Use of Participatory Epidemiology in Early Detection of Disease in Livestock in Community Farmer Groups on Lombok Island

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Abstract

Participatory epidemiology (PE) as a branch of veterinary epidemiology has been used for animal disease control, especially for the early detection of livestock diseases in areas with limited veterinary resources. The use of PE in livestock health is based on the combination of veterinary practitioner competence, knowledge, and experience of farmers in developing disease control strategies in livestock populations. Lombok Island, located in West Nusa Tenggara, Indonesia, is rich in livestock and is one of the national meat suppliers. Lombok Island experienced an outbreak of Foot and mouth disease (FMD) in 2022, and the impact of FMD was very detrimental to the livestock community. Farmers on Lombok Island can be the leading source of information regarding diseases in livestock for the application of PE in livestock group communities. The PE that is most likely to be used in livestock farming communities in Lombok is Participatory rural appraisal (PRA). PRA can be used effectively in livestock group communities to detect livestock disease by using simple tools to conduct interviews, proportional piling, and matrix scoring through direct discussions with farmers. PRA steps that can be used in livestock farming communities on Lombok Island include: 1. Secondary data collection; 2. Interviews with key persons; 3. Village mapping and livestock movement; 4. Focus group discussion (FGD) using scoring matrix and proportional piling; 5. Direct field observation; 6. Making a seasonal disease calendar; and 7. Surveillance with a one-health approach.

Keywords: PRA, Proportional piling, Matrix scoring, Seasonal calendar, Livestock disease

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Introduction

West Nusa Tenggara Province, consisting of Lombok and Sumbawa Islands, is a province rich in cattle and is one of the national meat suppliers. NTB Province until 2022 has a cattle population of 1,336,324 (Statistics of West Nusa Tenggara Province, 2022). Most of the cattle farms on Lombok Island are managed by community groups of farmers consisting of several local farmers. Farmers can be the leading source of information on diseases in livestock because they interact directly with livestock. The participation of local farmers is very much needed in overcoming livestock disease outbreaks, both emerging and remerging diseases that have the potential to become disasters (Kholik et al., 2024).

The national health disaster regarding the recent livestock disease outbreak felt by the people of Indonesia and the Province of West Nusa Tenggara is Foot and mouth disease (FMD). Farmers on Lombok Island usually know that their livestock are in trouble, but farmers do not get enough information about their livestock problems, diseases, treatment, and management. Generally, farmers on Lombok Island use local languages to refer to diseases in their livestock. Simple education for farmers on signs and symptoms of livestock diseases in

regional languages for detecting livestock diseases will enrich farmers' knowledge about diseases in their livestock. Knowledge of farmers about diseases based on signs and symptoms that adopt local languages will be a good source of information in collecting data on animal health problems. Collecting livestock health data and other veterinary knowledge can involve the participation of livestock communities. Surveys have become an important method for identifying and prioritizing animal health problems in the community, especially for rural development (Schwabe, 1964).

The method of collecting disease data in livestock that can be used by farmers in rural areas that has the potential to reduce the emergence of livestock disease outbreaks in Indonesia, especially in Lombok Island, both emerging and remerging diseases, is the use of Participatory Epidemiology (PE) with the Participatory Rural Appraisal (PRA) method. PE has been used in studies to identify disease problems and find the best solutions by working with the community (Catley, 2005).

This book chapter will explain the definition and development of participatory epidemiology, the principles of participatory epidemiology, methods of collecting information in participatory epidemiology, and the use of participatory epidemiology in livestock groups as well as recommendations for steps in using Participatory Epidemiology (PE) with a one health approach in livestock community groups on the island of Lombok.

Definition and Development of Participatory Epidemiology

Participatory epidemiology (PE) is an emerging field using participatory techniques to obtain qualitative epidemiological information based on community observations, existing veterinary knowledge, and traditional historical narratives. PE relies on widely accepted techniques of participatory rural appraisal, ethnoveterinary surveys, and qualitative epidemiology (Schwabe, 1964). PE is a systematic participatory approach and method for improving the understanding of animal diseases and their control. The word participatory is used to indicate the active involvement of the community in setting goals and developing disease control strategies rather than simply providing information (Catley et al., 2012)

PE uses the concept of conventional epidemiology by participatory methods to solve epidemiological problems in a population. PE has been stated as the systematic use of participatory approaches to improve understanding of diseases and options for animal disease control. PE, in the 1980s, has been used by veterinarians in community-based livestock projects in Africa and Asia (Catley et al., 2012).

The application of PE in its development has become an approach to the community in dealing with the risk of animal health and veterinary public health risks (Allepuz et al., 2017). This approach and method are a derivative of participatory appraisal in several conditions where conventional epidemiological approaches do not provide solutions to design appropriate actions in existing situations. In the veterinary world, PE has developed as a branch of veterinary epidemiology. PE has been used to detect diseases for early warning and controlling infectious diseases in populations with limited resources (Alders et al., 2020).

Principles of Participatory Epidemiology

In principle, the PE approach and methods include: 1. Practitioner attitudes and behaviors; 2. Mixed methods and triangulation; 3. Use of key informants; 4. Action-oriented; 5. Methodological flexibility, adaptation, and development.

1. Practitioner Attitudes and Behavior

Practitioners who conduct PE are required to assess professional bias (Catley and Mariner 2002). Practitioners in seeking information must be truly willing to learn from residents and appreciate, and respect local community knowledge and culture. Practitioners who conduct PE will place themselves on an equal footing with residents, not seeming to be patronizing or intervening in gathering information from the community. Information bias often occurs when professionals who conduct PE make a justification first, for example, a veterinarian with data on the characteristics of a particular disease decides that a particular disease has circulated in the community population without cross-checking with other data. Fanda (2023) stated, if researchers have hidden agendas or are interested in their own opinions, the discussion will not be very constructive.

2. Combined Methods and Triangulation

PE can be conducted using various methods including interviews, assessment and ranking, and visualization (Bach et al., 2017; Catley and Mariner 2002). Interviews can be conducted through interviews with key informants with focus-group discussions. Ranking can be in the form of Simple ranking, pair-wise ranking, proportional piling, matrix scoring, and wealth ranking. Visualization can be participatory mapping, diagrams, seasonal calendars, and timelines (Alders et al., 2020). These methods are combined with conventional veterinary investigation results and epidemiological tools. Triangulation in PE uses more than one method to collect data on the same topic to verify findings, including multiple qualitative sources, use of secondary documentation, clinical examination, and laboratory test results (Alders et al., 2020; Wang et al., 2018;

3. Use of key Informants

Key information can come from local experts who are important key informants for participatory epidemiologists Catley and Mariner 2002)). Local experts are individuals who are trusted by the community to have special knowledge and skills regarding issues in the community, for example, the head of a livestock group can be made a local expert. The head of a livestock group with his knowledge and experience has the potential to be a good source of data because he interacts directly with his livestock.

4. Action-oriented

PE will produce actions to address community problems. Actions are the result of a combined analysis of the collected epidemiological data. Data or information obtained from the results of PE are verified with the community which becomes an agreement to be used as a basis for taking action to address community problems *(*Catley and Mariner, 2002)).

5. Methodological Flexibility

PE is a relatively new branch of epidemiology and is still in the development stage. The methods used in PE are flexible based on the needs of the community, community, or specific organization so that the methods in their development will be adaptive to the needs of the community and the global situation (Catley and Mariner, 2002)). Based on the description of the PE principles above, PE has several important elements, including Community participation in solving problems, appreciating community problems and concerns, and triangulating the data obtained (Alders et al., 2020)

Collection of Information Methods in Participatory Epidemiology

The method of collecting information in the application of PE according to Catley and Mariner (2002) includes: 1. Secondary data based on references; 2. Timeline of problem occurrence; 3. Interviews with key persons; 4. Animal or livestock traffic and contact with other animals; 5. Matrix scoring; 6. Proportional piling; 7. Seasonal calendar of diseases; 8. Direct observation in the field.

Secondary data can be obtained from information on social media, public news, and other sources of information that are matched with related literature (Catley and Mariner, 2002). Secondary data included published and unpublished literature, for example, use PE to investigate of Newcastle disease, along with geographical and socioeconomic information about the villages in Zamfara state, Nigeria (Jibril et al., 2015). The timeline of a disease occurrence process regarding disease movement, mortality, and morbidity can be obtained from public news that will be verified with data obtained from interviews, observations, and valid literature reviews. Interviews with trusted people about a community problem including disease occurrences are very important because people experience and interact directly with animals or other materials. Key informant interviews can be conducted with focus group discussions (Alders et al., 2020). Animal or livestock traffic is important for the movement and spread of disease. Learning from the Foot and mouth disease study, livestock traffic is one of the factors that influences FMD occurrences (Mirzaie et al., 2023).

Matrix scoring of diseases, symptoms, and their impacts can be done quickly if supported by personnel with sufficient knowledge in the world of health or veterinary medicine. Proportional piling is a technique for quantifying information by giving value in interactive participatory discussions to produce an agreement. Proportional piling can be done individually or in groups for disease situations such as morbidity and mortality. Scoring or assessment by dividing stones, grains, or other tools familiar to the community) into different piles based on categories, so that scores are obtained based on the number of piles of stones or grains. Proportional piling and matrix scoring have been used by several researchers to obtain data on disease incidence in areas with limited resources and access (Catley and Mariner, 2002; Fanda, 2023)

A seasonal calendar of diseases in an animal population will help the community to prepare for its handling and factors that influence the occurrence of the disease. Seasonal calendars have been used to understand local people's perceptions of variations in livestock diseases, disease vectors, intermediate hosts and rainfall based on seasons (Catley et al., 2002). A good seasonal disease calendar will be formed after collecting data on the occurrence of the disease every season that is repeated because it will be related to the host, disease agent, environment, and its determining factors. Direct field observation is the key to obtaining disease data and its determinant factors to review the data obtained from interviews, matrix scoring, and proportional piling which are matched with the latest literature.

The Use of Participatory Epidemiology in Farmer Groups on Lombok Island

PE has been used in establishing community-based animal health systems, assessing disease impacts (animal health impacts, socio-economic impacts, animal health project impacts) in a community or society, and participatory disease tracking in communities.

Lombok Island, known as a national beef cattle supplier, is rich in traditional livestock community groups that have existed since ancient times. The experience and knowledge of livestock breeders on Lombok Island about animal diseases based on signs and symptoms in the local language have certainly been embedded in their minds. Knowledge of animal diseases, for example, clinical symptoms and others will be expressed in the local language, this knowledge will be a good source of information in collecting data on animal health issues.

PE that has been carried out on Lombok Island is a participatory rural appraisal (PRA) technique with a rapid assessment commonly known as Rapid rural appraisal (RRA). RRA is an initial approach commonly used to conduct studies in one or more rural communities (Alder et al., 2020). Data collection methods can use the matrix scoring method, seasonal calendars, and proportional piling. These methods are standard data collection methods carried out in PE (Catley and Mariner, 2002).

The proportional piling method was carried out by providing piles of stones to map diseases circulating in livestock communities on Lombok Island, specifically in the Pade Angen II livestock group in East Lombok Regency (Figure 1)

The symptoms of the disease conveyed by the community in the local language will be translated by the veterinarian into veterinary language, and the results of the disease ranking based on proportional piling obtained fever, diarrhea, wounds on the legs, hypersalivation, itching, and abortion.

Kholik et al. (2024) show that fever is a high frequency of symptoms (64.7%) because it is a common symptom when livestock are infected with the disease. Diarrhea, Wounds on the legs, and Hypersalivation reached 58.8% which refers to the symptoms of FMD. The results of other research in Indonesia on dairy cows showed that FMD caused Excessive salivation 77.27%, Lameness 77.27%, Loss of appetite 63.63%, Lesions on foot 27.27%, Fever 27.27%, and Ruptured vesicles in the mouth 18.18% (Ismail et al., 2023). Erosion of the epithelium on the tongue and inside the mouth which causes excessive salivation and lesions on the feet which cause lameness also found in symptoms of FMD (Fakhrul-Islam et al., 2023).

The results of the proportional piling of disease symptoms in livestock were then discussed by veterinarians with the head of the livestock group (key person) and discussed with members and village officials to carry out a disease symptom scoring matrix and diseases to determine the estimated disease based on symptoms by giving a mark (X). The results of the discussions continued to create a seasonal disease calendar (Figure 2). The results of the disease symptom matrix scoring in livestock (Table 1) and the example of seasonal disease calendar in livestock can be seen in Figure 3.

Fig. 1: Example of Proportional piling of disease symptoms in livestock using stones by the livestock community on Lombok Island

Fig. 2: Example of Discussion Between Veterinarians and Farmers on Disease Symptom Scoring Matrix and Creation of Seasonal Disease Calendar on Lombok Island

Table 1: Example of Scoring matrix of disease symptoms and suspected diseases on Lombok Island

Symptoms Vs Disease	Scabiosis	Foot and Mouth Disease	Helminthiasis	Hypocalcemia	Bovien Ephemeral Fever (BEF)
Diarrhea			X		X
Itching	X		X		
Hipersalivation		XXX			
Abortion		XXX			XX
Fever		X		X	XXX
Wound on the legs		XXX			

Source: (Kholik et al., 2024)

January	February	March	April	May	June
• Foot and Mouth Disease (FMD)	• Foot and Mouth Disease (FMD)	• Foot and Mouth Disease (FMD)	• Foot and Mouth Disease (FMD)	• Foot and Mouth Disease (FMD)	• Foot and Mouth Disease (FMD)
July	**August**	**September**	**October**	**November**	**December**
• Foot and Mouth Disease (FMD)	• Foot and Mouth Disease (FMD)	• Foot and Mouth Disease (FMD)	• Foot and Mouth Disease (FMD)	• Scabiosis, • Helminthiasis • Foot and Mouth Disease (FMD) • Hipocalcemia • Bovine ephemeral fever (BEF)	• Scabies • Helminthiasis • Foot and Mouth Disease (FMD) • Hipocalcemia • Bovine ephemeral fever (BEF)

Fig. 3: Example of seasonal Calendar of Livestock Diseases in the Livestock Group on Lombok Island (Kholik et al., 2024)

Tables 2 and Figure 3 explain that FMD is still present on Lombok Island based on the scoring matrix of disease symptoms that arise in livestock based on information from the livestock community, FMD symptoms are still widely found because from November 2022 to 2024, Lombok Island has not been declared free from FMD. In fact, FMD disease re-emerged in mid-2022, previously FMD was first reported in 1887 in Malang, which then spread to various regions of Indonesia and was declared free in 1986 through the Decree of the Minister of Agriculture Number 260/Kpts/TN.510/5/1986 (Adjid, 2020; Widayanti et al., 2023). Lombok Island, located in West Nusa Tenggara Province, Indonesia, was declared infected with FMD in November 2022 (Department of Animal Husbandry and Animal Health of West Nusa Tenggara Province, 2022). Other suspected livestock diseases found in people's livestock on Lombok Island are BEF, Helminthiasis, Scabies, and sometimes Hypocalcemia.

Tables 2 and Figure 3 also explain that BEF or three-day fever is a disease in livestock caused by *an Aphthovirus*, a member of the family Picornaviridae with symptoms of high fever (Kirkland, 2016). BEF in Indonesia has existed since the Dutch colonial era, BEF is one of the diseases that still exist on the island of Lombok, West Nusa Tenggara Province besides Anthrax, Septicaemia epizootica (SE), Surra, Malignant catarrhal fever (MCF), Scabies, and Helminthiasis (Astiti, 2010). BEF is a disease that can be transmitted through vectors, considering the tropical climate on the island of Lombok, it is estimated that the disease will continue to be on farms. St George and Standfast (1998) stated that BEF has been found in several subtropical, tropical, and hot climates including in Asia, Australia, and the Middle East.

The seasonal calendar in Table 3 explains that in November and December, which are months with high rainfall, BEF has the potential to be found frequently in livestock farms on the island of Lombok because, with high rainfall, the vector carrying BEF will easily develop. Figure 3 also states that helminthiasis disease is often found in November and December, which are months with high rainfall associated with the development of worm eggs and larvae which are closely related to the cleanliness of the pen and the administration of deworming drugs. Kholik et al. (2019) reported that gastrointestinal helminths from Bali cattle on smallholder farms on the island of Lombok have experienced resistance to Ivermectin and Albendazole. Scabies disease and sometimes hypocalcemia are also found on smallholder farms on the island of Lombok because the island of Lombok still has minimal knowledge about biosecurity and livestock health management. Factors that influence scabies disease include; maintenance management, cage sanitation and low knowledge of farmers regarding scabies disease (Aulyani et al., 2022)

Based on the analysis of the results of the use of participatory epidemiology in livestock groups on the island of Lombok, West Nusa Tenggara province, Indonesia, participatory epidemiology can be developed using PRA techniques with rapid assessments, namely RRA based on local livestock group communities with the steps in (Figure 4). RRA can be used effectively in livestock group communities because it can use simple tools to conduct interviews, proportional piling, and matrix scoring through direct discussions with farmers so that community problems will be captured.

Figure 4 shows the steps that can be taken in implementing PRA based on community farmer groups on Lombok Island. The steps include:

1) Secondary data collection

The first collection of secondary data usually comes from information from village heads and group leaders. The secondary data collection can be done through the website of the relevant agency and livestock records which are usually held by the head of the livestock group or journals that provide the necessary data.

2) Interviews with key persons

Interviews with key persons such as village heads, community leaders, and livestock group leaders. Interviews can be conducted by visiting key persons directly or during livestock meetings and religious or customary events to collect livestock data, livestock diseases, and livestock activities if there is a problem with their livestock, Key persons will be selected who have knowledge and experience in livestock farming. Key persons on the island of Lombok are usually the heads of livestock groups that have been agreed upon by the community.

3) Village mapping and livestock movement

Village mapping can be done by utilizing the Google Map application to describe the layout and roads related to livestock traffic so that you can find out the entry and exit routes of livestock and the activities of the village community. The description of traffic and activities of the village community will be related to the process of disease entry and spread if an outbreak occurs.

4) Focus group discussion (FGD) using a scoring matrix and proportional piling

Focus group discussion (FGD with members, village heads, and veterinarians for scoring matrices and proportional polling on disease symptoms, morbidity, mortality, and disease impacts, followed by the creation of a temporary livestock disease seasonal calendar.

5) Direct field observation

Direct field observation involving government, academics, livestock groups, and related parties with the one health approach. Direct field

observation is conducted to match data obtained from interviews, FGD scoring matrices, and proportional polling on diseases and their impacts.

6) Making a seasonal disease calendar

Making a validated seasonal calendar of livestock aims to make it easier to control diseases based on the calendar month. Making a seasonal calendar of suspected diseases can be done based on the data obtained which is flexible as a reference in anticipating the emergence of an outbreak by providing tools.

7) Surveillance with a one-health approach

Surveillance with a one-health approach is carried out if data on livestock diseases is valid for sampling to be used in laboratory tests so that a definite diagnosis of the disease circulating in livestock can be made. Data on confirmed livestock diseases will be input to the relevant government in early disease control to prevent outbreaks. Joint surveillance with the government and related parties is based on the priority of diseases detected by the PRA.

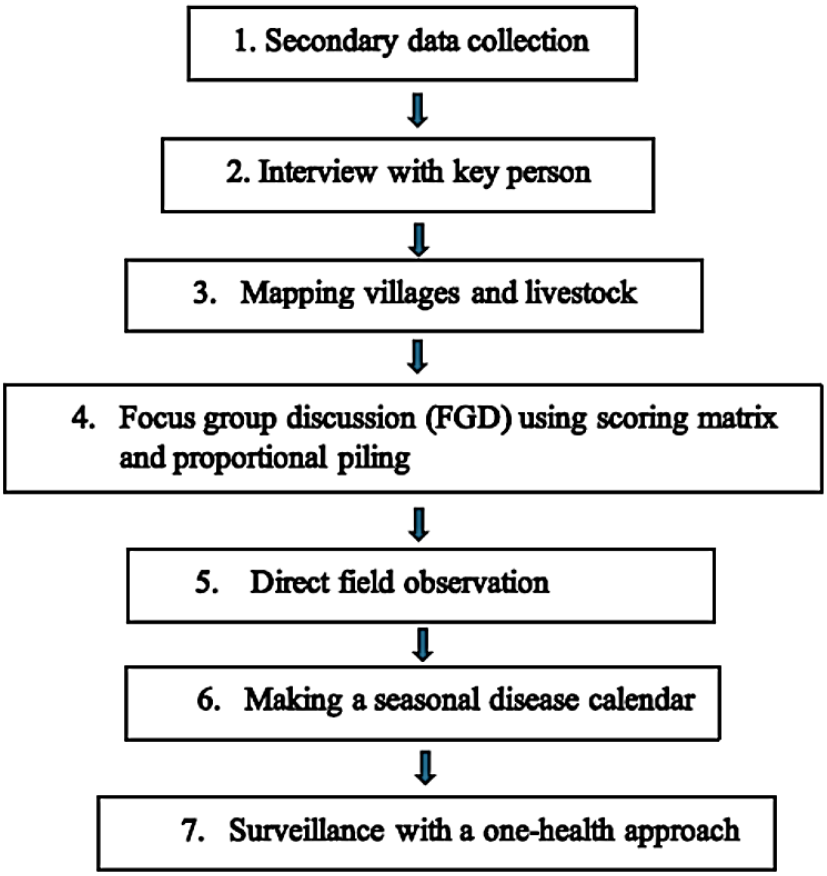

Fig. 4: Steps for implementing participatory rural appraisal (PRA) based on farmer groups on Lombok Island.

The problem with the use of PE will cause bias in data collection in Lombok, namely the low level of education of livestock farmers, which will affect their understanding of animal diseases that they have experienced. Kholik et al. (2024) reported that farmers on Lombok Island generally have elementary school education (29.4%), but some are graduates (5.9%). Failure to incorporate this local knowledge and experience can result in incorrect interventions that can lead to failure to address the problem effectively and sustainably (Alders et al., 2020). The problems in the use of PE can be reduced by conducting systematic PE training for professionals and farmers followed up by the preparation of a joint disease control strategy plan involving academics and government with a one health approach. The One Health approach is an integrated approach that aims to balance and optimize human, animal and ecosystem health in a sustainable manner. This approach recognizes that the three health sectors are closely interrelated and interdependent (OHHLEP, 2022)

Conclusion

Participatory epidemiology of participatory rural appraisal (PRA) techniques that are Rapid rural appraisal (RRA) based on livestock groups can be used for early detection of livestock and the creation of seasonal disease calendars in livestock group communities on the island of Lombok. Direct field observation followed up with surveillance with a one health approach is very necessary involving government, academics, livestock groups, and related parties to overcome livestock diseases and prevent emerging and remerging diseases. The use of participatory rural appraisal in livestock communities on Lombok Island through the following steps: 1. Secondary data collection; 2. Interviews with key persons; 3. Village mapping and livestock movement; 4. Focus group discussion (FGD) using scoring matrix and proportional piling; 5. Direct field observation; 6. Making a seasonal disease calendar. 7. Surveillance with a one-health approach. In the future, the use of PE in detecting infectious diseases in livestock groups on Lombok Island needs to be developed by involving all sectors, including competent laboratories for certainty of disease diagnosis, as well as including PE in university curricula and providing PE training to livestock communities.

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