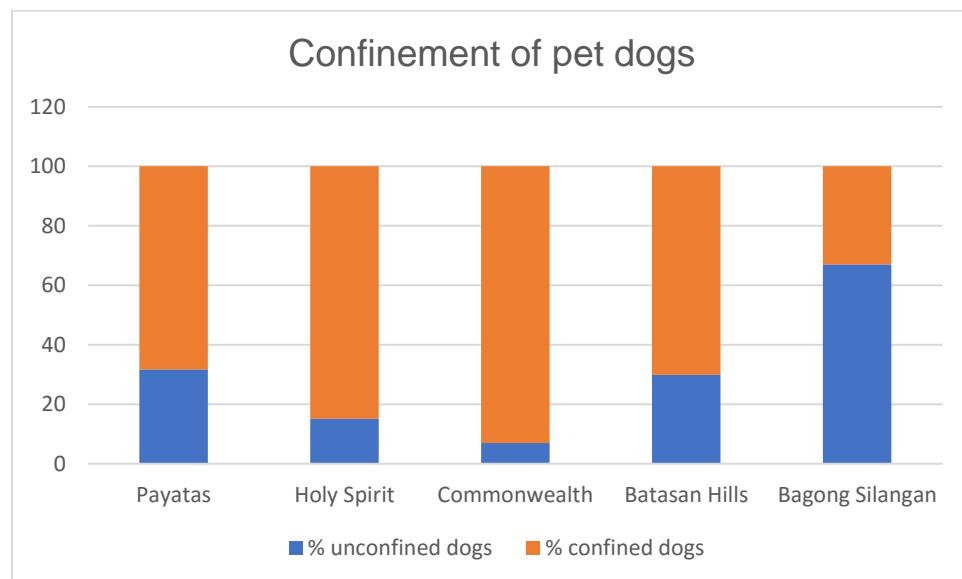
Table 5. Summary table of the predictive population data in comparison to the sight-resight method data.

Area	Human population	Number of households	Estimated number of dogs	Number of vaccinated dogs	% Vaccinated dogs	% Marked dogs (SR survey)
Predictive data derived from 2014 Barangay records						
Payatas A	56,455.3	11,459.7	10,085	1,560	15.47%	14%
Payatas B	35,118.3	9,841.3	8,660	1,468	16.95%	19%
Lupang Pangako	42,025.9	9,396.6	8,269	410	4.96%	
Barangay Payatas Total 2016	133,599.49	30,697.6	27,014	3,438	12.727%	
Data derived from 2016 City Planning Office records						
Barangay Payatas 2016	132,600	30,837	27,340	3,438	12.575%	

Confinement of dogs

About 33.17% of the owned dogs were allowed to roam freely at all times or at least once a day. Barangay Bagong Silangan, with 67% of the dogs roaming had the highest number of unconfined owned dogs while Barangay Commonwealth, with 7%, had the lowest number of unconfined dogs (figure 12). It should be noted, however, that owners might have felt uncomfortable admitting that their dogs roamed because of an existing city ordinance that mandates the fining of owners who allow their dogs to roam freely.

Figure 12. Summary table of unconfined dogs recorded during the household survey.



CONCLUSION AND RECOMMENDATIONS

The aim of this project was to provide an accurate estimate of the total number of owned dogs in District II of Quezon City, Philippines. The household survey additionally collected data on vaccination and sterilization status of owned dogs to inform a more effective and evidence-based mass rabies vaccination program.

It is estimated that there are 177,289 owned dogs in District II. The average number of dogs per household is 0.58 to 1.75 and there are 25 dogs per 100 humans in the district.

Vaccination coverage ranged from as high as 86.9% to as low as 39.3% per barangay. Barangays Batasan Hills and Holy Spirit were noted to have achieved the recommended 70% vaccination coverage.

Only 6.75% of the dog population was sterilized. The average percentage per barangay ranged from 1.0% to 17.9% of each of the barangay's dog population.

Combined with the high percentage of dogs being unconfined, dog reproduction rates are assumed to be high in the district. Over a third of the dog owners (33.17%) reported that they allowed their dog to roam on their own at least once a day. The average percentage of unconfined dogs ranged from 7.0% to 67% across the barangays, suggesting that law enforcement has not yet been successful in all parts of the district since confinement of dogs is mandatory by law. Promoting responsible dog ownership practices should be a key element in any proposed dog population program in the district, and confinement of dogs (tethering not included) should be promoted widely, not only to minimize rabies spread but also to address dog overpopulation issues due to uncontrolled breeding.

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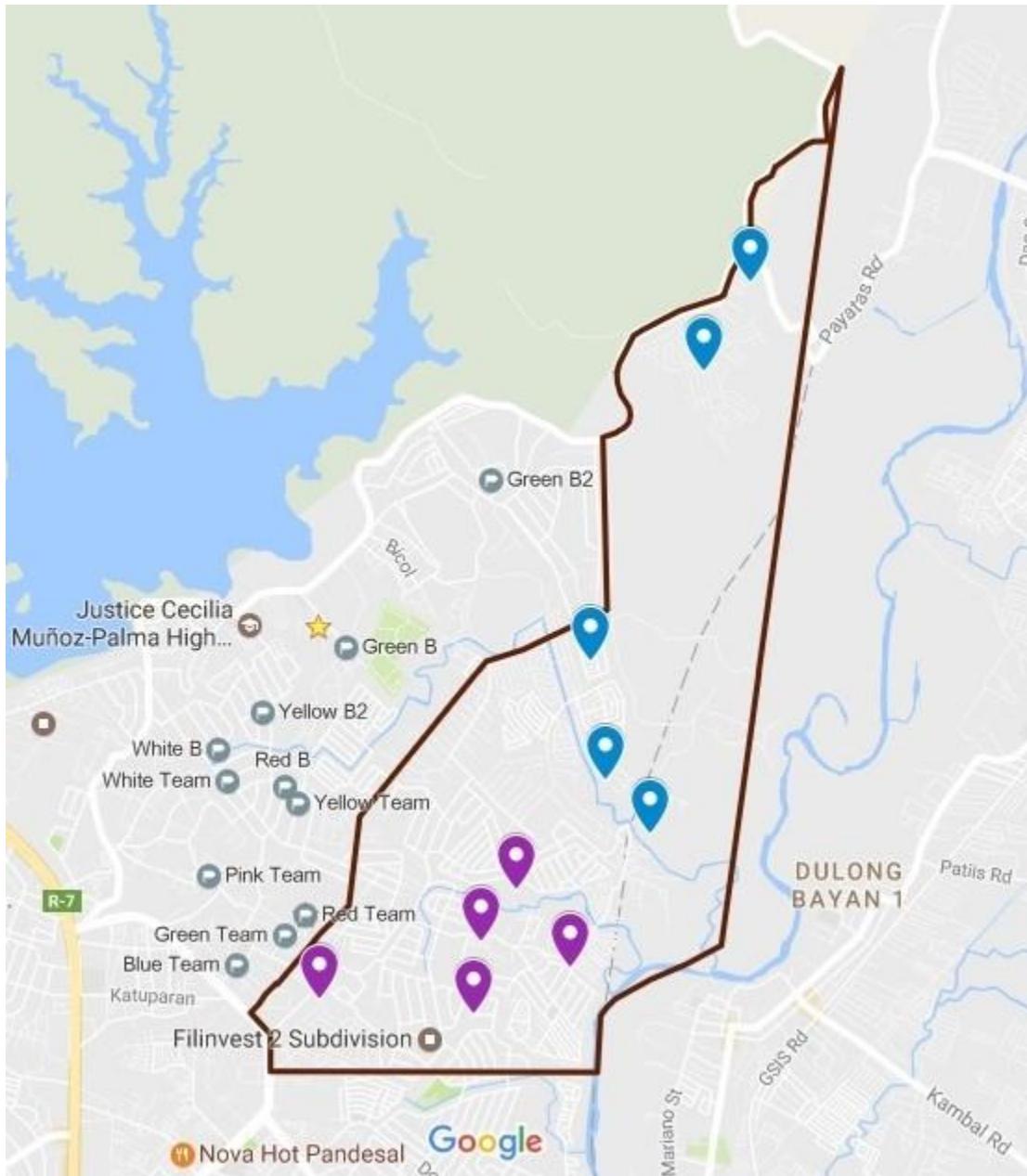
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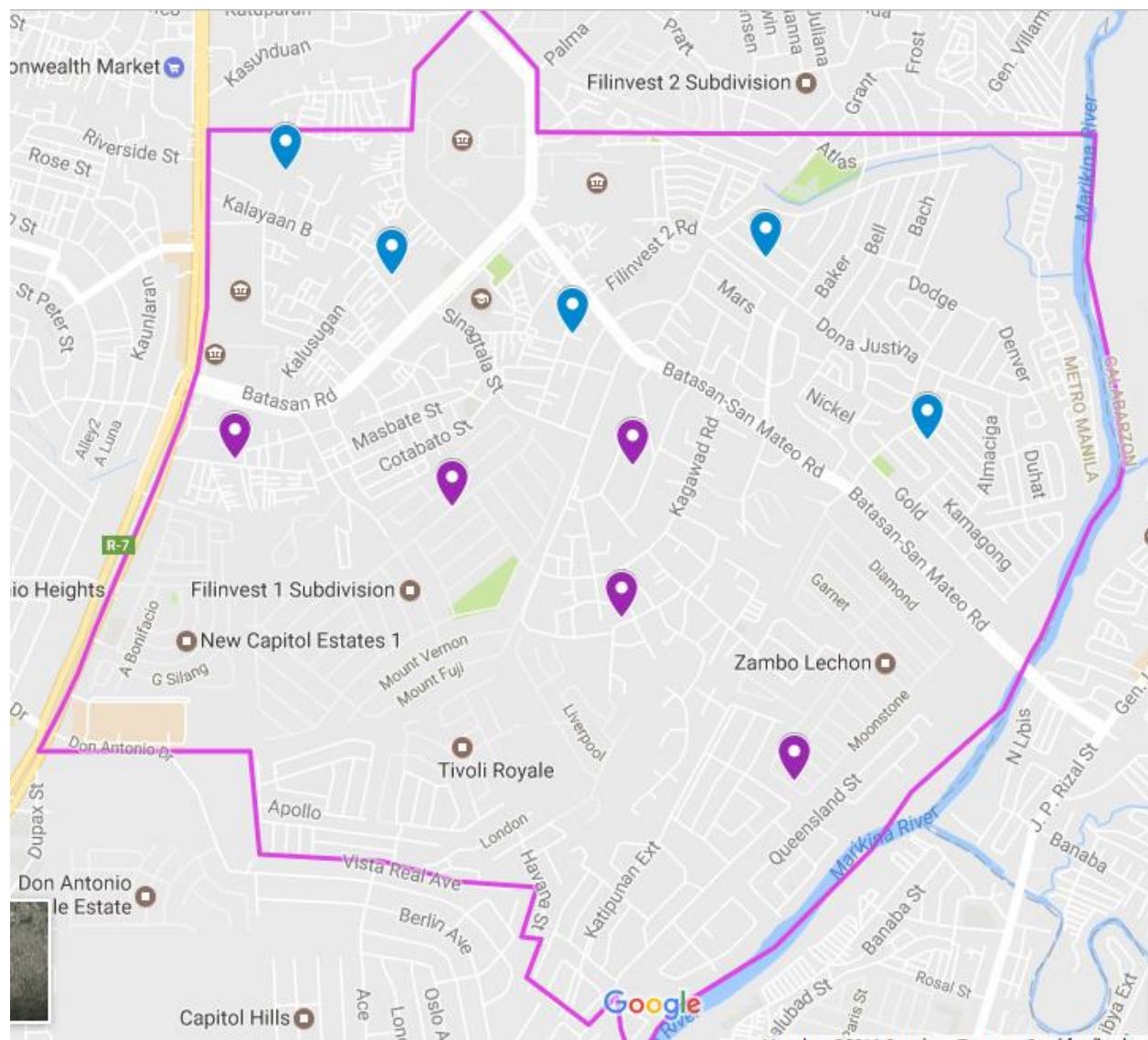
WINDIYANINGSIH, C. et al. 2004. The rabies epidemic on Flores Island, Indonesia (1998-2003). *Journal of the Medical Association of Thailand*. 2004 November; 87(11): 1389-1393. Bangkok, Thailand: The Medical Association of Thailand. Retrieved from
<http://www.jmatonline.com/index.php/jmat/article/view/7564>. Accessed on December 2016.

APPENDICES

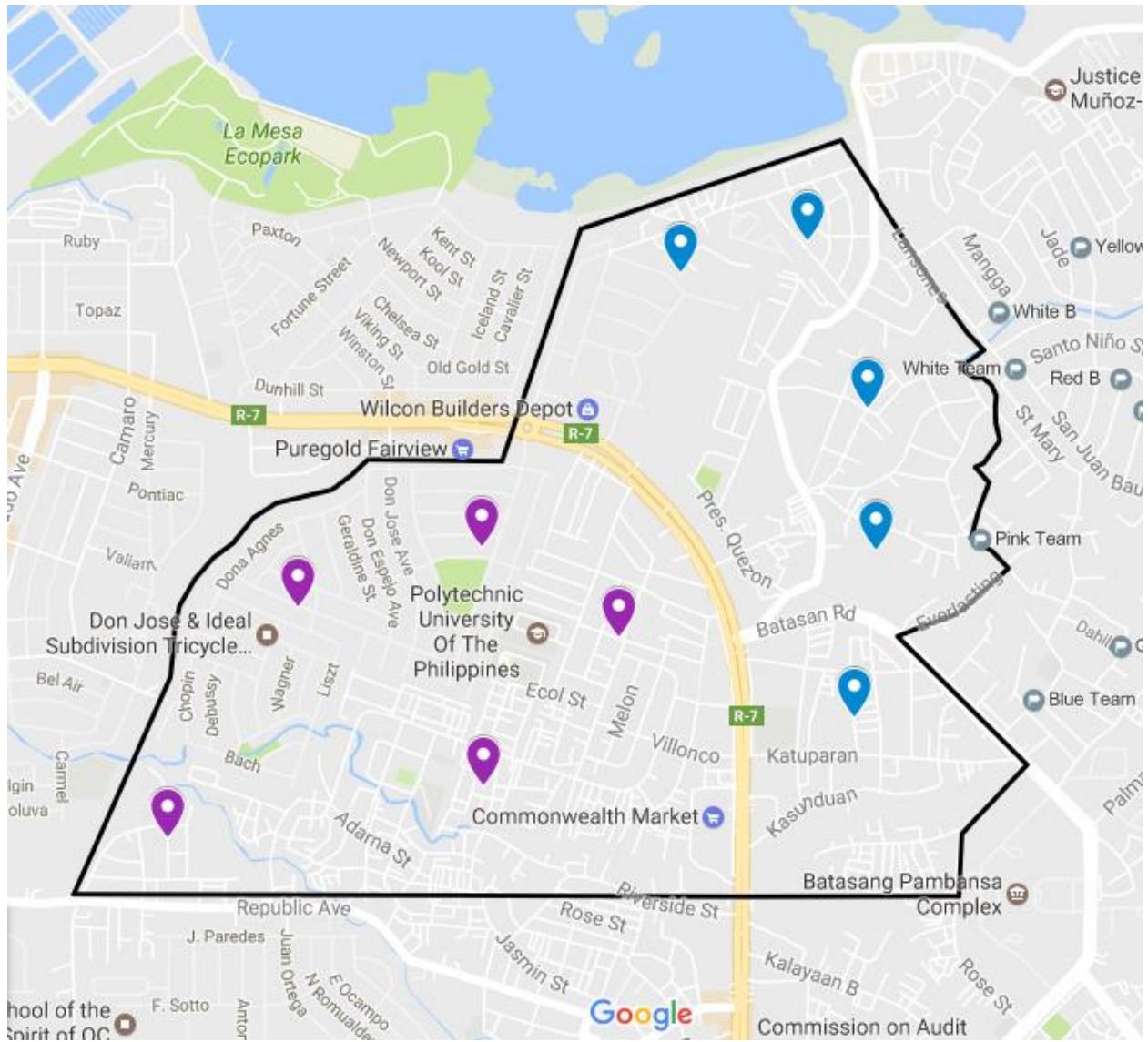
Appendix 1. Location map of area 1: Barangay Bagong Silangan.



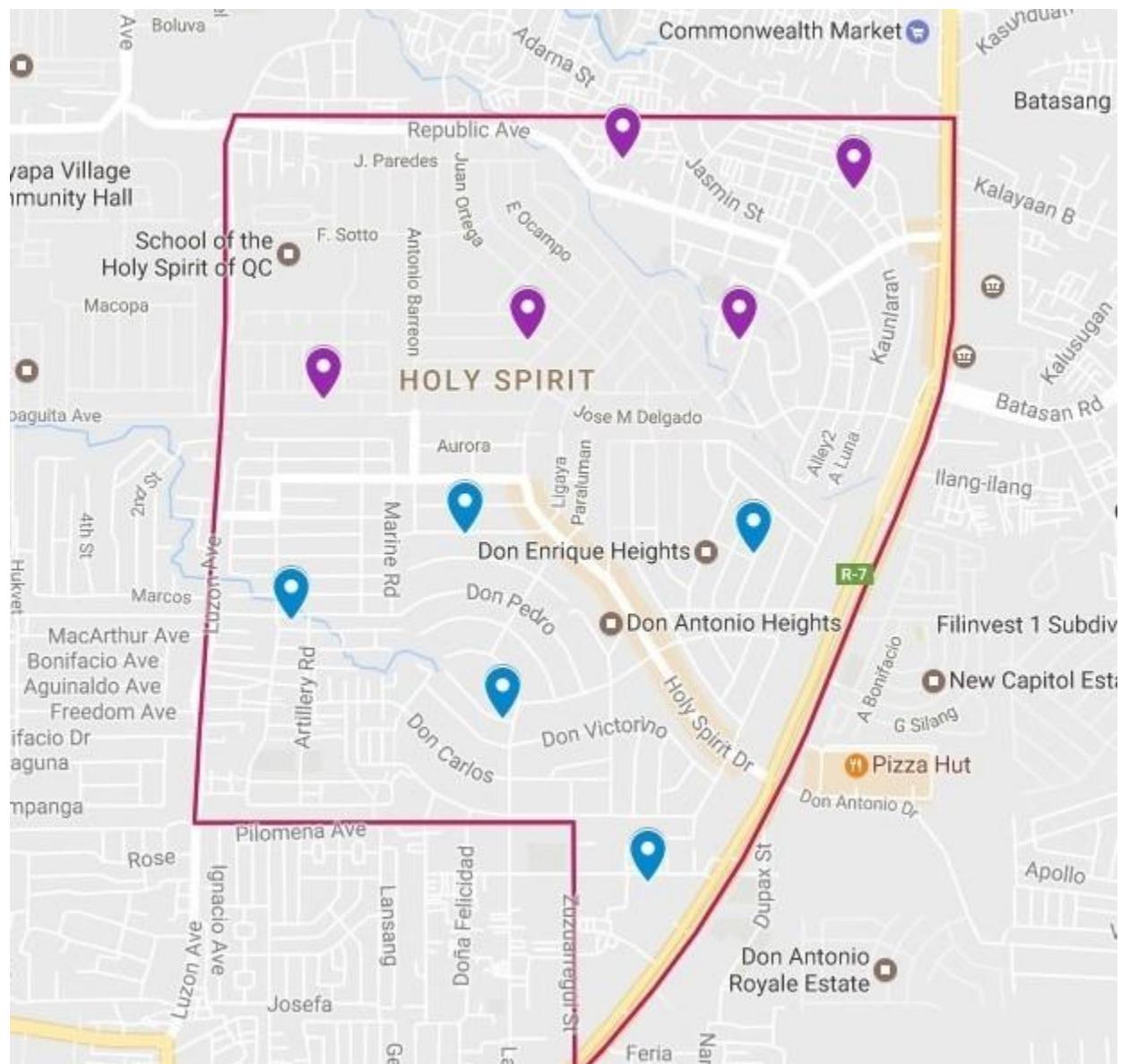
Appendix 2. Location map of area 1: Barangay Batasan Hills.



Appendix 3. Location map of area 1: Barangay Commonwealth.



Appendix 4. Location map of area 1: Barangay Holy Spirit.



Appendix 5. Location map of area 1: Barangay Payatas.

