

The Community-Based Disaster Risk Management (CBDRM) Model as a Strategy for Controlling Rabies in Bali Province

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Abstract

Rabies is one of the strategic zoonotic diseases caused by rabies virus of the genus Lyssavirus, family Rhabdoviridae, which remains a significant public health threat in Bali Province. Control measures through mass dog vaccination programs, education, and regulatory interventions have been implemented since 2009; however, challenges persist due to resource limitations and suboptimal community participation. This research aims to explore the application of Community-Based Disaster Risk Management (CBDRM) as a strategy for rabies mitigation through a disaster management approach. The research methodology employed a literature review of articles indexed in Scopus and Sinta databases, reports from international organizations, and national and regional policy documents from the period 2015–2025. The findings of this review indicate that CBDRM has the potential to strengthen community capacity, establish cross-sectoral networks, and enhance collective community awareness in rabies prevention. These findings affirm that strengthening community capacity through CBDRM can serve as a sustainable framework for zoonotic disease mitigation in Bali, while simultaneously expanding the disaster management paradigm into the field of veterinary public health.

Keywords: Non-natural disaster, Disaster Management, CBDRM, Rabies



INTRODUCTION

Rabies represents one of the critical zoonotic diseases in Indonesia that poses a significant threat to human life and must be controlled in accordance with the Coordinating Ministry for Maritime Affairs and Investment Regulation No. 7/2022, which aims to strengthen institutional preparedness, detection, and coordinated cross-ministerial response mechanisms. This requirement is further reinforced through the Ministry of Agriculture Decree 237/KPTS/PK.400/M/3/2019, with regional governments mandated to deliver minimum services consistent with the Ministry of Agriculture Regulation No. 39 of 2023 concerning Minimum Services for Priority Zoonoses. In Bali, the first reported case occurred in 2008 at Ungasan Village, Jimbaran, and subsequently the disease has spread throughout all districts and municipalities across the province, resulting in hundreds of human fatalities (Bali Provincial Health Office, 2023). Rabies is classified as a lethal zoonotic disease with a case fatality rate approaching 100 percent in humans if not promptly treated (WHO, 2022). Disease transmission through bites or scratches from infected animals has resulted in substantial economic losses, encompassing not only direct healthcare expenditures and post-exposure prophylaxis (PEP) vaccination costs, but also significant social consequences including stigmatization and heightened community anxiety regarding potential exposure to rabid animals.

As the Indonesian province with the highest dog population density, Bali faces distinctive challenges in achieving rabies elimination. The mass vaccination program implemented since 2010 by the Bali Provincial Government in collaboration with the Food and Agriculture Organization (FAO) and the World Health Organization (WHO) has demonstrated considerable effectiveness in reducing rabies cases among both canines and humans; however, the province has not yet achieved sustained disease-free status (Putra et al., 2020; FAO, 2021). Epidemiological data reveal annual case fluctuations, with certain regions experiencing concerning increases in animal bite incidents. A primary factor contributing to this persistence is insufficient active community engagement in reporting animal bites, responsible dog ownership, and routine vaccination programs (Windyaningsih et al., 2022). Additionally, inadequate dog population management practices, limited public awareness regarding rabies risk, and restricted access to health information in remote areas represent fundamental obstacles to effective disease control.

Within the context of disaster management frameworks, rabies can be classified as a non-natural disaster under Law No. 24 of 2007, given its substantial impacts on public health, social stability, and economic welfare. Conceptualizing rabies as a public health disaster underscores the necessity for coordinated, sustained, and multi-sectoral stakeholder responses. Consequently,



Community-Based Disaster Risk Management (CBDRM) approaches are considered particularly relevant for strengthening community-level preparedness and risk mitigation strategies in addressing rabies (National Agency for Disaster Management, 2020). Evidence from various endemic regions throughout Indonesia, particularly East Nusa Tenggara Province which has experienced recent rabies surges, demonstrates that top-down control efforts lacking meaningful local community involvement frequently prove unsustainable and ineffective.

Community-Based Disaster Risk Management emphasizes the empowerment of local communities to identify, evaluate, and reduce disaster risks through mobilization of existing environmental and social resources (United Nations Office for Disaster Risk Reduction, 2019). Through this approach, communities transition from passive recipients of government health interventions to active stakeholders exercising strategic roles in the planning, implementation, and monitoring of rabies control initiatives. Local communities, drawing upon their comprehensive understanding of social, cultural, and environmental conditions, possess capacity to develop contextually appropriate solutions aligned with specific territorial requirements. Implementation of CBDRM principles in zoonotic disease management, including rabies, facilitates expansion of the disaster management paradigm beyond post-event response toward prevention and strengthening of community resilience (Izumi et al., 2018). This strategic orientation extends beyond reactive management of rabies-related mortality to proactive capacity-building for viral transmission prevention, enhancement of risk awareness, and establishment of effective local surveillance mechanisms.

By integrating disaster risk management perspectives with community-based models within rabies control programs, Bali can leverage collective community resources to pursue more ambitious rabies elimination objectives. This approach aligns with the global commitment toward Zero Human Death from Rabies while embodying One Health principles that recognize the interconnectedness of human, animal, and environmental health domains. Comprehensive understanding of social dynamics, local cultural practices, and community leadership structures will facilitate implementation of programs characterized by enhanced effectiveness, efficiency, and long-term sustainability.

THEORETICAL INSIGHT

Epidemiology of Rabies in Bali

Rabies is caused by the *Lyssavirus* from the *Rhabdoviridae* family. It is a zoonotic disease that attacks the central nervous system of mammals, including humans. Transmission to humans



almost always occurs through the bite of a rabid animal, particularly domestic dogs (*Canis familiaris*), which act as the main reservoir in Indonesia (WHO, 2023). The incubation period for the rabies virus is said to be highly variable, ranging from two weeks to several months, and even several years. It is influenced by the bite location, the amount of virus that enters, and the distance between the wound and the central nervous system (Fooks et al., 2017).

Since the first case was reported in Ungasan Village, Badung Regency in 2008, the disease spread rapidly throughout Bali due to high dog mobility, high human population density, and low public awareness of vaccination (Sudarmaja et al., 2019). Between 2008 and 2015, almost all regencies in Bali had reported positive rabies cases in both dogs and humans, as presented in Table 1 (Putra et al., 2020).

Table 1. Rabies Cases in Animals and Humans in Bali (2008-2025)

Group	Period	Year	Confirmed (+) Animal Rabies Cases	Confirmed (+) Human Rabies Cases
1	Initial Outbreak	2008	8	4
		2009	78	32
		2010	421	83
2	Intensive Control	2011	91	-
		2012	121	-
		2013	44	1
3	Resurgence	2014	130	-
		2015	529	-
		2016	206	-
4	Stabilization	2017	92	-
		2018	149	-
		2019	230	-
5	Pandemic & Recovery	2020	100	-
		2021	233	1
		2022	690	22
6	Recovery & Elimination Target	2023	-	6
		2024	416	7
		2025	-	12
Source: processed by the author, 2025				



According to data from the Bali Provincial Health Office (2023), bites from rabid animals are still reported at an average of over 40,000 cases per year, with human deaths due to rabies reaching 5-10 cases annually. This situation indicates that although public awareness has increased, there is still a gap between prevention efforts and public behavior regarding dog ownership and compliance with vaccination (Windiyaningsih et al., 2022). Furthermore, Bali has a local dog breed known to be very territorial and often allowed to roam freely (free-roaming dogs), potentially expanding the chain of virus transmission between regions (Townsend et al., 2013).

Control strategies implemented by the Bali Provincial Government together with the FAO, WHO, and the Ministry of Agriculture through the Bali Rabies Eradication Initiative program have successfully reduced the case rate by over 80% since the peak of the epidemic (FAO, 2021). However, the challenges for program sustainability remain significant, particularly in maintaining annual vaccination coverage, managing the dog population, and securing long-term funding. Dependence on international donor programs and limited human resources at the village level often disrupt.

CBDRM and Community Resilience

The Community-Based Disaster Risk Management (CBDRM) model fundamentally adheres to a bottom-up paradigm that positions the community as the primary actor in the entire disaster management cycle, from threat identification and vulnerability assessment to the implementation of mitigation and preparedness measures (BNPB, 2021). This approach indirectly shifts the traditional top-down model into a collaborative and participatory one, where decisions and actions are taken collectively based on available local potential and resources (UNDRR, 2019). Through this process, the community does not merely become aid recipients, but the main empowered subjects in managing disaster risks in their respective areas (Shaw et al., 2016).

The implementation of CBDRM in Indonesia has been carried out in several regions, particularly in natural disaster management, and has proven effective in controlling disaster risk to minimize losses, such as floods in Jakarta, the eruption of Mount Merapi in Yogyakarta, and the earthquake in Lombok. A study by Lassa et al., (2019) shows that CBDRM successfully enhanced community resilience through the strengthening of social capacity, local knowledge, and cross-sector collaboration between local government, NGOs, academia, and the community. Community resilience itself encompasses the ability of a community to absorb, adapt, and recover from the impacts of a disaster without losing its main socio-economic functions (Aldrich & Meyer, 2015).



The main components in implementing the CBDRM model include: (1) enhancing individual and local institutional capacity, (2) strengthening social networks and cross-sector coordination, and (3) integrating local wisdom into early warning systems and decision-making (Izumi & Shaw, 2015; BNPB, 2020). In practice, CBDRM acts as a bridge between national policy and local action, thereby ensuring the sustainability of Disaster Risk Reduction programs (Nakasu & Shaw, 2018).

In the context of zoonotic diseases, the application of CBDRM is not yet common, although its concept is highly relevant, similar to One Health with its core collaborative principle. Zoonotic diseases such as rabies, leptospirosis, and avian influenza have transmission characteristics closely linked to community behavior, environmental conditions, and human-animal interactions. Community-based approaches have proven effective in controlling these diseases through community engagement and participatory surveillance strategies, where the community is directly involved in early case detection, rapid reporting, and advocacy for preventive behaviors (FAO, 2020; Rachman et al., 2021).

Studies by Izumi et al. (2018) in Japan and Lassa et al., (2019) in Indonesia indicate that the success of implementing the CBDRM model in disaster risk control is largely determined by three key factors: (1) risk knowledge and awareness, (2) strong social capital, and (3) inclusive local policy support. These three components are interconnected in forming a social system that is adaptive to risks, including the threat of zoonotic diseases. In the context of Bali, CBDRM has great potential to integrate cultural values and traditional institutions (customary villages) as the basis for community organizing in rabies prevention and enhancing community resilience.

Furthermore, the application of CBDRM for zoonoses like rabies aligns with the One Health framework, which emphasizes the integration of human, animal, and environmental health (WHO, 2022). By involving traditional community leaders, customary security guards (Pecalang), women's groups, and schools, CBDRM can expand the reach of public education and strengthen community-based surveillance mechanisms at the village level. The experience of the FAO (2021) in implementing the Community-based Rabies Control Program in West Nusa Tenggara demonstrated that actively involving the community in case reporting and dog vaccination could increase program effectiveness by up to 60% compared to conventional approaches relying solely on government intervention.

Thus, CBDRM is not only a disaster risk management model oriented towards reducing physical losses from natural disasters but also an adaptive social framework that can be used to strengthen community resilience against biological disaster threats like rabies. The integration of



CBDRM with the One Health approach can be an innovative strategy connecting the social, cultural, and health dimensions within a sustainable risk management ecosystem.

METHODOLOGY

This study employs a descriptive – qualitative approach through literature review and document analysis to relation rabies policy and community-based disaster risk management (CBDRM). The literature search used keyword such as “rabies policy”, “control rabies”, “community-based disaster risk management”, “knowledge, attitude and practice”, and “Bali culture”. The primary literature sources in this study are Scopus (Q1–Q3), national scientific journals indexed in Sinta (S1–S4), national regulations, and official national reports, all of which specifically address issues related to rabies controlling.

The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) methodology was adopted to ensure a comprehensive, transparent, and replicable process for the literature search, selection, and analysis. From an initial screening of 246 articles, 50 met the inclusion criteria and were included in the review, as detailed in Figure 1. (Haddaway et al., 2022)

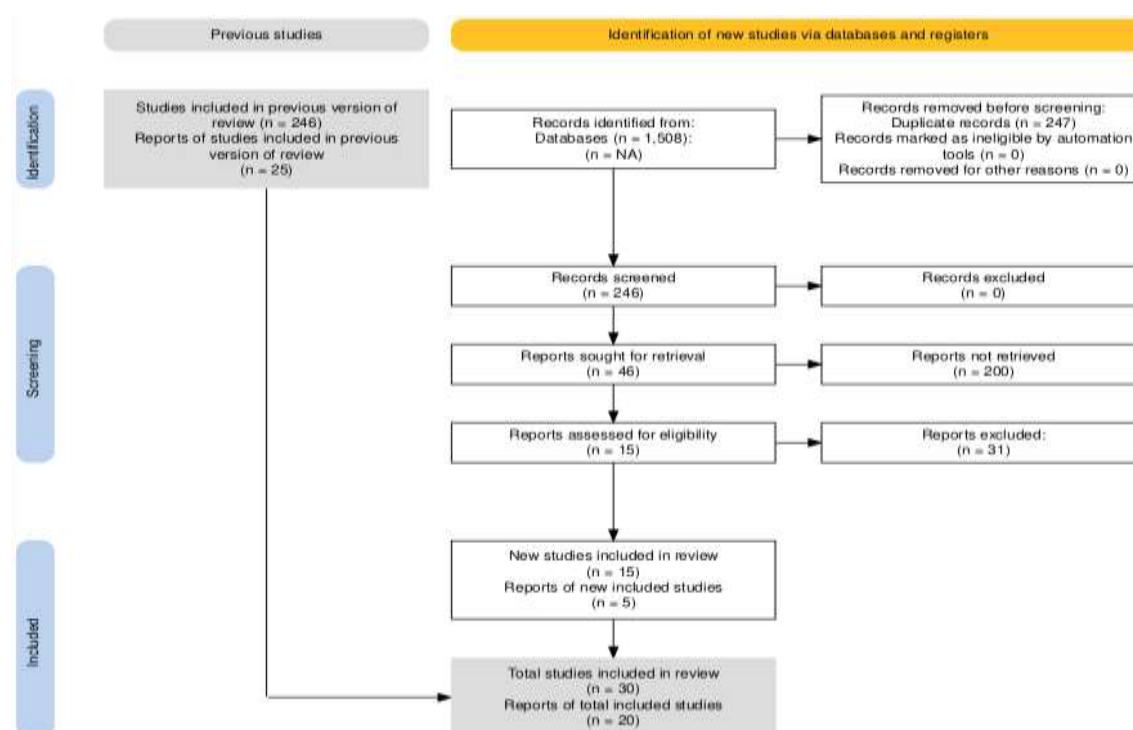


Figure 1. PRISMA Model

RESULTS

Comparative Analysis of Rabies Control in Bali and Community-Based Disaster Risk Management Approach

ANALYSIS OF PRBBK PRINCIPLES IN RABIES MANAGEMENT IN BALI

Community-Based Disaster Risk Management Framework for Rabies Control

PRBBK Aspect/Principle	Implementation in Rabies Management in Bali	Alignment Analysis
Community Participation	The Mass Dog Vaccination (MDV) Program involves local communities in bringing their dogs to vaccination sites. Several villages have established Village Rabies Task Forces (Satgas Rabies Desa).	High community participation at program initiation; however, it declines when external support diminishes. There is a need for increased community ownership of the program.
Empowerment and Local Capacity Building	Training for village cadres and local vaccination officers is conducted by the Livestock and Animal Health Service (Dinas Peternakan) and NGOs such as BAWA and WSPA.	Consistent with CBDRM principles. However, sustainability depends on funding and supervision from local government.
Strengthening Local Institutions	Village governments are involved in reporting bite cases and conducting dog population surveys.	Institutional integration has begun; however, cross-sectoral coordination (human health, animal health, and village government) remains suboptimal.
Integrated Risk Reduction	One Health approach is implemented, integrating animal health and human health aspects. School education activities and rabies awareness campaigns are conducted.	Highly consistent with CBDRM principles because it employs cross-sectoral and preventive approaches.



Based on Local Knowledge	Several local practices such as traditional bite management are still observed. Public education is tailored to local cultural contexts.	Cultural values have been integrated into education; however, more adaptive approaches are needed to address local beliefs and practices.
Program Sustainability	Massive vaccination programs are conducted annually; however, they depend on central government budget allocations and donor support.	Not yet fully consistent with CBDRM principles because external dependency remains substantial. Community-based funding mechanisms are needed.
Participatory Monitoring and Evaluation	Rabies cases are reported by relevant agencies and NGOs, but the community is not yet actively involved in monitoring activities.	Weak in participatory aspects. This can be strengthened through community-based village reporting systems.
8. Inclusivity and Gender Equality	Vaccination and education activities involve women, schoolchildren, and traditional leaders.	Already becoming more inclusive; however, systematic planning within CBDRM policies has not yet been established.

Source: processed by the author, 2025

DISCUSSION

Challenges of Rabies Control in Bali

Efforts to control rabies in Bali for over a decade have shown significant progress in reducing case numbers. However, various structural, social, and institutional challenges remain major obstacles to achieving sustainable elimination. The main constraints lie in the sustainability of vaccination programs, the mobility of ownerless dogs, and social resistance to dog culling policies, which are considered contrary to the cultural and religious values of the Balinese people (Windiyarningsih et al., 2022; Putra et al., 2020).

First, the sustainability of vaccination programs is heavily influenced by limitations in



human resources, funding, and vaccine logistics at the field level. The mass dog vaccination program initiated in 2010 showed a positive impact, reducing rabies incidence by over 70% in the 2010-2015 period (FAO, 2021). However, annual vaccination coverage often fails to reach the minimum threshold of 70% recommended by WHO to establish herd immunity (WHO, 2022). Contributing factors include fluctuating numbers of vaccinators, delays in vaccine distribution, and weak village-based reporting systems.

Second, the mobility of ownerless dogs and free-roaming pet dogs is a crucial epidemiological factor that prolongs the virus transmission cycle. According to an FAO survey (2020), approximately 60% of Bali's dog population are free-roaming, either as stray or semi-stray dogs, which complicates vaccination and surveillance efforts. The inter-regional mobility of dogs, including the movement of animals through cultural and economic activities, further increases the risk of rabies spreading to previously case-free villages (Townsend et al., 2013).

Third, social and cultural resistance to dog culling policies presents an ethical and practical dilemma in dog population control. The Balinese people view dogs as symbols of loyalty and part of the spiritual order; therefore, mass culling policies are seen as violating local cultural values (Putra et al., 2020). As an alternative, the Bali Provincial Government, together with the FAO and WHO, subsequently developed strategies based on local culture, such as mass vaccination, dog registration, and community-based dog management, emphasizing persuasive and educational approaches over culling (FAO, 2021; Widyastuti et al., 2021).

Fourth, the gap between central policy and village-level implementation remains a significant challenge. Although the Indonesian government has established the National Action Plan for Rabies Elimination 2030 (Ministry of Agriculture of the Republic of Indonesia, 2022), inter-agency coordination at the provincial and district levels is still not optimal. Many villages lack adequate resources or training to conduct active surveillance, report bite cases, and implement preventive measures according to national standards (Rachman et al., 2021).

Furthermore, challenges also arise from aspects of community behavior and health awareness. A study by Windiyaningsih et al., (2022) indicates that some community members still do not understand the importance of dog vaccination and proper bite wound management. Many bite victims do not immediately seek medical help or post-exposure prophylaxis (PEP), thereby increasing the risk of fatality. Economic factors and limited access to veterinary services in rural areas worsen this situation (FAO, 2020; Tenzin & Ward, 2019).

From an institutional perspective, cross-sectoral synergy within the One Health framework is not yet fully integrated. Collaboration between health services, livestock services, and village



governments often operates sectorally without a unified coordination mechanism. However, cross-sector integration is a crucial prerequisite for creating a rapid and effective response system to rabies cases in the field (Cleaveland et al., 2022).

In addition to technical and institutional constraints, the challenge of sustainable funding also needs attention. Most rabies programs in Bali depend on support from international institutions such as the FAO, WHO, and bilateral donors. When this support decreases, the local capacity to maintain vaccination and surveillance activities also weakens (Loka et al., 2020). Therefore, strengthening local village-based financing models and allocating funds from the Village Revenue and Expenditure Budget (APBDes) could be an innovative solution to ensure program sustainability.

Thus, the challenges of rabies control in Bali are not only biomedical but also encompass social, cultural, economic, and institutional dimensions. A comprehensive and participatory approach through Community-Based Disaster Risk Management (CBDRM) can help bridge these gaps by placing local communities at the center of planning and implementing sustainable rabies control programs.

Integration of CBDRM into Rabies Control Strategy

The integration of Community-Based Disaster Risk Management (CBDRM or PRBBK) into Bali's rabies control strategy is an innovative approach that combines the principles of community resilience with the One Health paradigm already applied in the medical field. Fundamentally, both CBDRM and One Health hold the principle of cross-sector collaboration to build a sustainable system. However, the foundation of CBDRM emphasizes strengthening local capacity through three main pillars: (1) enhancing community capacity in early detection and bite reporting, (2) building cross-sector networks between livestock services, health services, and village apparatus, and (3) strengthening the role of traditional leaders and local institutions in socializing dog vaccination and rabies prevention. Meanwhile, the One Health principle emphasizes collaboration between human, animal, and environmental health. Despite their different focal points, these two models are highly aligned to be collaborated as an adaptive and collaborative model for managing biological disasters.

The application of CBDRM allows the community to become the main actor in the rabies control cycle, not merely recipients of policy interventions. Through the establishment of village rabies cadres, community task forces, and participation-based training, the community can play an active role in participatory surveillance, public education, and local policy advocacy (BNPB,



2020; Izumi et al., 2018). The success of similar models in several regions, such as CBDRM for leptospirosis in Yogyakarta and avian flu in Central Java, proves that community involvement in community-based early warning systems can increase response speed and control effectiveness (FAO, 2020; Rachman et al., 2021).

In the context of Bali, the integration of CBDRM with the animal health system can be done through a '*rabies-resilient village*' mechanism, which is the strengthening of local institutional structures based on the traditional and social values of Balinese society. Traditional institutions such as *desa adat* (customary villages) and *banjar* have great potential in disseminating information, organizing vaccination activities, and enforcing local regulations regarding dog ownership and bite reporting (Sudarmaja et al., 2019). By adopting CBDRM principles, traditional institutions can function as social nodes that strengthen community resilience against zoonotic outbreaks, as has been successfully implemented in the Disaster Resilient Village program by BNPB (2021).

In addition to strengthening community capacity, CBDRM also encourages collaborative networks across sectors between government agencies, academia, the private sector, and civil society. Synergy between the Livestock Service, Health Service, Environment Service, and non-governmental organizations can create an integrated coordination system for the planning, funding, and evaluation of rabies programs (Lassa et al., 2019). In this approach, the animal health sector plays a role in surveillance and vaccination, the human health sector handles bite cases and PEP provision, while the village and traditional government coordinate socialization and citizen mobilization. This collaborative pattern aligns with the multisectoral collaboration principle that forms the foundation of the One Health Joint Plan of Action 2022–2026 (WHO, 2022).

The integration of CBDRM can also be implemented through a participatory approach based on local data (community mapping and risk assessment). Through participatory mapping, the community can identify high-risk rabies areas, bite-prone spots, and areas with low vaccination coverage (Izumi & Shaw, 2015). This data then becomes the basis for formulating a Village Rabies Contingency Plan, a village emergency action plan focused on mitigation and preparedness measures. This local data-based approach has been proven to increase policy effectiveness as it is designed according to the local socio-ecological context (Nakasu & Shaw, 2018).

Beyond technical aspects, the success of CBDRM integration also depends on building collective awareness and social capital at the community level. Aldrich and Meyer (2015) emphasize that social networks and trust among residents play a crucial role in accelerating



disaster response processes. In the context of rabies, public trust in vaccinators, veterinarians, and village officials is a key determinant of vaccination campaign success. Therefore, the CBDRM approach emphasizes the importance of transparent risk communication, based on trust, and respecting the norms and local wisdom of the Balinese people (Izumi et al., 2018).

The integration of CBDRM with One Health principles also opens opportunities to expand the scope of veterinary public health policies towards greater sustainability. Strengthening local capacity in participatory surveillance, improving health literacy, and multi-level collaboration can position CBDRM as a strategic framework for systematically addressing zoonotic threats. By placing the community at the center of the early warning system, Bali can build a sustainable, adaptive, and replicable Community-Based Rabies Management model for other provinces in Indonesia.

CONCLUSIONS AND RECOMMENDATIONS

Based on the analysis of rabies control activities in Bali, it can be concluded that rabies management in Bali has reflected most of the principles of Community-Based Disaster Risk Management (CBDRM), particularly in the aspects of community participation, local empowerment, and integrated risk reduction. However, there remains a need to strengthen village institutions, involve the community in monitoring activities, and enhance program sustainability to ensure full alignment with the CBDRM framework. The collaborative principles inherent in the CBDRM model have proven not only theoretically relevant, but also practically effective as a strategy for rabies control in Bali, and are worthy of adoption as a reference for other regions.

The following recommendations are provided to optimize the rabies elimination strategy using a participatory and sustainable approach, centering on a structured 12-month action plan to be carried out periodically: First step (Months 0–2): Risk mapping, establishment of hamlet-level CBDRM (PRBBK) teams, and initial community awareness campaigns. Second step (Months 3–4): Cadre training and procurement of vaccines and supplies; preparation for the synchronized mass vaccination month. Third step (Months 5–6): Mass vaccination and priority sterilization in red zones; daily monitoring (to be seamlessly integrated with the regular schedules of relevant government agencies). Fourth step (Months 7–12): Coverage evaluation, intensification of Communication, Information, and Education (KIE) activities in schools and the tourism sector, planning for follow-up vaccinations, and reallocation of village budgets and CSR funds.



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