Conference Paper

Effects of Rabies Elimination Program on Rabies Cases in Bali, 2008–2015

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Abstract

Rabies is zoonotic disease that can be fatal to the infected host. Indonesia has reported cases in Bali in 2008, since when the government has been taking action to eliminate the disease with a strategy of vaccination of dogs as its main focus. This research aims to describe rabies cases in dogs and humans and to measure the effects of the rabies elimination program in Bali during the period 2008–2015. Data covering this period are collected from the Livestock and Animal Health Service Bali, Human Health Service Bali, and Disease Investigation Center Kota Denpasar. The study design is an observational, ecological investigation analyzed with the Poisson panel method. The results of the analysis show that there were no significant changes in the mean and proportion of rabies cases in dogs by dog vaccination, area coverage of dog vaccination, dog depopulation or dog density. The factors of rabies cases in dogs, depopulation in dogs, dog bites, anti-rabies vaccines administered to bitten humans, and the ratio of humans to dogs were not associated with the occurrence of rabies cases in human. In conclusion, the rabies elimination program in Bali has not been successful in eliminating the prevalence of the disease. Vaccine data, which may be causally relevant, were not analyzed. Therefore, it is suggested that the efficacy of the vaccine used be assessed.

Keywords: rabies, elimination, Bali, Indonesia.

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1. INTRODUCTION

Rabies is a fatal viral disease that has been reported in almost all continents. According to the Centers for Disease Control and Prevention (CDC) and World Health Organization (WHO), rabies incidents are mostly reported in developing countries, such as in Africa and Asia, including Indonesia [1, 13]. Bali is one of the provinces in Indonesia that has reported incidents of rabies in human and animals. The first case was reported

in southern Bali, in 2008, in a human who died after being bitten by suspected rabid dog [12].

Rabies not only causes problems in the field of public health but is also a burden to the economy. Besides addressing the 100% mortality in the infected host, therefore, rabies elimination programs are also directed at the macro-economy impact of the disease [11]. Over three million US dollars has been spent on the rabies elimination program in Indonesia. Worldwide, a total budget of some 585 million USD was allocated to tackling the disease in 1996–2000, but 85% for post-exposure in humans and only 10% used for prevention of rabies in dogs [4, 8].

Bali has come to the public's attention as one of the most popular tourist destinations in the world. It also has a traditional culture raising dogs as home-guards, with the dogs either kept in houses or left to roam freely in the roads. This poses a risk for wider rabies transmission if the unvaccinated population and infected dogs stray into public places. The Bali local government has thus initiated control measures to eliminate rabies by implementing dog vaccination as the main tool, along with a program of selective depopulation in dogs, prophylaxis administration of anti-rabies vaccine in humans bitten by dogs, and raising public awareness [3]. The impact indicator of the success of this program is the reduction of rabies cases in animals and humans.

The objective of this study is to describe rabies cases in dogs and humans and to measure the effects of the rabies elimination program on rabies cases in Bali during the period 2008–2015. The Indonesian government has committed to the development of a roadmap of priority diseases, one of which is rabies, aiming to achieve freedom from them by the year 2020, [2]. It is expected that the results of this study can benefit the Indonesian government regarding its strategy of rabies elimination on a scientific basis.

2. METHODS

The study had an observational and ecological design. Secondary data covering 2008–2015 were obtained from the Department of Animal Health, Department of Human Health, and the Disease Investigation Center in Bali. The data were statistical analyzed using the Poisson panel method. The variables for analysis were rabies cases in dogs and humans, number of vaccinated and depopulated dogs, area of vaccination coverage, dog density, number of humans bitten and given prophylaxis, and the ratio of humans to dogs.

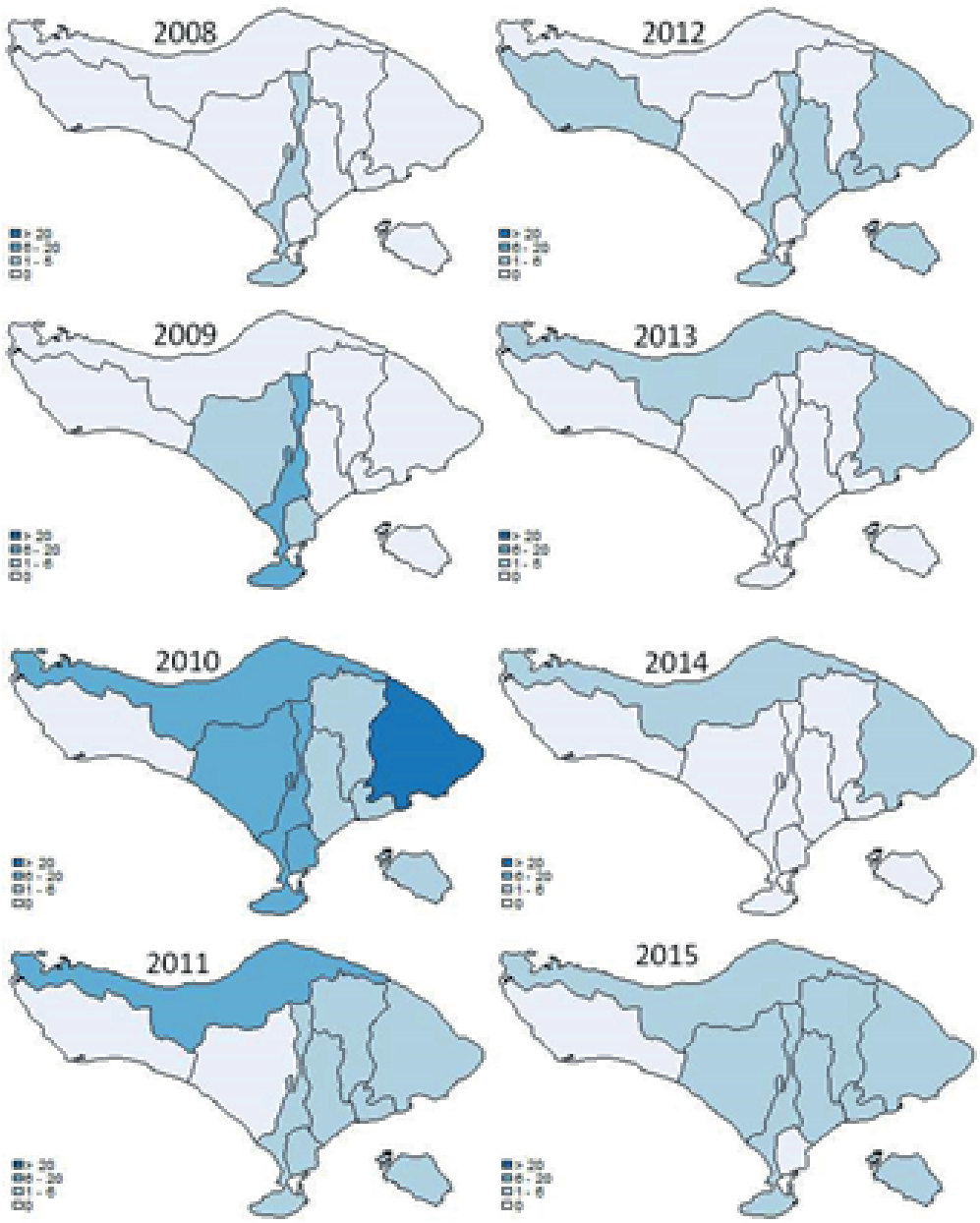

Figure 1: Rabies cases in humans.

The data is statistically analyzed to 1) describe the variables and measure the mean change and change in the proportion of rabies cases in dogs due to the effect of the rabies vaccination in dogs, vaccinated villages, depopulation in dogs, and the density of dogs, and 2) analyze mean change and change in the proportion of rabies cases in humans as an effect of the incidence of rabies cases in dogs, as well as changes in the incidence of dog bites, prophylaxis in humans, ratio of human to dogs, and dog depopulation.

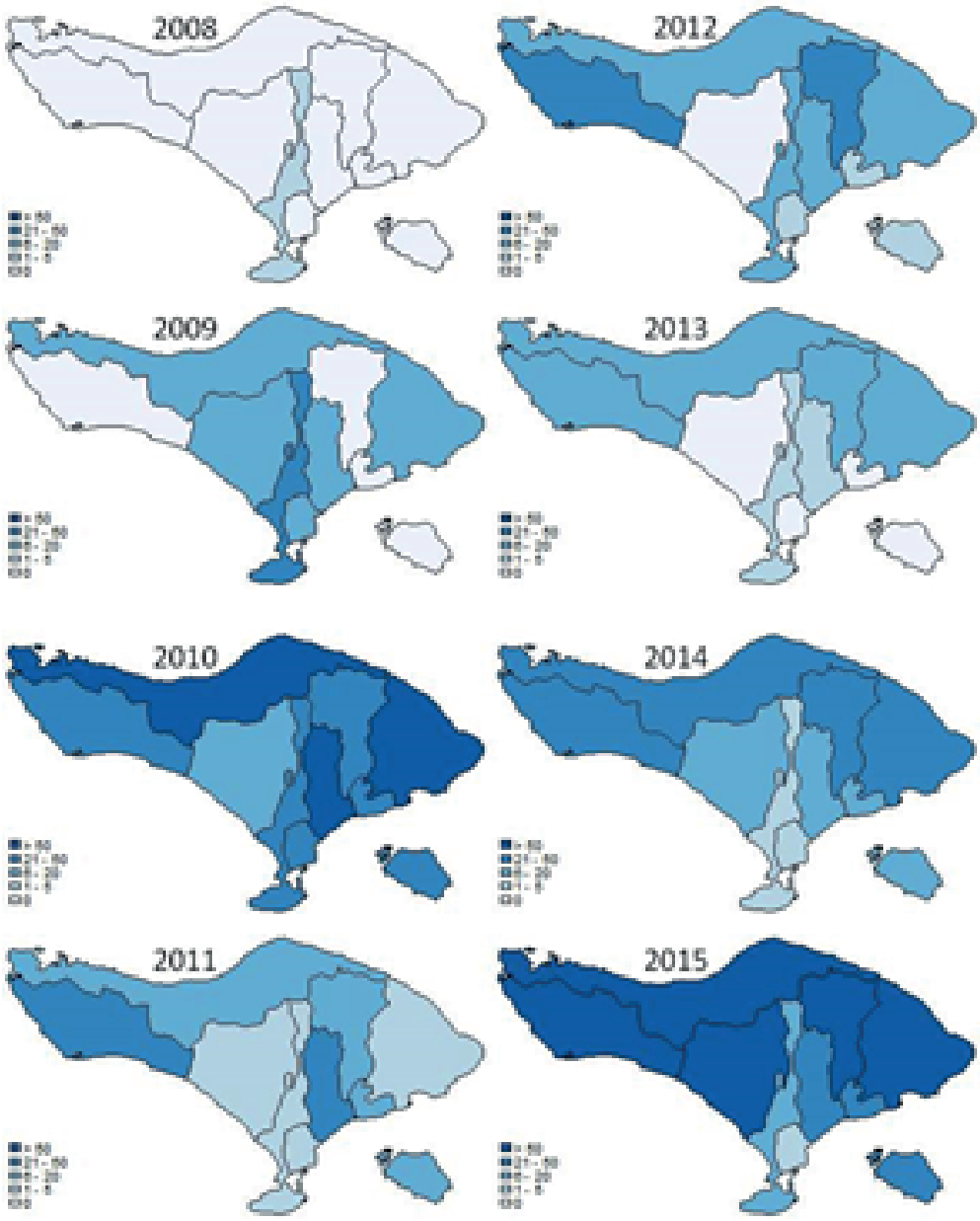

Figure 2: Rabies cases in animals.

3. Results

The first rabies case was reported in the Badung district in 2008 and caused human death. Cases in animals and humans were then found in all the districts of Bali in the following years (see Figures 1 and 2).

The average time for death after victims were bitten was 3.8 months, ranging between 0 and 19 months. Rabies vaccination in dogs was initially conducted only in

Table 1: Rabies cases in humans in Bali, 2008–15.

Variable	Frequency	Percentage (%)
Type of animal bites		
Dogs	161	98.77
Other (unspecified)	2	1.23
Vaccine anti-rabies completion		
Yes	2	1.23
No	161	98.77
Sex		
Female	62	38.04
Male	101	61.96
Age group		
Toddler (0–5 years)	8	4.91
Childhood (6-11 years)	17	10.43
Teenager (12-25 years)	26	15.95
Adult (26-45 years)	53	32.52
Old (>45 years)	59	36.2
District		
Badung	24	14.72
Bangli	7	4.29
Buleleng	35	21.47
Gianyar	11	6.75
Jembrana	3	1.84
Karangasem	42	25.77
Klungkung	11	6.75
Kota Denpasar	11	6.75
Tabanan	19	11.66
Time difference between human bitten to death (months):		
Mean: 3.80		
Median: 3		
Minimum: 0		
Maximum: 19		

the Badung and Kota Denpasar districts. The number of dogs vaccinated was increased, and vaccination was implemented in all areas in the following years (Figure 3).

Depopulation in dogs was also implemented as part of the program in all districts. The figures show that the highest dog depopulation was conducted in 2010. The estimated dog population was far below the depopulation, however, except in Klungkung (Figure 4).

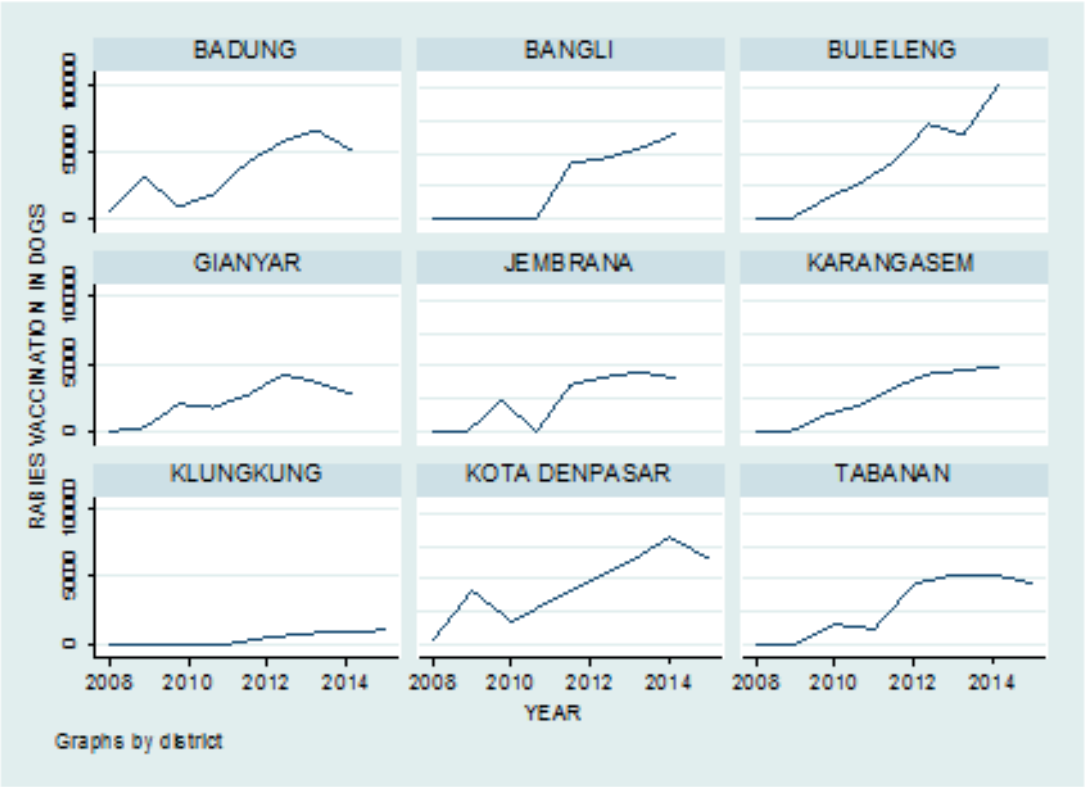

Figure 3: Rabies vaccination in dogs.

Table 2: Ratio of human and dogs.

District	Estimated dog population (average 8 years)	Mean	Std dev	Minimum	Maximum
Badung	62,964	8	2.4	6	13
Bangli	51,007	4	1.59	3	8
Buleleng	72,483	9	2.38	7	13
Gianyar	54,187	8	1.95	7	12
Jembrana	35,092	8	2.2	6	12
Karangasem	38,964	12	5.17	7	20
Klungkung	10,444	22	10.1	8	33
Kota Denpasar	52,130	13	3.9	8	20
Tabanan	43,493	10	1.8	8	13

The ratio of humans to dogs in Bali varies by district; on average, the ratio for the period covered was 8:1, Klungkung was highest at 20:1, and the lowest was 4:1, in Bangli (Table 2).

The reported numbers of humans bitten by dogs averaged 4,025 across the study years, with the highest in 2010, at 10,289. The anti-rabies vaccine was also given to the victims, following the number of bites cases (Figures 5 and 6).

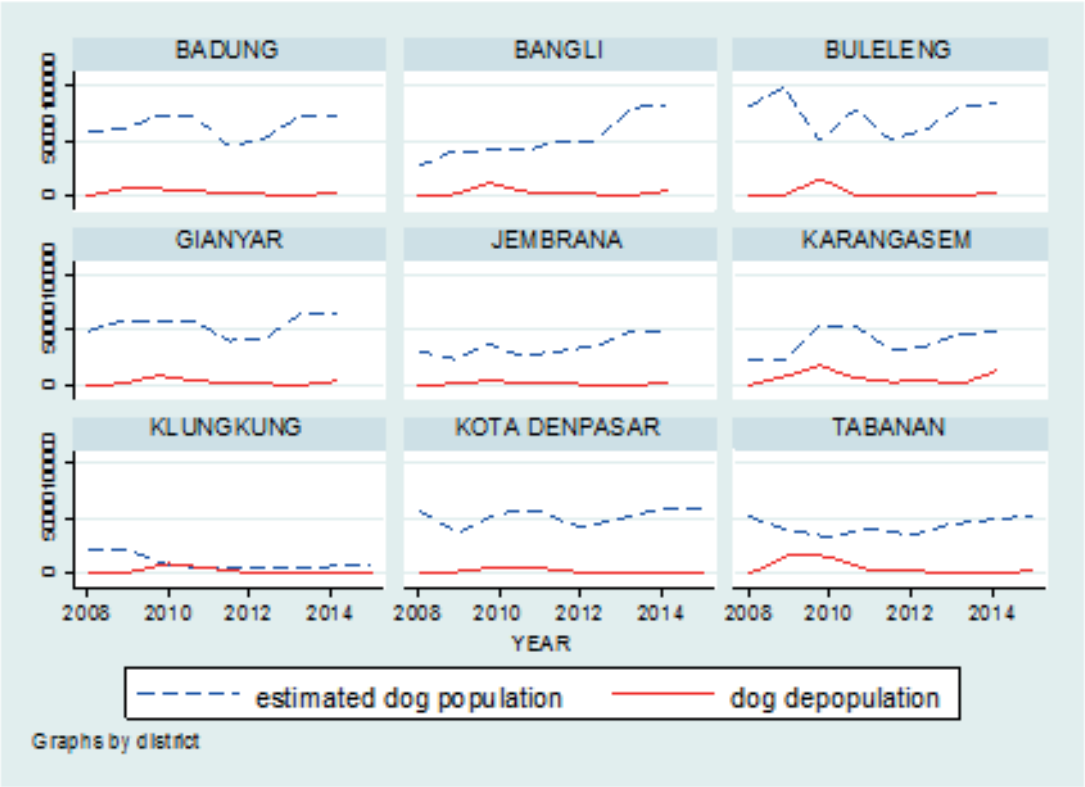

Figure 4: Depopulation in dogs compared to estimated dogs population.

Table 3: Effect of rabies elimination program on rabies cases in dogs.

Variable	Mean change	Proportion change
Rabies vaccination in dogs	1.0 (1.000028–1.000037)	1.0 (1.000024–1.000033)
Dog depopulation	1.0 (1.00016–1.00018)	1.0 (1.00016–1.00019)
Vaccination area coverage	0.86 (0.68–1.10)	0.99 (0.7–1.2)
Dogs density	1.0 (1.0039–1.0094)	0.99 (0.9–1.0)

The association between outcome and predictor variables is described in scatter plots (Figure 7). These show that there was no significant correlation between cases and predictors.

The effect of predictor variables is measured using the panel Poisson method. Table 3 shows that the combined elimination program of rabies vaccination in dogs and dog depopulation did not reduce the number of rabies cases in dogs, and the increase of vaccination area coverage did not significantly reduce the cases in dogs, either. It is also shows that the number of rabies cases in dogs increased with dog density.

Table 4 shows that giving humans a prophylaxis anti-rabies vaccine did not reduce the rabies cases in humans. Dog depopulation also failed to reduce rabies cases. This shows that the increases of rabies cases in dogs and dog bites increased the incidents

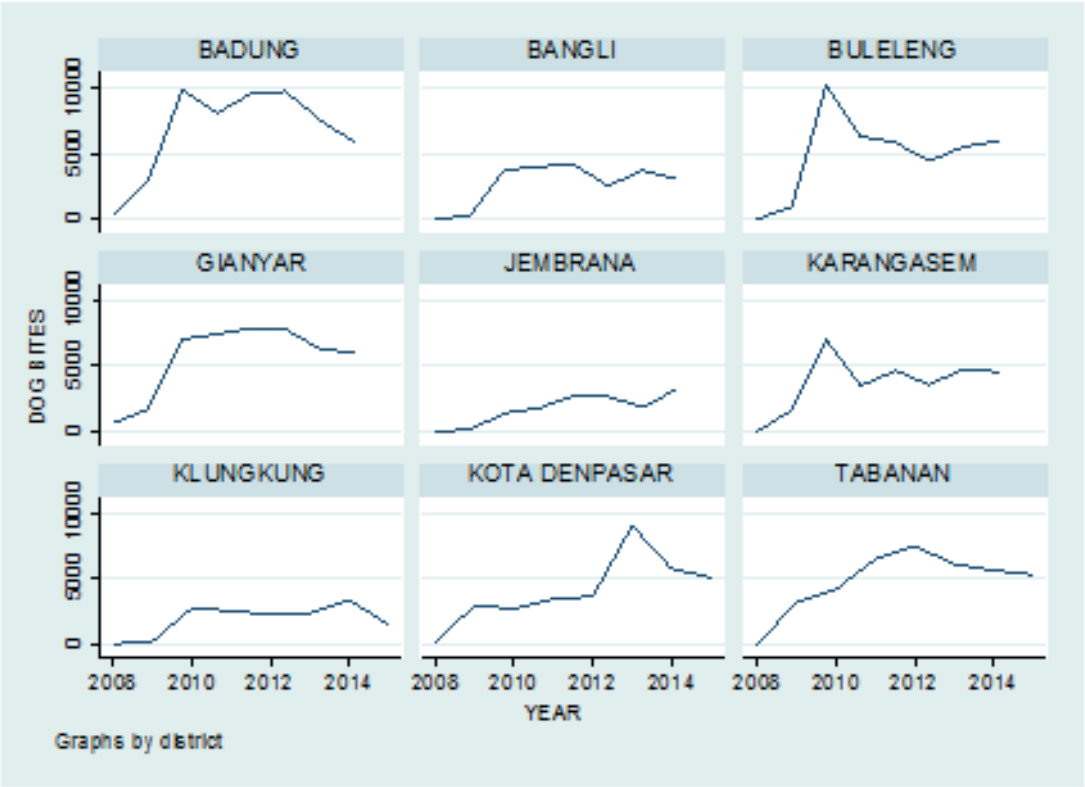

Figure 5: Dog bite cases.

Table 4: Effect of rabies elimination program on rabies cases in humans.

Variable	Mean change	Proportion change
Rabies in dogs	1.0 (0.9–1.0)	1.0 (0.9–1.0)
Dogs bite	0.99 (0.9991–0.9998)	0.9 (0.9991–0.9997)
VAR	1.0 (1.0002–1.0009)	1.0 (1.0003–1.001)
Dogs depopulation	0.99 (0.95–1.04)	0.9 (0.95–1.04)
Ratio human and dogs	1.0 (1.0001–1.0002)	1.0 (1.0001–1.0002)

of rabies in humans, while the increased ratio of humans to dogs did not reduce rabies cases among humans.

4. Discussion

Rabies case data is related to rabies surveillance in animals. The first rabies case was detected in humans and only later in animals. This suggests that the surveillance of rabies in animals was originally not well carried out. The clinical signs of rabies in dogs are usually not noticeable, especially if the rabid dog is still at the prodoromal stage. In general, rabies is shown by the changing behavior of the animal, and usually the dog owners are the people who can identify unusual behavior of their dogs [9, 10]. This

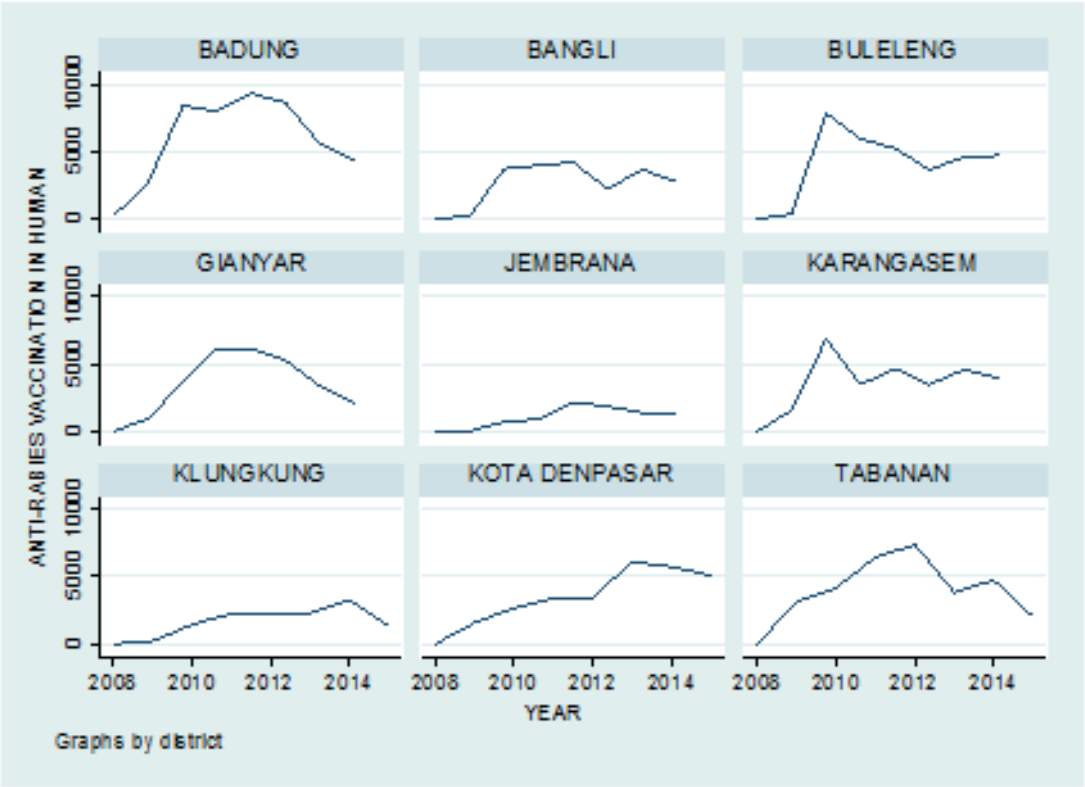

Figure 6: Rabies anti-prophylaxis.

suggests that public awareness of community needs is important to help veterinary services increase sensitivity in detecting the clinical signs of rabies in dogs. In addition, it is important to obtain the number of total samples collected from animals to better assess the surveillance of rabies in animals.

In Bali, rabies vaccinations of dogs between 2008 and 2015 did not reduce the case. There are many factors that may have contribute to this failure, such as vaccinations not being completed and the use of an insufficiently effective vaccine. It is advisably, therefore, that further analysis be conducted related to vaccine efficacy.

According to the results analyzed, the rabies vaccination coverage area in the years 2008 to 2011 was low. Nearly all villages were visited under the vaccination program in the years 2012–14, while the villages visited for the vaccination program in 2015 slightly decreased. There is need to evaluate why all villages were not covered in 2015.

The selective dog depopulation aiming to reduce the population of dogs was carried out to reduce the risk of rabies infected dog bites of animals and humans. However, with an estimated dog population in Bali of around 500,000 dogs, the dog depopulation percentage is low at 0.7–2%. However, dog depopulation may not reduce the likelihood of transmission since the dog dynamics are also influenced by birth and migration,

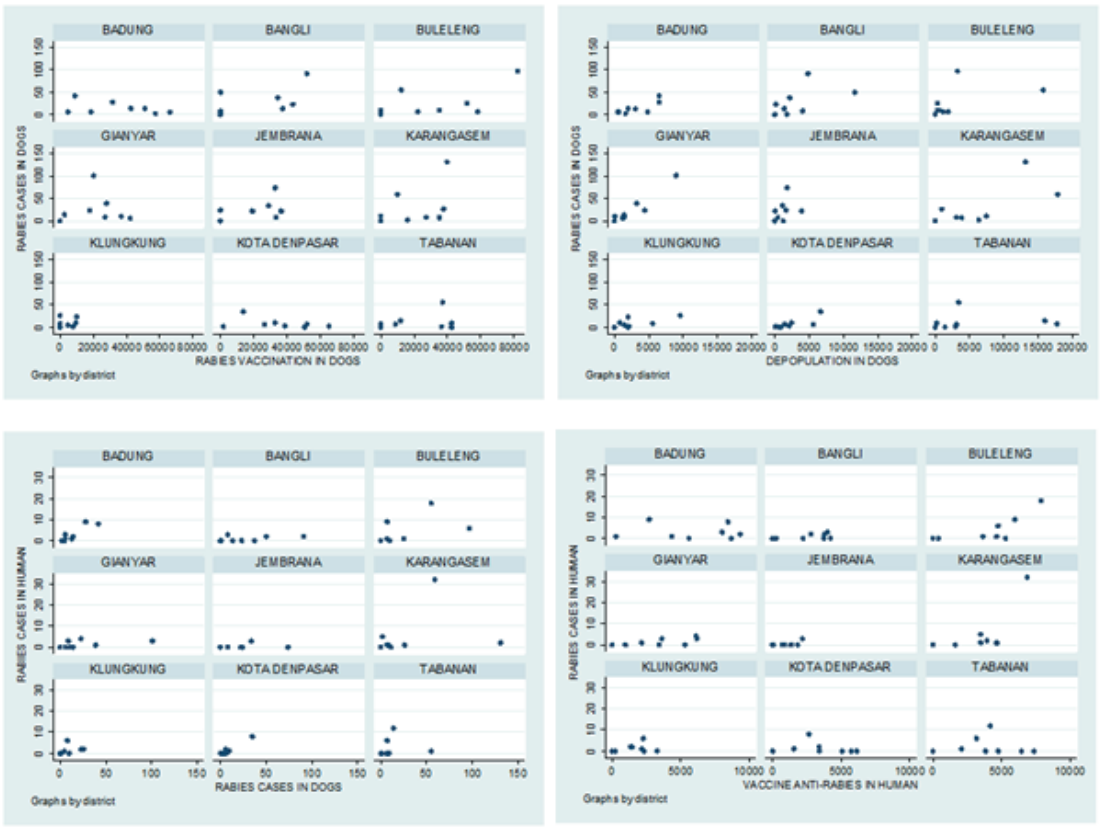

Figure 7: Association between rabies cases and its predictors.

which was not measured in this study. It is suggested that dog dynamics are analyzed in the future to gain a better understanding of the factors related to rabies transmission in Bali.

The rabies elimination program in humans focusing on prophylaxis treatment did not reduce the cases either. Based on a descriptive analysis, two victims died even though they had received completed anti-rabies vaccination. It should be evaluated further why these people failed to survive, despite the treatment. It may also be suggested that the elimination program should have more focus on the prevention of rabies in dogs with a one-health concept [5].

5. Conclusions

The rabies elimination program in Bali between 2008 and 2015 did not successfully eliminate the cases. There are many factors that may have mitigated against the success of the program but which are unknown at present, such as vaccine type and rabies surveillance in dogs. Therefore, the government should evaluate the efficacy

of the vaccine used. It is also important to correctly assess the number of targeted vaccinations in dogs.

Acknowledgments

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