EFFECTIVENESS AND OUTREACH OF ATWO-YEAR WEEKLY VACCINATION CAMPAIGN AGAINST PPR IN BAGAMATI PROVINCE: A COMPREHENSIVE REVIEW

Abstract:

This report presents a comprehensive analysis of the efficacy of a biennial, two-year weekly vaccination campaign aimed at combating Peste des Petits Ruminants (PPR) within Nepal's Bagmati Province. PPR, a viral disease with fever, skin lesions, respiratory, and gastrointestinal symptoms that have significant implications for small ruminant populations and local economies, prompted the implementation of a proactive vaccination strategy. Bagamati province, one of the provinces of Nepal with potential scope for the goat sector, has formulated an action plan with the vision of eliminating PPR by 2030 and, through a series of tasks, conducted a week-long vaccination campaign against PPR in Fiscal year 2021/22 and 2022/23. Through active surveillance, serological monitoring, and epidemiological surveys, the study evaluates the impact of this initiative on disease prevalence and transmission dynamics. Initial findings indicate promising outcomes in reducing PPR transmission; however, challenges related to coverage rates and logistical execution underscore the need for continuous refinement of the campaign's implementation strategies. It also demonstrates that a successful vaccination program is only possible through coordinated collaboration between the three levels of government. The insights gained from this study contribute to the broader discourse on effective PPR control measures and informs future efforts to safeguard livestock and rural livelihoods in the region.ac

Keywords: *PPR, Vaccination, campaign, action plan.*

INTRODUCTION

Peste des Petits Ruminants (PPR), often referred to as "goat plague," is a highly contagious viral disease that primarily affects goats and sheep, although other small ruminants can also be susceptible (12). Morbidity can reach 90-100% and mortality can reach 50-100% in severe cases (11). The severity of PPR varies, but in severe cases, the disease can lead to high mortality rates, especially in young or immunologically naive animals.

CAUSATIVE AGENT:

PPR is brought on by the Peste des Petits Ruminants Virus (PPRV), which belongs to the family Paramyxoviridae and genus Morbillivirus (8). Additionally, this genus contains the viruses that cause rinderpest in cattle and measles in humans.

TRANSMISSION:

PPR (Peste des Petits Ruminants) is mostly transmitted by direct contact between infected and vulnerable animals, including interactions such as nose-to-nose contact, sharing of food and water supplies, sexual activity, grooming, and living in close proximity to sick animals (6). Additionally, the virus is present in respiratory discharges, enabling aerosol transmission when sick animals cough or sneeze, releasing virus-laden droplets into the air that can be inhaled by animals who are close by who are vulnerable (17). The virus can survive on surfaces and in the environment despite direct contact being the most common form of transmission, which can result in indirect transmission. This happens as vulnerable animals come into touch with infected tools, food, water, or facilities, aiding in the disease's spread.

CLINICAL SIGNS:

Infected animals typically display a range of clinical signs associated with Peste des Petits Ruminants (PPR), including high fever as an early and consistent indicator, along with runny nasal and ocular discharges (11). Respiratory symptoms like coughing, sneezing, and labored breathing arise due to respiratory tract inflammation, often accompanied by conjunctivitis marked by red, swollen, and teary eyes. Lesions in the mouth and on gums cause discomfort, hampering eating and drinking, while gastrointestinal effects encompass diarrhea, reduced feed intake, weight loss, and dehydration. Although less common, skin lesions like redness, swelling, or blisters can occur. Behavioral shifts like depression, isolation, and decreased activity might manifest, and in pregnant animals, PPR can lead to abortion or stillbirth, contributing to reproductive losses.

Post-mortem examinations of animals affected by Peste des Petits Ruminants (PPR) often uncover distinctive lesions indicative of the disease, encompassing inflammation, ulceration, and hemorrhages in the gastrointestinal tract particularly the stomach and intestines and Zebra markings are a significant diagnostic feature of PPR and are typically seen in the posterior part of colon and rectum as discontinuous streaks of congestion, particularly the jejunum (2). Additionally, respiratory tract involvement becomes evident through inflammation and congestion in the lungs and trachea, sometimes leading to lung consolidation and pleural effusion. Lymphoid tissues, central to PPR's impact, exhibit enlargement and congestion in the lymph nodes, spleen, and tonsils. Oral lesions manifest as erosions and ulcerations on the tongue, gums, and mucous membranes. Depending on disease severity, other observations might include organ congestion, such as in the liver and kidneys, and sporadically, skin lesions like blisters or erosions. These post-mortem findings play a crucial role in confirming PPR diagnoses and differentiating the disease from similar conditions in small ruminants.

The economic impactof Peste des Petits Ruminants (PPR) is substantial, exerting far-reaching consequences on livestock and communities. When goats are infected with PPR, their productivity takes a hit on multiple fronts. Reproductive capabilities are impaired, causing a decrease in fertility rates and potentially leading to a rise in abortions and stillbirths. Additionally, growth rates among infected animals diminish, resulting in delayed maturation and reduced body weight gain. The combined effect of mortality and decreased productivity can result in significant economic losses, affecting not only individual goat herders but also entire communities that rely on these animals for their livelihoods and sustenance (5).

The geographic distributionof PPR is wide-ranging, primarily affecting regions in Africa, Asia, and the Middle East (3). This disease is particularly prevalent in areas with substantial populations of goats and sheep, given that these species are highly susceptible to PPR. In these regions, where small ruminants are integral to the local economy and social fabric, outbreaks of PPR can lead to cascading economic and social challenges. The disease's impact extends beyond the immediate loss of animals to encompass disruptions in the supply of meat, and other byproducts and can even hamper access to resources such as leather and wool. This underscores the urgency of effective control measures to mitigate the disease's economic toll and preserve the livelihoods of those reliant on small ruminant husbandry.

Prevention and control strategies for Peste des Petits Ruminants (PPR) encompass vaccination, considered the primary and most effective method, with various vaccines employed in endemic areas to safeguard vulnerable animals. Complementary biosecurity measures, including isolating infected animals, imposing movement limitations, and upholding hygiene standards, play a vital role in limiting disease transmission. Additionally, raising awareness among farmers and herders about the significance of vaccination and implementing biosecurity practices is crucial for comprehensive disease management.

BACKGROUND:

One of the seven provinces of Nepal established by the constitution is Bagmati Province. It is the second-most populous and fifth-largest province in terms of area in Nepal. The province, which has Hetauda as its provincial seat and is also where Kathmandu, the nation's capital, is located, is largely hilly and mountainous and is home to high peaks including Gaurishankar, Langtang, Jugal, and Ganesh.Bagmati Province, which makes up around 13.79% of Nepal's total area and has an area of 20,300 km2, contains 13 districts and has a population of 6044022.

Figure 1: Districts of Bagamati Province

Source: NepalNews, 2022 (https://www.nepalnews.com)

There have been several commercial goat farms as well as conventional farms that raise both native and foreign varieties of goats. Following figure will illustrate the total number of goat and sheep in 13 districts of Bagamati Province and the meat production status of Bagamati Province among 7 provinces of Nepal.Bagamati Province have 89014 sheeps and 2593899 Goats in Number and total meat from sheep and goats of this province are 14096 MT in a year 2021/22 (Statistical-Information-on-Nepalese-Agriculture-2078-79-2021-22)

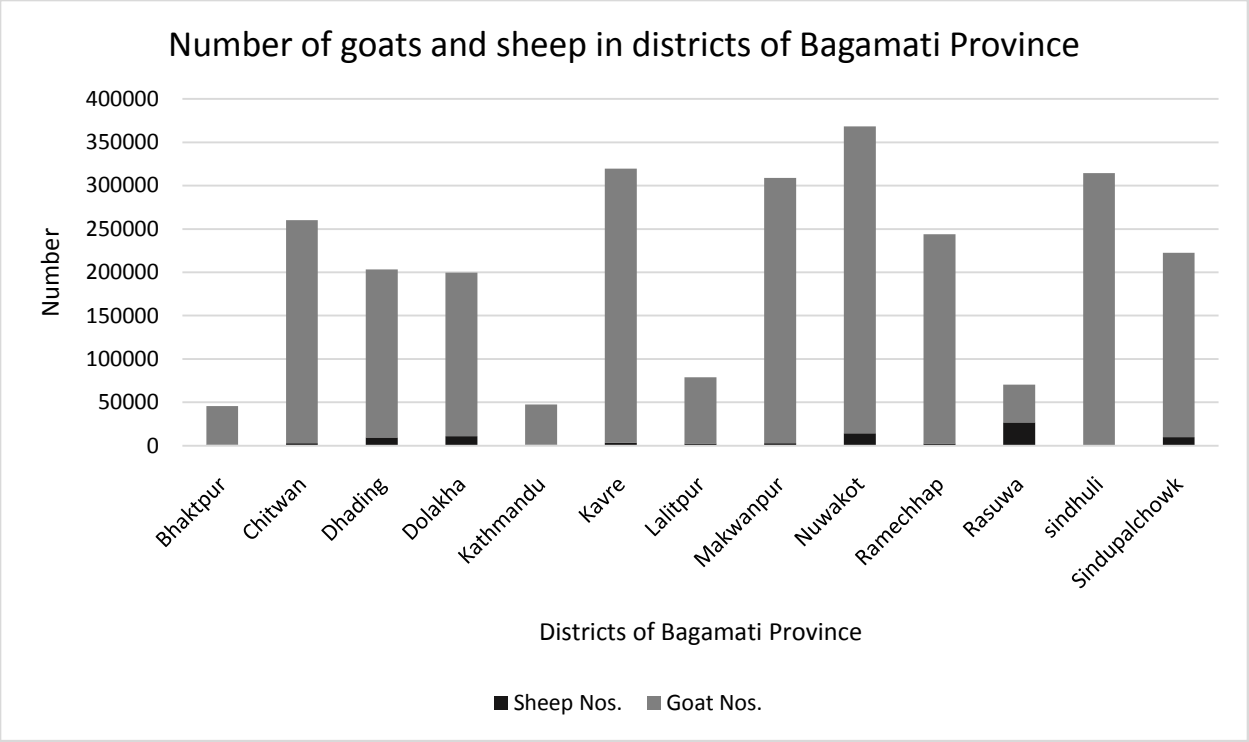

Figure 2: Total number of goats and sheeps in year 2021/22 of Bagamati Province

Source: (Statistical-Information-on-Nepalese-Agriculture-2078-79-2021-22)

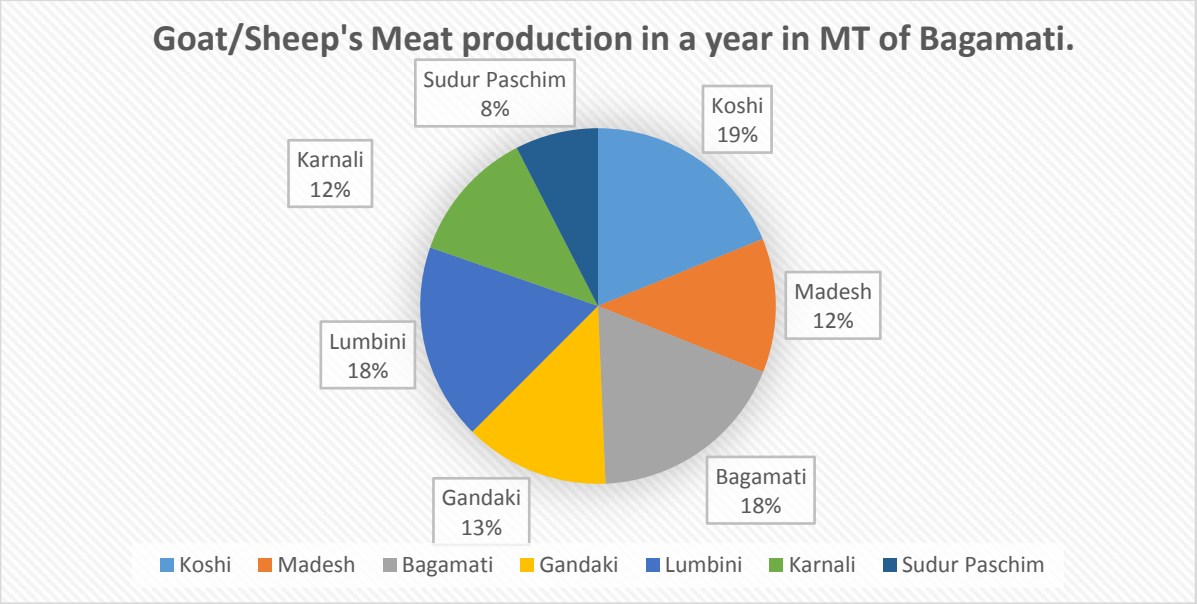

Figure 3: Meat production from goat and Sheep in Year 2021/22 of Bagamati Province.

Source: (Statistical-Information-on-Nepalese-Agriculture-2078-79-2021-22)

PPR first appeared in the African country of Ivory Coast in 1942(18). This disease, which was initially confined to the continent of Africa, has now spread to many countries around the world. This disease has appeared first in 1995 (1) and had speeded in all districts of Nepal. When this disease appears in old places, the death rate is low, but if it spreads to new places, the death rate is high. The national PPR disease control program is currently being implemented throughout the country to control this disease, which causes great economic and social damage to farmers. In order to ensure the leading and significant role of Bagmati Province in eradicating PPR disease from the country by 2030 by implementing the same program effectively in all the districts within the Bagmati Province district, the Bagmati Province Government conducted a weekly vaccination program against PPR disease throughout the province in Fiscal Years 2021/22 and 2022/23.

In view of the fact that the World Animal Health Organization (Office International des Epizooties, OIE) and the United Nations Food and Agriculture Organization (Food and Agriculture Organization of the United Nations, FAO) have moved forward the strategy to eliminate PPR by 2030, and through the Animal Health Program Implementation Procedure, 2075 Chapter 3, the implementation of the PPR disease control program, a clear action plan has been created to effectively control this disease, and a PPR vaccination campaign is being conducted.

PPR disease causes many sheep and goats to die each year in Nepal, costing farmers a fortune. This makes it imperative to take strong measures to control the PPR disease, and the vaccine program may be a key first step, given the risk that farmers and suppliers who depend on sheep and goat farming may leave the industry.

OBJECTIVES OF THE PROGRAM:

- To conduct a vaccination program against PPR at the same time throughout the provincial districts
- Facilitating, systematic and effective immunization programs.
- To eliminate PPR by 2030 from Nepal.

IMMUNIZATION PROGRAM CONDUCTED IN FY 2021/22 AND FY 2021/22

3.1 Campaign Operation Date for Fiscal Year 202: 2022/02/08 to 2022/02/14
3.2 Campaign Operation Date for Fiscal Year 2022/23: 2023/02/13 to 2023/02/19

List 1 :Action plan model for Campaign

Date	Job description	Responsible body
15 days before campaign	Publish notification for appointment of vaccinator. To hold a coordination meeting regarding the vaccination campaign with the Goat Traders Federation.	▪ Related Veterinary Hospital and Livestock Services Expert Center in coordination with the concerned local level ▪ Ministry of Agriculture and Livestock Development, Bagmati Province
10 days before campaign	▪ To appoint the vaccinator in the area of work. ▪ Designate the vaccination center as per requirement and request the related ward office for assistance along with the information.	▪ Related Veterinary Hospital and Livestock Services Expert Center in coordination with the concerned local level

	▪ Farmers raising more than 20 sheep and goats can be identified and vaccinated at the same place. ▪ Production and printing of PPR vaccination cards, campaign logos, jingles, pamphlets and brochures etc.	
7 days before campaign	▪ Spreading propaganda through various media including radio FM newspapers. ▪ Storing vaccines and purchasing the necessary materials for vaccination and providing them to the vaccination center. ▪ Identify the areas with high risk of disease and determine the first priority location for vaccination. ▪ Making the necessary arrangement for insufficient vaccine quantity ▪ To inform the relevant local level and security agencies about the vaccination campaign.	▪ Veterinary hospital and local government ▪ Directorate of Livestock and Fisheries Development and Ministry of Agriculture and Livestock development ▪ Veterinary hospital
One day before campaign	▪ Press briefing regarding vaccination campaign	▪ Ministry of Agriculture and Livestock Development, Bagamati Province
1st day of campaign	▪ Inaugurate the vaccination campaign. ▪	▪ Ministry of Agriculture and Livestock Development, Bagamati Province
2nd to 7th day	▪ Expert centers should collect vaccination data from the relevant local animal service branch or vaccination center and send it to the Directorate of Livestock and Fisheries Development.	▪ Vetrinary Hospital
After vaccination campaign	▪ In order to monitor the efficacy of the vaccine, the relevant laboratory will collect the serum and provide the preliminary test report to the Directorate of Livestock and Fisheries Development located in the province and the Directorate will inform the relevant local level through the Veterinary Hospital and Animal Services Expert Center. ▪ Monitoring and follow-up of vaccination work.	▪ Directorate of Livestock and Fisheries Development, Bagmati Province, related expert centers and Central Livestock Disease Research Laboratory, Tripureshwar, Kathmandu ▪ Directorate of Livestock and Fisheries Development and Ministry of Agriculture and Livestock development

Source: PPR control action plan, 2021and 2022

Financial Management: The available vaccines were provided by the federal government, and the Department of Livestock Services has allocated budget for logistics support through the Federal State Program. The remaining needed budget was supplied by the provincial government to the Veterinary Hospital and Livestock Expert Services Center, which is located in 8 districts and has working areas in 13 districts of Bagamati Province. Seromonitoring was performed by the Central Veterinary Laboratory, Tripureswor. Besides vaccines and seromonitoring, the total budget allocated was approximately 91,500 USD in one year.

VACCINE COVERAGE REPORT

Vaccine coverage in the Year 2021/22.

S.N.	District	Vaccine available in 2021/22	Vaccinated number in 2021/22	Progress report	Remarks
1	Bhaktpur	30000	6181	21	
2	Chitwan	127000	71418	56	
3	Dhading	107000	83270	78	
4	Dolakha	96000	94998	99	
5	Kathmandu	36000	31557	88	
6	Kavre	165000	99182	60	
7	Lalitpur	56000	27587	49	
8	Makwanpur	176000	166423	95	
9	Nuwakot	220000	120019	55	
10	Ramechhap	102000	44610	44	
11	Rasuwa	29000	23165	80	
12	sindhuli	30000	45825	153	Local governments also work together.
13	Sindupalchowk	16000	15952	100	
	Total	**1190000**	**830187**	**70**	

Table 1: Vaccination coverage of one week campaign against PPR in year 2021/22 of Bagamati Province

Vaccine coverage in the Year 2022/23.

S.N.	District	Vaccine available in 2022/23	Vaccinated number in 2022/23	Progress report	Remarks
1	Bhaktpur	32000	4153	13	
2	Chitwan	135000	86802	64	
3	Dhading	114000	97407	85	
4	Dolakha	102000	84176	83	
5	Kathmandu	38000	40143	106	Local governments also work together.
6	Kavre	176000	132270	75	

7	Lalitpur	60000	44513	74	
8	Makwanpur	188000	159007	85	
9	Nuwakot	235000	145281	62	
10	Ramechhap	109000	106202	97	
11	Rasuwa	31000	30440	98	
12	sindhuli	32000	30400	95	
13	Sindupalchowk	17000	19135	113	Local governments also work together.
	Total	**1269000**	**979929**	**77**	

Table 2: Vaccination coverage of one week campaign against PPR in year 2022/23 of Bagamati Province

Though vaccine coverage had not been completed at the time of the campaign and there had been a continual procedure till the remaining vaccine was done, we only considered the one-week campaign.

PROBLEMS ENCOUNTERED IN CONDUCTING THE VACCINATION CAMPAIGN

Conducting an effective vaccination program is a difficult task, especially during a global epidemic like COVID-19. The challenges experienced can vary depending on the geography, the resources available, and the level of coordination amongst various parties. Let us expand on the points raised:

- **Inadequate Vaccine Supply:** Providing a constant and sufficient supply of vaccines is one of the most difficult difficulties in immunization programs. When there is a vaccine scarcity, it can cause delays in the immunization process and frustration among the people. Manufacturing constraints, distribution challenges, strong global demand, or supply chain interruptions could all contribute to this.
- **Geographic Difficulties:** Some places may have geographical difficulties, such as distant areas, rough terrain, or areas with little infrastructure. These variables can make it difficult to distribute vaccinations and deploy immunization teams efficiently. This can cause delays in reaching all communities, particularly those in difficult-to-reach areas.
- **Inadequate Vaccinators:** A successful campaign requires adequate staffing of vaccination centers and teams. If there are fewer vaccinators than there is demand for immunization, vaccination rates may slow. Time and money are required to train and mobilize a sufficient number of technician experts to deliver vaccines.
- **Limited Publicity:** Effective communication is required to inform the public about the importance of vaccination, the vaccination process, and the advantages of vaccination. There may be skepticism or disinformation flowing among the population if there is a lack of publicity and clear information regarding the campaign. This may reduce people's willingness to have their pets vaccinated.
- **COVID-19 Nationwide Transmission:** The extensive transmission of COVID-19 inside a country can make a vaccination program difficult.

Addressing these issues would necessitate a multifaceted approach combining government agencies, non-governmental organizations, and foreign partners. Some potential strategies include:

- Increasing Vaccine Production: Collaborating with vaccine manufacturers to increase production and maintain a consistent supply of vaccines.
- Infrastructure Improvement: investing in infrastructure to facilitate vaccine distribution to remote and hard-to-reach areas

- Vaccinator Training: Fast-track the training and deployment of veterinary technician to serve as vaccinators.
- Communication efforts: Starting information and awareness efforts to educate the public about the importance of vaccination and the details of the campaign.
- Adapting to Conditions: Flexibility in campaign planning to adapt to changing COVID-19 transmission rates and related restrictions

Successfully conducting a vaccination campaign requires a well-coordinated effort that addresses the unique challenges posed by the pandemic and the specific circumstances of each region.

EFFICACY OF VACCINATION

Seromonitoring was performed with collaboration of Central Veterinary Laboratory, Tripureshswor and they have provided the following report.

S.N.	District	Seroconversion percentage 2021/22	Seroconversion percentage 2022/22
1	Bhaktpur		
2	Chitwan	92.66	59
3	Dhading	83.66	54.93
4	Dolakha	85.37	
5	Kathmandu	85.9	
6	Kavre	61.5	
7	Lalitpur		74.29
8	Makwanpur	87.37	71
9	Nuwakot	92	
10	Ramechhap	88.83	
11	Rasuwa	52.53	
12	Sindhuli	43.59	

Table 3: Report provided by central veterinary laboratory to Bagamati province on Seromonitoring of PPR.

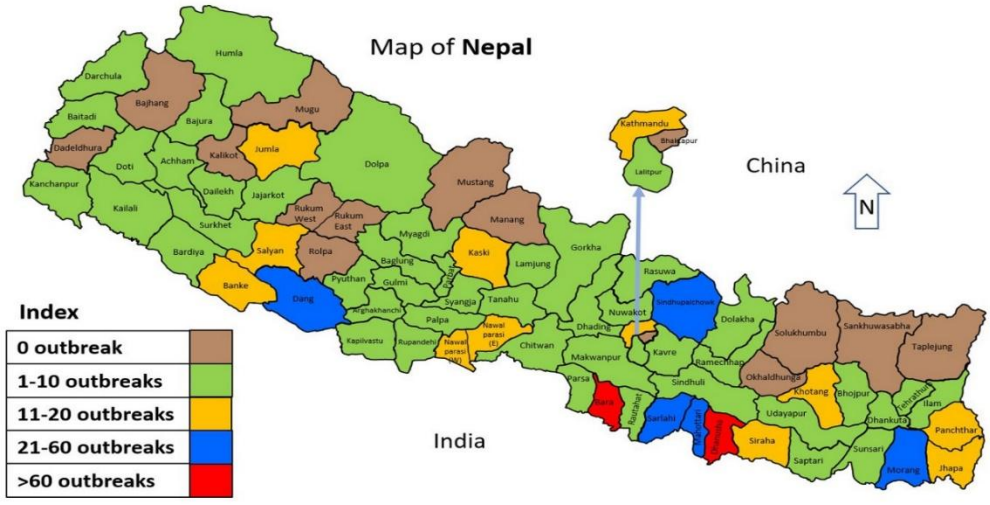

Figure 4: District-wise distribution of PPR in Nepal

Source: (1) and *Situation analysis of Peste des Petits Ruminants (PPR) for past 10 (2008–2017) years in Nepal, Veterinary Epidemiology Section, Animal Disease Investigation and Control Division, Tripureshwor, Kathmandu*

In an annual report of Central veterinary laboratory of Nepal a serum sample of 29 goats from district Kathmandu, Dhadhing and Chitwan were tested against PPR through ELISA 96.5% sample were found to be positive against PPR in Fiscal Year 2019/20. In the year 2021/22, after the vaccination campaign was conducted in all the districts of Bagmati Province, there has been only 2 outbreak notification of PPR disease infection in this province till 14th of March, 2023which in the sense, proving the weekly campaign vaccination against PPR to be successful.

CONCLUSION:

In conclusion, the one-week vaccination campaign has been a resounding success, effectively reaching a substantial portion of the target population. The collaborative efforts of federal government,Ministry of Agriculture and Livestock development, Bagamati Province, Directorate of Livestock and Fisheries Development, Veterinary Hospital and Livestock Services expert center and related local government have led to a significant increase in vaccine uptake. The campaign's strategic planning, efficient execution, and accessibility have played pivotal roles in achieving widespread immunization coverage within a short timeframe. As a result, the community is now better protected against infectious disease PPR, laying a foundation for improved animal health outcomes in the future. Continued momentum in such campaigns is crucial to ensuring the longevity of this positive impact and fostering a healthier and more quality products of sheep and goat. Furthermore, Bagmati Province Government, Ministry of Agriculture and Livestock Development, which conducts the vaccination program against the infectious disease PPR in sheep and goats as a campaign every year, it is seen that the vaccination program against PPR has been effective.

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