THE USING OF PARTICIPATORY EPIDEMIOLOGY (PE) APPROACH IN SUPPORTING OF RABIES CONTROL PROGRAM IN DISTRICT OF KARANGASEM, BALI, INDONESIA

Basri C[1], Suandy I[2,] Mariner J[3], Hendrickx S[3]

[1] Department of Animal Disease and Veterinary Public Health, Faculty of Veterinary Medicine. IPB University.
Jl. Agatis, Kampus IPB Dramaga, Bogor. Indonesia
[2] Directorate of Veterinary Public Health Services, Directorate General of Livestock Services, Ministry of Agriculture, Republic of Indonesia, Bogor, Indonesia.
[3] International Livestock Research Institute (ILRI)

ABSTRACT

The effort to control rabies in Bali requires an alternative approach to surveillance system that is cheaper, more effective and was validated such as participatory epidemiology (PE) technique. PE study was conducted to analyze the incidence of rabies and other things associated with the event using the PE. The study was conducted in 12 villages in four subdistricts randomly selected in District of Karangasem, Bali province. Data were collected by a group discussion using the techniques developed in PE as simple ranking, proportional piling, matrix scoring, seasonal calendar and mapping. The results of this study showed in the District of Karangasem found various animals that could transmit rabies as dogs, cats, bats, squirrels and monkeys. Dogs are non-livestock animals most commonly found in the environment and the most important role in people's lives. About 20% of all dogs in the area are estimated to have the disease, including rabies problem. The problems of rabies in dogs in the region are expected to have morbidity of 3.6 %, mortality of 3% and case fatality of 81.8%. In general, the incidences of dog bites on humans have increased, especially in the months of April and June. The pattern of increased incidence of bites do not occur simultaneously with an increase in the number of breeding dogs at breeding season (February-April) and increased number of cultural and religious ceremonies (April and August). Our study revealed, that PE is a useful approach in an effort to control non-livestock animal diseases such as rabies. Based on our experiance, PE could be a useful tool to evaluate the success of public awareness program concerning rabies in Bali.

Keywords: participatory epidemiology, rabies, Karangasem, Bali

Introduction

Rabies is one of important diseases for the public health. Unfortunately, it is often put behind mostly in developing countries (Taylor and Nel, 2015). In Indonesia, several rabies cases have been reported in the last decades. Since 2004, it occured in Maluku (Kementan 2004), West Borneo (Kementan 2005), North Maluku (Kementan 2005), and then continue to Bali in 2008 (Kementan 2008), West Java and Banten in 2009 (Kementan 2009), and 2010 in North Sumatra (Kementan 2010).

Bali itself was one of the islands in Indonesia which historically free from rabies disease (Susilawathi *et al.*, 2012). When rabies was first reported, the disease then spreaded

rapidly and uncontrolable to almost every regions of the island (Clifton, 2010). The high population of stray dogs in Bali island, as well as the existence of other rabies-transmitter animals (rabies vector) such as cats, and monkeys within the heavily populated dogs, were the supporting factors for transmitting rabies disease rapidly (Putra *et al.* 2013). In a survey conducted by Balai Besar Veteriner Bali (Disease Investigation Center-Bali) showed that from 3,500 dogs randomly selected in 8 different regents in Bali as samples, approximately 400 dogs (11.4%) were infected by the rabies virus.

In 2009 to 2015, the numbers of dog bite case in humans increased significantly. There were 274.792 bite cases happenned in Bali with 161 of them resulted in death. (Santhia and Sudiasa, 2019) This was the largest outbreak ever happened in Bali.

In effort to control and eliminate the infectious disease such as rabies, a well-organized surveillance system is needed (Townsend *et al.,* 2013). The recent surveillance system applied needs a use of numerous resources, particularly high-cost financial support as well as adequate human resources. Commonly in developing countries as Indonesia, financial support to control infectious disease and professionals or experts to complete the surveillance program are limited. This will affect the rabies controling in Bali. Hence, a relatively low-cost, more effective and World Animal Health Organization (OIE)-approved approaches is required as an alternative of surveillanvce system.

The study of participatory epidemiology (PE) is one of surveillance method that is approved by OIE. Compare to other epidemiology surveillance method, PE technique is considered less expensive and very compatible for countries with limited financial support. In addition, this technique enables us to identify health problems in certain regions promptly by studying the local people's knowledge. PE technique also enhances the comprehension of distribution and determination of certain disease in a population, based on the locals'knowledge in a social context. By participating actively, the locals are expected to have role in protecting their neighborhood and sorrounding from the danger of infectious disease.

By means of studying the participatory epidemiology (PE), we intend to be able to understand further about the locals' perception and knowledge related to rabies in effort to support the continous program of controlling and preventing rabies. The result of this study will be reported and maintained to what have been done recently in Bali.

Materials and Methods

The research was conducted in Karang Asem, Bali. This regent is located in the east side of the island (Figure 1) and known as one of the regents in Bali where the locals perform strong custom. Based on the data from the local livestock service, two rabies cases in human from approximately 3,500 cases of dog biting were reported in the beginning of 2011 and resulted in deaths.
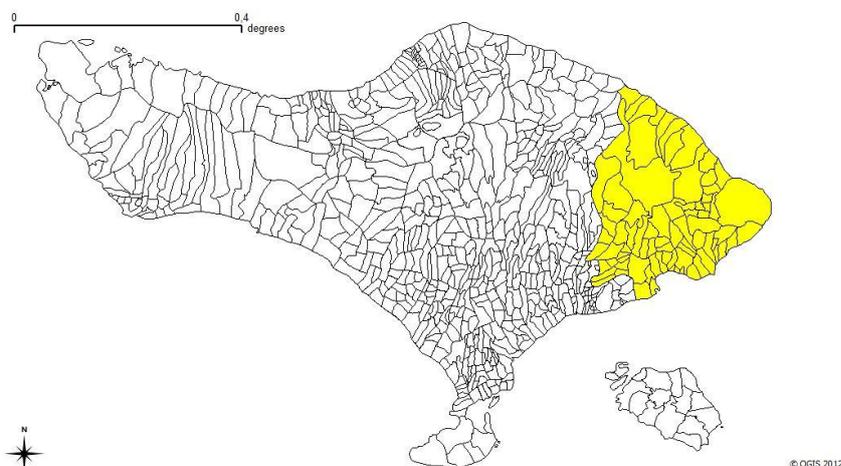
Figure 1. Karang Asem Location in Bali Province (yellow-colored).

In this research, villages were determined as sampling unit. Karang Asem consists of 8 counties, 68 villages, and 608 small villages (known as *banjar*). Four of eight counties were selected randomly, as well as three villages from those counties. Random counties and villages as sampling sites are shown in Table 1.

Table 1. List of Random Counties and Villages in Karang Asem

No	Name of Counties	Name of Villages
1	Manggis	Antiga, Ulakan and Selumbung
2	Abang	Ababi, Bunutan, and Pidpid
3	Bebandem	Bungaya, Bebandem and Bungaya kangin
4	Kubu	Tianyar tengah, Baturinggit dan Sukadana

This research involved several stakeholders: villagers; village and small villages chief; local health and livestock services staff. Limited discussion by several groups conducted toward ten until fifteen selected persons from each village. The selection of persons who would involve in the discussion groups would be determined by the local service staffs and the locals'chiefs. Interviews held at least once a day, and implemented if all the members of the discussion groups were all set.

The concept of the interview arranged to explore knowledges, perceptions, and common practices perform by the locals related to the rabies outbreak. Obtained informations through the interviews scored and ranked regarding to the consensus result of the groups. Several tools which are commonly used in PE technique includes seasonal calendar, timeline, mapping, and matrix scoring (Catley *et al*. 2012) also applied in these groups to assess the impact of rabies incident in the community according to the groups comprehension and consensus.

Qualitative and semi-quantitative data explored by using PE technique. Qualitative data concluded descriptively, while semi-quantitative data analyzed by using SPSS 16.0.

Results

Regarding to the consensus result of the participants, the orders of the animals from the highest amount of their population are listed below in Table 2.

Table 2. List of the Animals by the Amount of Their Population

No	Type of Animals	Score	Order
1	Dog	96	1
2	Bird	81	2
3	Cat	73	3
4	Fighting Cock	53	4
5	Bat	39	5
6	Rat	37	6
7	Monkey	30	7
8	Swan	6	8
9	Squirrel	5	9

As a result of the discussion, the locals mentioned several animals as listed orderly from the most to less important in their lives in Table 3. The word 'important' at this point refers to animals which related to diseases, or might having roles as source of income, or their existences were frequently found around the area (due to their high population)

Table 3. List of Important Animals in People's Lives

No	Type of Animals	Score	Order
1	Dog	138	1
2	Cat	121	2
3	Bird	111	3
4	Fighting Cock	68	4/5
5	Monkey	68	4/5
6	Bat	25	6
7	Eel	10	7
8	Swan	9	8
9	Squirrel	8	9
10	Weasel	8	10
11	Rabbit	8	11
12	Porcupine	8	12

In this discussion, participants were also asked to select and rank those animals around them which they considered to have main role in transmitting the rabies disease (rabies vector). Among those animals mentioned above, six animals were considered as rabies vector (Table 4).

Table 4. List of Animals Considered as Rabies Vectors

No	Type of Animals	Score	Order
1	Dog	60	1
2	Cat	50	2
3	Bat	20	3
4	Monkey	18	4
5	Squirrel	8	5
6	Rat	7	6

By using the piling proportional technique, the participants were asked to estimate the percentages of dog-keeping systems which consist in three categories: stray dog; semi-stray dog; captive dog. The consensus result can be seen in Figure 2.
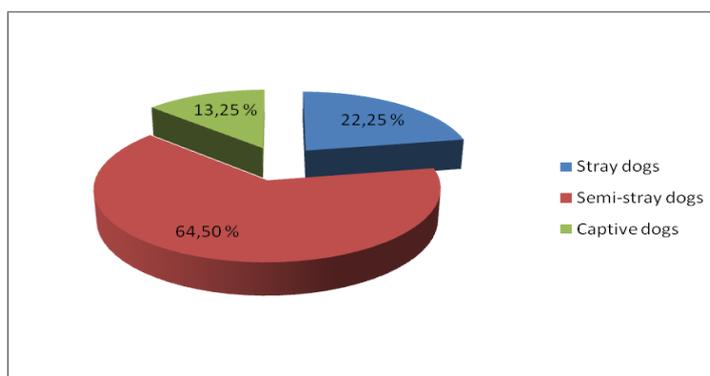

Figure 2. Dog-keeping System in Karang Asem According to the Locals' Perception

In the discussion, piling proportional technique was applied in order to estimate the morbidity and the mortality rate of dogs. The participants were also asked to estimate the health status (in healthy or sick condition) of the dogs around them regarding to the percentages estimated by using peanuts. The result was approximately 80% from total population of dogs were healthy (Figure 3).
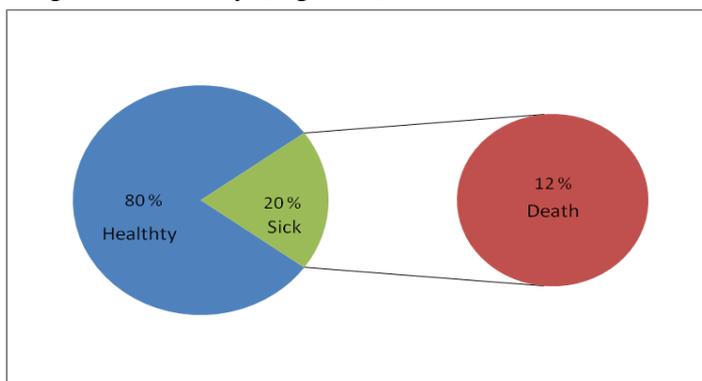

Figure 3. The Percentage of Health Rate, Morbidity Rate, and Mortality Rate of Dogs in Karang Asem

Matrix scoring technique was also applied to estimate the type of diseases in dogs based on the clinical symptoms known by the locals. There were 7 names of disease identified as a result within the discussion (Table 5).

Table 5. List of Various Diseases Found by the Locals

No	Name of the Diseases	Local Names	Explanation
1	Scabies	*Gudigan/geruh/genit*	Open wound caused by fighting or other activities which then irritated the dogs and made them rubbing their wounds and rolled their bodies on the ground
2	Wound	*Berung*	Commonly caused by fighting
3	Flea Manifestation	*Limpitan/kutu berakan*	Caused by fleas or *limpit* (local name for flea)
4	Rabies	*Anjing buduh*	Dogs seemed mad or *buduh* (local name for mad/crazy)
5	Distemper/dysentri	*Sakit perut*	Unknown causes but looked like stomachache followed by vomitting or bloody feces
6	Orchitis	*Sypilis/sakit prana*	Wound or mange found in male dog genital
7	Poisoning	No local name	Uncertain cause

Mainly, every diseases found by locals have local names. The result of matrix scoring of the clinical signs is shown in Table 6.

The result of proportional piling which estimated the morbidity, mortality, and case fatality rate of dogs with those diseases above is shown in Table 7. Total morbidity rate of dogs reached 20% (10.01-29.99), while total mortality rate reached 12% (0.47-23.53).

Table 7. Morbidity, Mortality, and Case Fatality Rate Data of Dogs in Karang Asem

Diseases	Morbidity	Mortality	Case Fatality
	% mean (95% of CI)		
Scabies	10,5 (2,71 - 18,29)	6,58 (0 - 14,38)	62,70 (54,90 - 70,50)
Wound	1,17 (0 - 2,72)	0,58 (0 - 1,78)	50 (48,80 - 51,20)
Flea Manifestation	3,33 (0,50 - 6,16)	0,75 (0 - 2,18)	22,5 (21,07 - 23,93)
Rabies	3,67 (0,48 - 6,86)	3 (0 - 6,08)	81,82 (78,74 - 84,90)
Distemper	0,67 (0 - 2,02)	0,67 (0 - 2,02)	100 (98,65 - 101,35)
Orchitis	0,25 (0 - 0,77)	0,00	0,00
Poisoning	0,42 (0 - 1,62)	0,42 (0 - 1,62)	100 (98,80 - 101,20)
Overall	20 (10,01 - 29,99)	12 (0,47 - 23,53)	-

Table 6. The Result of Matrix Scoring of the Clinical Signs

No	Clinical sign/symptom	Name of diseases (Mean score (95% of CI))						
		Scabies	Wound	Flea Infection	Rabies	Distemper	Orchitis	Poisoning
1	Irritation	5,50 (0 - 12,11)	0,67 (0 - 2,14)	0,83 (0 - 2,67)	0,17 (0 - 0,54)	-	0,33 (0 - 1,06)	-
2	Hair Loss	14,67 (7,83 - 21,51)	1,17 (0 - 2,62)	6,33(1,08-11,58)	2,50 (0 - 6,34)	-	0,33 (0 - 1,06)	-
3	Lameness/paralysis	4,33 (0 - 10,03)	0,17 (0 - 0,54)	1,50 (0 - 3,87)	1,92 (0 - 5,58)	2,92 (0 - 8,42)	-	1,67 (0 - 5,34)
4	Cough and or Vomit	3,17 (0 - 8,74)	0,75 (0 - 2,4)	-	1,08 (0 - 3,46)	3,33 (0 - 8,97)	-	1,67 (0 - 5,34)
5	Wounds	6,25 (0 - 13,04)	1,42 (0 - 4,54)	2,33 (0 - 5,03)	-	-	-	-
6	Ulcers/sores	3,67 (0 - 9,23)	2,08 (0 - 6,67)	1,58 (0 - 5,06)	0,17 (0 - 0,54)	-	-	-
7	Loss Appetite	2,08 (0 - 4,30)	2,75 (0 - 6,84)	1,58 (0 - 3,38)	2,75 (0 - 6,69)	1,25 (0 - 4,00)	0,83 (0 - 2,67)	1,25 (0 - 4,00)
8	Hydrophobia	0,83 (0 - 2,67)	-	0,83 (0 - 2,67)	-	-	0,83 (0 - 2,67)	-
9	Emaciated	5,67 (0 - 10,94)	1,75 (0 - 4,11)	2,50 (0 - 5,37)	0,50 (0 - 1,29)	0,83 (0 - 2,67)	-	1,25 (0 - 4,00)
10	Ocular discharge	7,50 (0 - 13,99)	0,83 (0 - 2,09)	2,25 (0 - 5,01)	1,08 (0 - 2,95)	0,83 (0 - 2,67)	-	-
11	Tongue-lolling/salivating	2,75 (0 - 5,66)	1,00 (0 - 2,84)	1,92 (0 - 5,13)	6,33 (0 - 13,33)	0,50 (0 - 1,60)	-	-
12	Hiding	1,17 (0 - 3,08)	3,00 (0 - 7,46)	0,58 (0 - 1,46)	0,25 (0 - 0,80)	-	-	-
13	Hyperactive/biting	0,58 (0 - 1,86)	-	-	**11,92 (2,48 - 21,36)**	-	-	-
14	Sudden Death	1,17 (0 - 3,74)	1,00 (0 - 3,20)	-	0,17 (0 - 0,54)	-	0,17 (0 - 0,54)	-
15	Tail-tucking	2,17 (0 - 6,94)	-	0,33 (0 - 1,06)	-	-	-	-
16	Mad/furious	0,75 (0 - 2,40)	-	-	2,50 (0 - 8,00)	-	-	-

The case of dog bite in Karang Asem was suspected to have connection with number of activities happened in that region. Those activities were dog-mating season, local ceremonies, vaccination programs, etcetera. Seasonal calendar method was applied to learn the connection between the dog bite case and number of actitvities occurred in the survey region. The data of those activities is described in Table 8 below.

Table 8. Number of Activities per Month Related to the Dog Bite Case in Karang Asem

Risk Factors	Mean of number of activities per month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Local ceremony	1.42	1.83	6.75	3.67	0.92	1.50	1.92	3.83	1.92	3.25	1.42	1.58
Mating season	0.92	3.83	10.92	3.92	2.25	1.33	2.00	1.33	0.83	0.75	0.92	1.00
Vaccination program	2.58	0.08	0.08	9.00	0.08	7.83	2.17	1.08	4.33	1.33	0.08	1.33
Dog Bite cases (2011)	1.67	2.08	1.58	5.08	2.50	6.42	2.75	2.50	1.75	1.33	1.17	1.17

The transformation of various activities which related to dog bite case is shown in Figure 5 below.
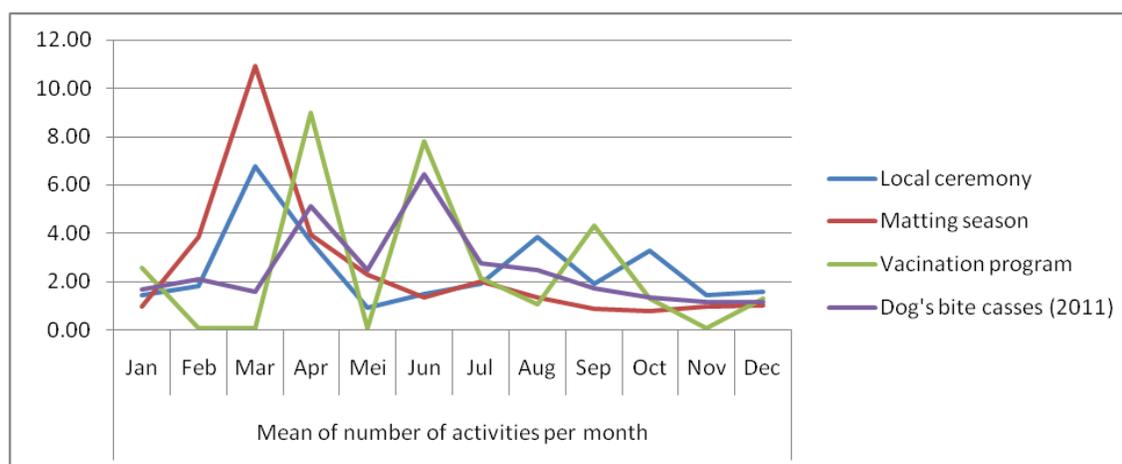

Figure 5. Mean of Number of Activities per Months in a Year related to Rabies

Discussion

The data above orderly showed dog, cat, fighting cock, and bat are the dominant animals in the survey regions. It also informs that dominant animals in the community mainly are rabies-transmitter animals. This indicates that the locals in the survey regions lead their life surrounded by susceptible animals and are able to transmit rabies to other animals as well as humans.

The data in Table 4 above shows five most important animals in life for Karang Asem people are dog, cat, bird, fighting cock, and monkey. Regarding to the list above, dog ranked in first place since it have the highest population, important means related to local customs, as well as its role in the recent outbreak (rabies). Occasionally, dogs are used as objects in local ceremonies. In the meantime, other animals were considered important due to their frequent existences and contributes source of incomes to certain people. Except for fighting cock which was considered to have prestigious value due to the locals' hobby by raising roosters and use them for a game.

Based on the result above, it is important that the locals have knowledge about rabies vectors due to their abilities to name precisely various animals which transmitting the rabies disease (except for the rat which is actually not a rabies vector).   This was probably since the rabies occurred in Bali, the government and officials have given them instructions and guidances in order to improve people's awareness and knowledge related to rabies.

The result above shows that most dogs were kept cageless (64.50%). Only few kept their dogs in cages and domesticated (13.25%), and the rest were stray dogs (22.25%). The reasons that the locals kept their dog cageless (semi-stray dogs) were for the sake of the neighborhood safety and also the owners would not want to feed their dogs regularly. Commonly, semi-stray dogs would look for their own food, because locals used to place offerings (usually contains of various food) on the street daily, and those dogs seemed to eat the offerings (Figure 3). Mostly when a local ceremony was held, the source of food for the dogs would be plenty.

According to the locals' perception, approximately 20% of total dog populations around them were sick. And from the total percentage of sick dogs, the mortality rate was 60%. This indicated that most dogs in Karang Asem were healthy. On the other hand, more than half of total sick dogs resulted in deaths. This happened because most dogs were stray dogs and semi-stray dogs. Therefore, health services for those dogs were poor, which then resulted in high mortality rate.

Initially, locals were questioned whether they had ever known or seen sick dogs near them; what were the clinical symptoms of those sick dogs; what kind of diseases they had seen. In matrix scoring technique, each clinical signs or symptoms mentioned would be scored toward several diseases which frequently found by the locals. Generally, the name of the diseases would be mentioned using their common or local names. Based on the scoring result, the actual disease could be identified by the symptoms characteristics as well as specific signs. The list above is the consensus result of the discussion, in which the participants have experienced, seen, and noticed those diseases from the other locals. Several diseases above could be explained by the participants. This indicated that those diseases were common.

Based on the matrix scoring result, several diseases explained by the participants were having similarities to certain clinical sign characteristics. Scabies disease for example, the locals in fact have brought up several local names (*gudigan* or *geruh* or *genit*) without specifically mentioned scabies.   This disease is characterized by hair loss; conjunctivitis (as *belekan* or *pecehan* in local names); wounded-skin caused by scratches; emaciated, sometimes followed by lameness. *Berung,* local name for wounds, mostly due to overfighting, and is characterized by loss appetite; tend to hide; develop sores or abcess as a result unmedicated wounds. *Limpitan* is the local name of a disease caused by flea

manifestation, and is characterized by hair loss; bony appearance; ocular discharge; wounds. Rabies disease is described by the locals as *anjing buduh* (mad dog) and is characterized by hyperactivity; tend to bite every object including other animals as well as humans; tongue-lolling and salivating; hair loss; the dog appeared to be mad or delirious. As for distemper, the locals did not mention specifically the name of the disease, and it was only mentioned as stomachache. This disease is characterized by coughing and vomiting; followed by paralysis or weakness and resulted in death. *Sakit prana* or orchitis is described as the wounds around the male dog genital by the locals. It is characterized by loss appetite and hydrophobia (in this case, the dog is afraid of being bathed). Meanwhile, no specific clinical sign or characteristic mentioned in poisoning since this case is rare and the locals did not mention the cause particularly.

According to the result correlated with rabies, several villages which have encountered with rabies were able to descript the signs of rabid dogs based on their own perceptions. They concluded that rabid dog: frequently seemed to bite any objects including other dogs, animals or even humans; appeared delirious and seek solitude; reddened eyes; frequently howls at night. Regarding to the data analyzes in matrix scoring, hyperactive and or biting is significantly similar to the rabies. While other clinical signs and diseases could not be distinguished since they did not have significant scores toward each other. This means those clinical signs could be identified either in other diseases.

The highest morbidity rate is scabies, followed by rabies, flea manifestation, wounds, distemper, poisoning, and orchitis (male genital disease). While the highest mortality rate is scabies, followed by rabies, flea manifestation, distemper, wounds, and poisoning. On the other hand, the case fatality rate of scabies (62.70%) is not major as distemper and poisoning which reached 100%. Rabies relatively has high case fatality rate (81.82%), but this is a little bit deviated since normally reaches 100% (CDC, 1992). There was probably misperception in several villages which indeed were not accustomed to rabies. As have stated before that typically villages which have encountered the rabies outbreak were able to identify the disease, but not for other villages which have not experienced it yet.

According to the locals, several dogs which were infected by scabies probably died of man-slaughtered. This because scabies dogs were considered disturbing due to their unattractive physical appearance and unpleasant odor caused by the sores on their bodies. That was probably happened also to rabid dogs which were considered threatening. According to the locals, since rabies outbreak occurred in Bali, a custom regulation was announced to slaughter every dog which had bit humans.

Rabid dogs normally change their behavior such as becoming furious and frequently bite every object around them, including humans (King and Turner 1993). The informations obtained from 12 villages showed that case of human bitten by suspected rabid dogs happens almost every year with various numbers. This case intensified particularly in April and June.

Dogs are known to have mating season repeatedly every year or as Balinese pronounce 'sasih kesangeh'. Regarding to the result of the discussion, mostly locals were aware of the mating season in their regions. The data in Table 8 shows the increasing numbers of mating dogs was around February to April, while March was considered to be the top of the month of mating season every year.

Like normally Balinese, many people of Karang Asem used to hold local as well as religious ceremonies regularly (Widyastuti *et al.* 2015). This would transfer them from home to the temples which caused mobilization. Those ceremonies require food as an offering, and usually the food would be left behind in the temple. The result of the discussion showed that those ceremonies always happen every year, mostly in March through April and in August. After the rabies outbreak occurred in Bali, the government has assigned vaccination programs for rabies-transmitter animals as a strategy to control the disease. To implement the strategy, the government formed task forces from the local livestock service which would regularly vaccinate rabies-transmitter animals in the whole regions in Bali. The informations collected as a result of the discussion indicated that almost every year the locals had noticed the officials routinely vaccinated most dogs in their neighborhood. Regarding to the locals, the vaccination programs mostly increased in April and in September.

Technically, the application of participation method in PE technique can be applied as one of tools in rabies surveillance program. This has been approved in several countries, whereas PE technique is able to overcome the weaknesses in conventional surveillance technique approaches and is succed to answer surveillance problems and animal disease research (Josh *et al.*, 2007). The critical point which is needed to be noted is how to determine the type of people or community that would involve in exploring the information through a semi-structured interview by discussion group approaches. The participants or members of the discussion groups are mostly selected local people which generally are familiar and recognize their community completely.

Typically, keeping dogs in Karang Asem is strongly related to the locals' culture. The existence of the dogs can be found in every single part of the villages, where dogs live side by side with humans and are supposed to get more attention from the community.

PE approaches is a comprehensive method of location by studying from, to, and with the community, to identify, analyze, and evaluate common problems (diseases) happened there (Catley *et al.*, 2011). Related to the rabies outbreak occurred in Karang Asem which associated to the locals' habit in keeping dogs, PE approaches is more compatible to be applied in this case. Since it has been recognized and approved by the OIE, PE approaches is also an option to perform the study of epidemiology as more relevant in financial matter with simple logistic needs, particularly for regions with limited financial support as well as resource.

CONCLUSION AND RECOMMENDATION

Conclusion

In Karang Asem, rabies as well as suspected rabies (dog bite case in human) is still occured although it tends to be controllable. Based on the time pattern, normally the dog bite case that has happened before was not related to the activities of dogs and human in that region. Refers to the data of existences; total population; the role in people's lives; types of keeping the rabies-transmitter animals, particularly dogs; locals' awareness of rabies disease, therefore the potency of rabies transmission in this region is relatively high.

Participation from the locals is needed in order that the effort to control and prevent rabies in this region could be improved.

Recommendation

1. PE method can be applied as one of techniques used in non-livestock disease surveillance as rabies in dogs.
2. In effort to control the disease in pet animal non-livestock e.g rabies, people's involvement is important to be improved.
3. PE technique could be applied to measure the success of counseling program as well as becomes one of the tools used in surveillance.

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