

Assessing the Economic Sustainability of early GALVmed Market Development Pilot Projects: 5 Years On

A GALVmed Monitoring and Evaluation Study



Executive summary

This study sought to assess the sustainability and durability of private sector Newcastle Disease (ND) vaccine supply into the smallholder sector. The approach was to return to three locations that had been used as ND vaccine pilot studies five years previously and to assess which aspects of vaccine supply and demand had stood the test of time and which had not.

The results of the study showed a surprising degree of economic durability. The original pilot studies had not been initiated through a commercial partner (as is current GALVmed market development practice in partnering with vaccine manufacturers and distributors) and they had received no further assistance or input from GALVmed or other NGOs. It therefore seemed reasonable to assume that these sites might have experienced a decline and possible complete failure in ND vaccine supply and demand. In contrast to these expectations, the results from the study showed:

- That over 50% of rural retailers (agro-veterinary type shops) in the three study areas were stocking and selling ND vaccines. This represents a healthy level of rural supply and indicates that retailers consider the vaccine to be a product that can be sold in sufficient volumes and at sufficient margins to justify stocking as a refrigerated product.
- That of the ND vaccinators trained in the original pilot projects, and who could be traced in the current study, 77% were still regularly vaccinating poultry. This indicates that ND vaccination can be seen as a long term and viable commercial activity for appropriately trained individuals in rural regions.
- That of the 245 poultry-owning smallholders sampled across the three study sites, 61% were purchasing ND vaccines (either through retailers or through vaccinators) for their poultry. This represents a healthy level of adoption given that no marketing or awareness activities had taken place in the area for five years.
- That ND vaccinating households reported monthly poultry income as being 50% higher than non-ND vaccinating households.

While the study did not attempt to quantify the degree of 'spill-over' of ND supply and usage to adjacent areas, the fact that more retailers were stocking ND vaccines 5 years on than before the pilot started indicates that there was some expansion. Whether this was linked to the pilot and driven by retailers, vaccinators, or smallholders would be an interesting focus for further study.

The study has important consequences for GALVmed and its partners. Economic sustainability is at the heart of GALVmed's strategic vision. Significant numbers of smallholders need to be realising sufficient productivity gains from the use of animal health products to continue paying the market price for these products. The various links and players in the supply chain need to be generating sufficient revenue and profit to incentivise their continued stocking and selling of these animal health products. It is these ongoing forces of demand and supply that ensure the long-term economic sustainability and viability that GALVmed seeks to catalyse in the smallholder animal health sector. This study has afforded the first tangible evidence that achieving such sustainability is a practical reality.

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Background

This GALVmed Monitoring and Evaluation (M&E) study looked at the economic sustainability of early GALVmed market development pilot projects. The purpose of the study was to gain insight into factors affecting the sustainability of Newcastle Disease (ND) vaccination for all stakeholders in the distribution chain including retailers, vaccinators, and smallholders.

Introduction

In 2016, GALVmed sought to evaluate the sustainability of the earliest market development pilot projects that had been undertaken five years previously. The requirement was that these pilot projects would not have received any additional support or assistance in the intervening period. This requirement significantly reduced the field of potential study sites. All East Coast Fever Infection Treatment Method (ECF-ITM) vaccine pilot project areas were still subject to ongoing scale-up support activities by GALVmed. Similarly, most ND vaccine pilot sites had been subsequently scaled up into larger market development field projects. Only three ND vaccine pilot project sites were identified as being 'untainted' and therefore suitable for the study¹.

The pilot project areas included in the M&E study were:

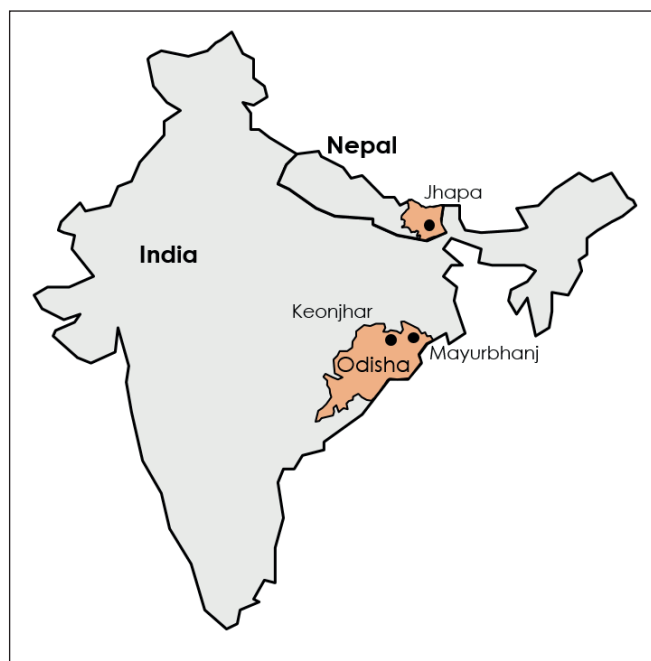
Table 1. Pilot project areas included in the M&E study sample

Country	District/State	Local Area
Nepal	Jhapa District, Mechi Zone	7 wards within the Arjundhara and Khudnabari Village Development Committees (VDCs)
India	Keonjhar District, Odisha State	117 villages in 21 Gram Panchayats (GPs) in the Banspal and Patna blocks of the district
	Mayurbhanj District, Odisha State	92 villages in the Rasgovindpur and Morada blocks of the district

As the level of supply and demand were unknown, an initial scoping exercise was undertaken to assess the situation in the three study sites. The scoping exercise suggested buoyant levels of supply and demand for the ND vaccine. The study design therefore changed in orientation, from a 'post-mortem' looking at learning what might have failed and why (in order to incorporate these learnings in future market development work) to, instead, collecting data on the current supply and demand of ND vaccine in three pilot project sites. This data and understanding would then subsequently feed into GALVmed's current market development strategy.

¹A small percentage of the study sites in Mayurbhanj were later found to have received GALVmed interventions.

Map of project areas in India and Nepal



Project Background

The pilot projects originally established ND distribution networks over a period of 12 to 18 months in 2010 and 2011. Core activities included training retailers in cold chain logistics and sourcing ND vaccines from distributors. The pilot project implementers also identified and trained vaccinators in vaccine administration and built awareness of the ND vaccine among smallholders in the project areas. The pilot project characteristics are summarised below:

Table 2. Pilot project summary

Component	Pilot project 1	Pilot project 2	Pilot project 3
Site of pilot project	Jhapa, Nepa	Keonjhar, India	Mayurbhanj, India
Duration of pilot project (months)	13	18	16
Households participating in pilot project	2,300	7,587	9,160
ND doses sold during pilot project	60,000	169,000	265,000
Cost of pilot projects (USD)	44,000	57,000	81,000
Original no. retailers stocking ND vaccine	1	1	5
Original no. vaccinators trained	5	27	66

Study design

Questionnaire

This M&E study was implemented through questionnaire-based surveys (Appendix 1 – Retailer questionnaire; Appendix 2 – Vaccinator questionnaire; Appendix 3 – Smallholder questionnaire).

The smallholder questionnaire looked at the household ND vaccination profile, productivity, and income from poultry in the project area. The vaccinator questionnaire looked at delivery of animal health services and ND vaccination services, the amount and consistency of these services, and income derived from these services. Finally, the retailer questionnaire reviewed the profile of local agro-veterinary retailers, whether retailers stocked ND vaccines, and the income they derived from ND vaccine sales.

The survey questionnaires comprised a mix of structured open and closed questions. The English questionnaires were translated into local languages during enumeration. Following the completion of each survey, data was entered into a customised database.

Sampling

A sampling frame of all known villages was constructed for each study area. Fifty households per block were sampled using proportional allocation to determine the number of villages from which to sample. Five poultry-owning households per village were randomly selected from within the sample. Retailers were identified by the data collection team and vaccinators were either identified through these retailers or identified via consultation with the pilot project partners. Altogether, 251 smallholders, 54 vaccinators, and 30 retailers were surveyed across the three pilot project areas in India and Nepal.

Table 3 shows the survey base sizes across the study areas for each of the three parts of the distribution chain: retailers, vaccinators, and smallholders.

Table 3. Survey base sizes

Pilot Project Area	No. Retailers Surveyed	No. Vaccinators Surveyed	No. Smallholders Surveyed
Jhapa	18	14	50
Keonjhar	5	20	102
Mayurbhanj	7	20	99

Data processing and statistical analysis

Data was collected on paper forms before being manually entered into electronic format. Outliers were removed on a single-metric basis (rather than declaring entire records void). Subsequent analysis was completed using Microsoft Excel. Low base sizes resulted in predominantly descriptive methods being used. Most comparative indicators were calculated using only the data provided in the surveys.

Findings

The M&E study explored the sustainability of ND vaccination activities in the pilot project areas from the perspective of all stakeholders in the distribution chain: retailers, vaccinators, and smallholders. This section first looks at ND vaccine supply and then looks at ND vaccine sales and profitability from the perspectives of local retailers and vaccinators before turning to smallholder vaccine use and profits derived from poultry. The vaccinator and smallholder sample characteristics are provided in Appendix 4 and Appendix 5.

Supply of ND Vaccines

A key question was whether the establishment of local vaccinators would generate sufficient business to increase demand for ND vaccines in the pilot project areas. The underlying assumption was that demand for these products would, in turn, encourage local retailers to source and stock these products.

Before the pilot projects began, only a single retailer stocked ND vaccines in Jhapa (Nepal) and Keonjhar (India) whereas in Mayurbhanj (India), 5 retailers stocked these vaccines. With GALVmed involvement, the numbers increased. However, there was no guarantee after the pilot projects ended in 2011 that the retailers affiliated with the projects would continue stocking vaccines or that other retailers, not affiliated with the pilot projects, would start stocking ND vaccines.

Five years later, of the 18 retailers surveyed in Jhapa, 4 were found to stock ND vaccines. Of the 5 retailers surveyed in Keonjhar and of the 7 surveyed in Mayurbhanj, all stocked ND vaccines (Figure 1). Given that the increase in the number of retailers stocking ND vaccine were seen in a small sample, it is reasonable to assume that the actual number of retailers stocking these vaccines is higher.

Despite the overall increase in retailers stocking ND vaccines, most retailers surveyed in Jhapa either did not stock the vaccine or discontinued stocking the vaccine over the intervening 5 years (Figure 1). Jhapa retailers cited lack of profit margins, no cold chain storage facilities, and poor smallholder awareness and demand as key factors discouraging them from stocking the vaccine (Figure 2).

Only 4 of the 18 retailers surveyed in Jhapa indicated that they were affiliated with the original pilot project compared to all the retailers surveyed in Keonjhar and Mayurbhanj. This difference could explain the lower numbers of Jhapa retailers stocking ND vaccines, assuming the initial GALVmed-retailer relationship instigated the stocking and selling of the vaccine. Another possibility is that lack of refrigeration facilities may have affected ND vaccine stocking in Jhapa. Only the 4 retailers that stocked ND vaccines in Jhapa had fridges, along with all the retailers in Keonjhar and Mayurbhanj. Conversely, those that did not have refrigerators did not stock ND vaccines.

All retailers stocked the Lasota / I2 vaccine. Half of the retailers also stocked the R2B injectable vaccine. Across the board, there was limited stocking of commercial pack sizes greater than 100 dose vials, indicating that retailers were catering to the smallholder market through sales of smaller, more suitable, pack sizes.

Figure 1. Retailers stocking ND vaccines

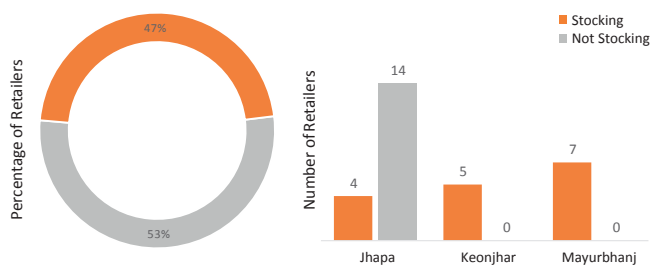
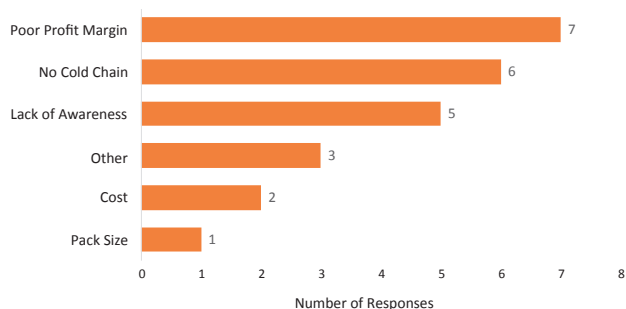


Figure 2. Retailer reasons for not stocking ND vaccines



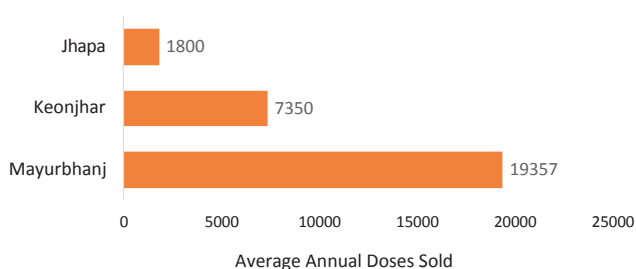
Sale of ND Vaccines

Retailer Sales

To assess whether retailers benefitted from ND vaccine sales 5 years on, the surveyed retailers were asked to provide information on the number of doses that they sold, the average profit that they derived from the sale of ND vaccines as a percentage of shop profit, and their estimated gross profit from the sale of ND vaccines.

Retailers in Jhapa sold around 1,800 doses per annum compared to 7,350 doses in Keonjhar and 19,357 doses in Mayurbhanj (Figure 3). The variation in sales between the different pilot areas likely reflects the relative market size of each location². These findings suggest that even modest sales may be sufficient for commercial viability of the ND vaccine in some areas.

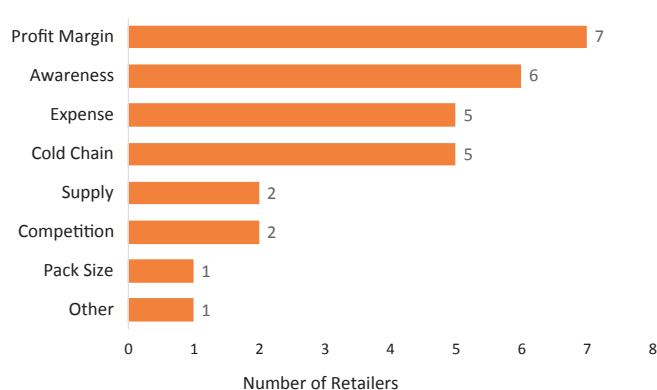
Figure 3. Retailer annual sales of ND vaccines



Retailers that stocked ND vaccines cited challenges such as high expense, low profit margins, and poor smallholder awareness as key factors affecting sales (Figure 4). These challenges would likely feature in any viable market and, as such, are unsurprising.

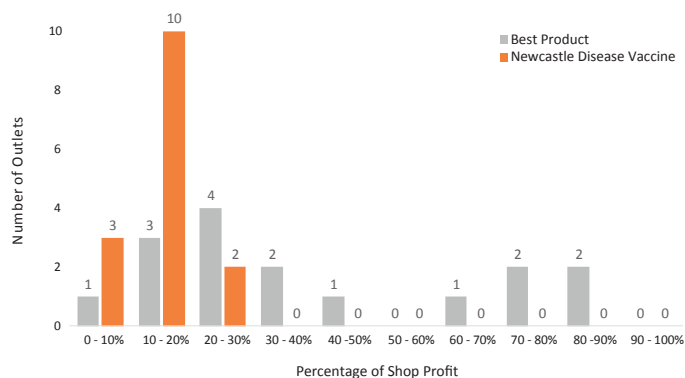
² After the study was completed, it became clear that project activities had continued in approximately 20% of the survey sites in Mayurbhanj. Therefore, the higher sales in this area likely reflect the continued activities of the programme in these sites.

Figure 4. Key challenges affecting ND vaccine sales



In the retailer shops that stocked ND vaccines, ND sales comprised between 10 – 30% of shop profit compared to the “best-selling” product in the shop (Figure 5). While ND vaccine sales did not drive most of the profit, they drove sufficient profit to warrant continued stocking of the vaccine.

Figure 5. Profit from ND vaccine sales as a percentage of retailer profit



Looking at the income retailers derived from sales of ND vaccines, approximately half of the retailers that provided data (5 of 9 retailers) made an average gross profit of up to Rs. 1,333.33 (USD 20.00) per month (Figure 6). Complete data was only available for the Indian retailers and the situation in Nepal is not reflected in these numbers. Overall, the profits retailers derived from sales of ND vaccines were modest.

Figure 6. Retailer estimated gross profit per month



Vaccinator Sales

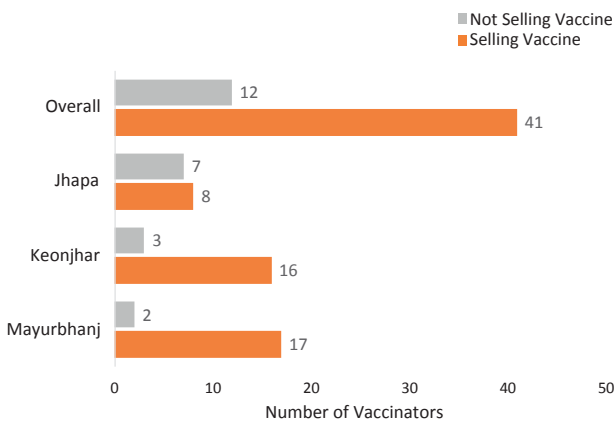
Retailers represent the first link of the distribution system for ND vaccines. While retailers sell some ND vaccines directly to smallholders, they also rely on vaccinators to distribute and administer the products. One of the key questions in the follow-up study was whether vaccinators continued providing ND vaccination services five years after formal support ended in the pilot areas. The understanding was that if this were the case then vaccinators must have been making sufficient income to encourage them to continue to provide these services to smallholders.

At the start of the pilot projects, 5 vaccinators were identified and trained in Jhapa while in Keonjhar this number was 66 and, in Mayurbhanj, 27. Five years later, GALVmed was able to identify, through the retailers in the study, 4 vaccinators working in Jhapa, 11 in Keonjhar and 26 in Mayurbhanj. Given the convenience sampling strategy used to find vaccinators for the follow-up study, the actual number of working vaccinators is probably much higher.

Of the vaccinators accessed in the follow-up study, 69% were male and 31% were female (Appendix 4, Figure A 4.1). For two-thirds (66%) of these vaccinators, sales of animal health products were their main source of income (Appendix 4, Figure A 4.2). Half (53%) of the vaccinators reported travelling by bicycle while a quarter (25%), mainly in Jhapa, travelled via motorbike (Appendix 4, Figure A 4.3).

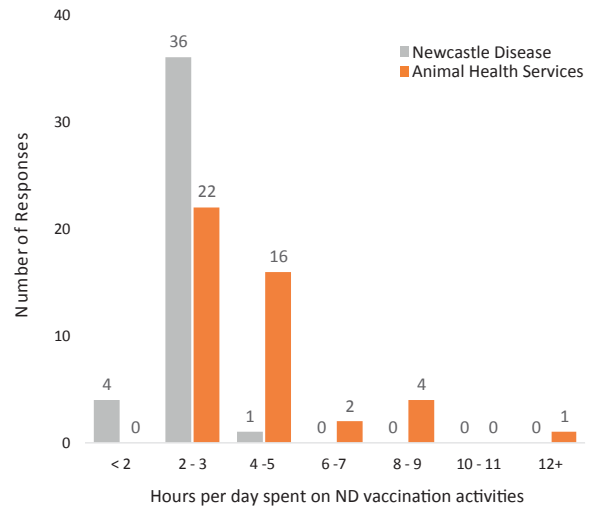
Across all three pilot project locations, approximately three quarters (76%) of the vaccinators surveyed in the M&E study continued to sell ND vaccines 5 years later (Figure 7). This number was lower for Jhapa where just over half of the vaccinators (53%) sold ND vaccines compared to 84% of vaccinators in Keonjhar and 89% in Mayurbhanj. Overall, vaccinators typically spent 2 to 3 hours on vaccination services per day (Figure 8), indicating that ND vaccination services formed only a part of their daily work.

Figure 7. Number of vaccinators selling ND vaccines



³ For most vaccinators, animal health services were their primary form of income.

Figure 8. Hours per day spent on ND vaccination activities



Vaccinators in the sample sold, on average, 21,025 doses of ND vaccine in Mayurbhanj, 13,480 doses of ND vaccine in Keonjhar and 1,783 doses of ND vaccine in Jhapa per annum (Figure 9). The variation in sales between the different pilot areas, again, likely reflects the relative market size of each location with Jhapa delivering far fewer doses than either of the pilot locations in India.

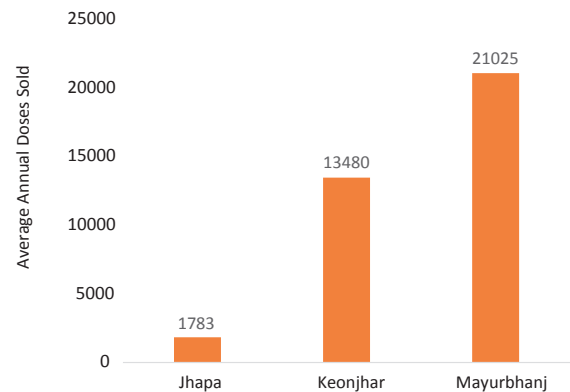
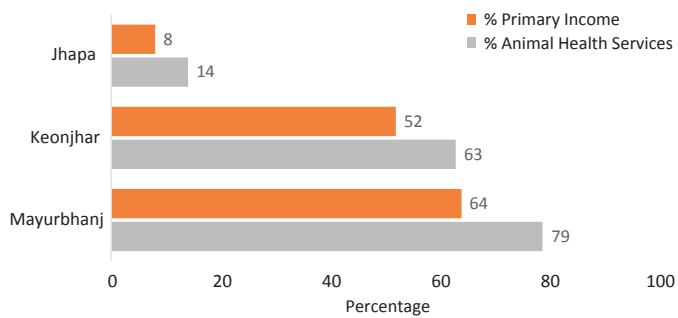


Figure 9. Vaccinator annual sales of ND vaccines

For the vaccinators in Keonjhar and Mayurbhanj, ND vaccine sales made up more than 50% of their primary income (Figure 10). In Mayurbhanj, ND vaccine sales comprised 64% of vaccinators' primary income³ and 79% of income from animal health services. In Keonjhar, ND vaccine sales made up 52% of vaccinators' primary income and 63% of their income from animal health services. The exception was Jhapa where ND vaccine sales comprised only 8% of their primary income and 14% of their income from animal health services.

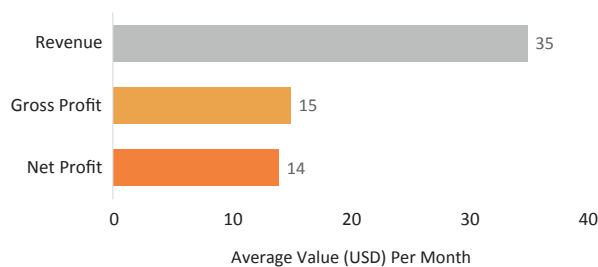
The differences in ND vaccination sales between the vaccinators in India (Keonjhar and Mayurbhanj) and Nepal (Jhapa) may partially reflect the types of vaccinators trained in these pilot areas. In India, the vaccinators were given basic training in poultry vaccination. In Nepal (Jhapa), vaccinators were already working as Community Animal Health Workers (CAHWs) and had prior training in vaccinating other animal species. Therefore, the Jhapa vaccinators had other sources of income and may not have had to rely as heavily on ND vaccine sales.

Figure 10. Profit from ND vaccination as a percentage of vaccinator profit from other sources



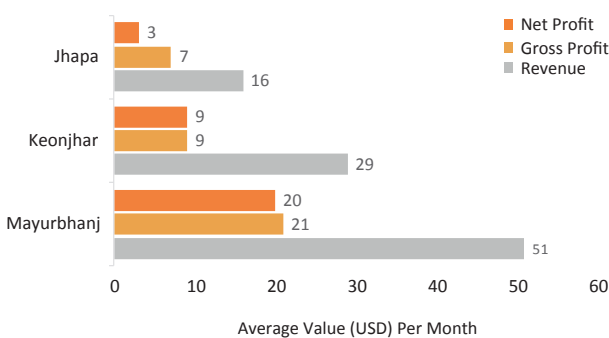
In terms of the income vaccinators derived from sales of vaccines, vaccinators made an average gross profit of USD 15.00 per month (Figure 11). This is very close to the monthly gross profit of up to Rs. 1,333.33 (USD 20.00 / NRs. 2,150.54) per month for most retailers (Figure 6).

Figure 11. Vaccinator monthly earnings



Again, the distribution of profit between the three pilot locations is consistent with the sales of ND vaccines in these areas (Figure 12), with Mayurbhanj generating Rs. 1,333.33 (USD 20.00 / NRs. 2,150.54) net profit on average per month, Keonjhar generating Rs. 600.00 (USD 9.00 / NRs. 967.74) net profit on average per month and Jhapa generating NRs. 322.58 (USD 3.00 / Rs. 200.00) net profit per month. The vaccinator gross profit in Jhapa was comparable to that in Keonjhar, despite much lower volumes of sales, suggesting that vaccinators in Jhapa may have substantially marked up the price of ND vaccines in this area and/or charged considerably more for ND vaccination services.

Figure 12. Vaccinator monthly profit from ND vaccination services by location



⁴ This may reflect the fact that in 20% of the sample sites in Mayurbhanj, project activities continued after the pilot project.

Some of the key challenges vaccinators faced in selling ND vaccines included safety concerns, upfront costs associated with purchasing ND vaccines, travelling between houses, and finding new customers. Female vaccinators were more likely than males to find safety and travelling particularly challenging (Appendix 4, Figure A 4.5). Vaccination often occurs in the evenings when free ranging poultry return from scavenging and so vaccinators are often required to travel late. This fact could partially explain the larger numbers of male versus female vaccinators (Appendix 4, Figure A 4.1).

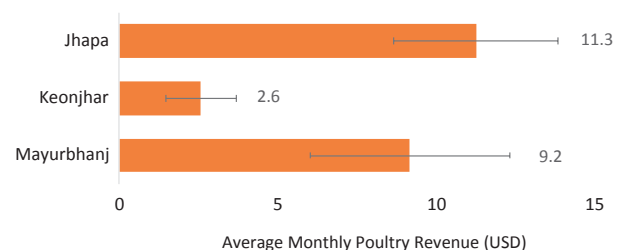
Purchase and Use of ND Vaccines

On the supply side of ND vaccination, the findings indicate that the retailers involved in the pilot project continued to sell ND vaccines after the end of GALVmed support and that the vaccinators continued to vaccinate. Smallholders constitute the last piece of the puzzle. One of the key questions of the follow-up M&E study was whether smallholders were using ND vaccines and, if so, whether they were realising sufficient returns to sustain their vaccination activities.

Of the smallholders surveyed, half (54% in Mayurbhanj and 50% in Keonjhar) were male in the Indian pilot sites, while only a third (30%) were male in Jhapa (Appendix 5, Figure A 5.1). For most smallholders (92% in Mayurbhanj and 98% in Jhapa), poultry was a source of income. The exception was Keonjhar where only 41% of smallholders made an income from poultry (Appendix 5, Figure A 5.2). Adult female smallholders spent the most time looking after poultry. This trend was strong and consistent across the study locations (Appendix 5, Figure A 5.3). Approximately three quarters of the smallholders in Jhapa (76%) and Keonjhar (77%), and two-thirds in Mayurbhanj (67%), were below 50 years of age (Appendix 5, Figure A 5.4). Smallholders in the sample were generally well educated with 94% of smallholders in Jhapa, 74% of smallholders in Keonjhar and 91% of smallholders in Mayurbhanj having a secondary education or higher (Appendix 5, Figure A 5.5).

Of those smallholders that derived an income from poultry, smallholders in Jhapa made the most income at an average monthly amount of NRs. 1,215.05 (USD 11.30 / Rs. 753.33). Comparatively, smallholders in Mayurbhanj made Rs. 613.33 (USD 9.20 / NRs. 989.25) per month, and smallholders in Keonjhar made Rs. 173.33 (USD 2.60 / NRs. 279.57), on average (Figure 13). The income derived from poultry was mainly made up of poultry sales as compared to egg sales.

Figure 13. Smallholder monthly income from poultry



Five years after the pilot project activities ended, 61% of the sample of smallholders in the pilot areas (150 smallholders) reported using ND vaccines (Figure 14). Adoption rates varied across each of the three locations: Mayurbhanj leading with 96% adoption⁴, Jhapa following with 56% adoption, and Keonjhar with 30% adoption (Figure 15). Most smallholders reported that they started to use ND vaccines during the pilot projects, signifying that vaccine use persisted past the end of pilot project activities.

Figure 14. Smallholder ND vaccine adoption

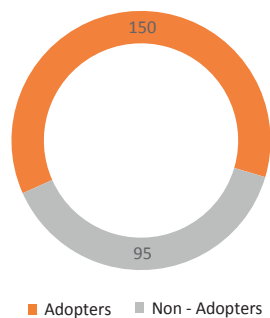
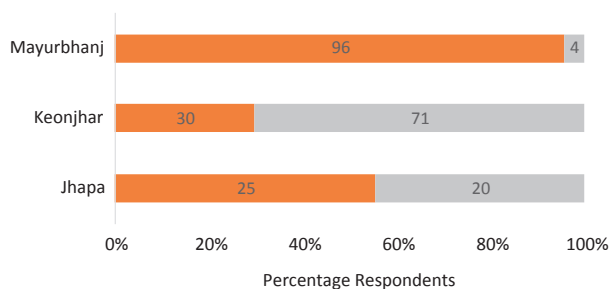
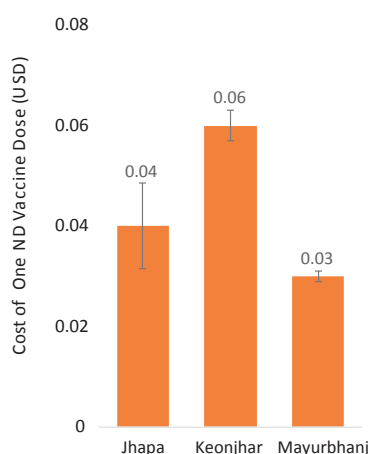


Figure 15. ND adoption rates by location



On average, smallholders in Keonjhar paid the most for ND vaccines at Rs. 4.00 (USD 0.06 / NRs. 6.45) per dose. Jhapa followed closely behind at NRs. 4.30 (USD 0.04 / Rs. 2.67) while smallholders in Mayurbhanj paid the least at Rs. 2.00 (USD 0.03 / NRs. 3.23) per dose. Per Figure 16, there was reasonable consistency in the cost within each location. However, there were some differences between locations with smallholders in Keonjhar paying almost twice as much as smallholders in Mayurbhanj. This is interesting given that the income derived from poultry was smaller in Keonjhar than in any other location. Overall, the cost of the ND vaccine was reasonable across the pilot locations suggesting that product mark-ups may not be the main factor driving vaccinator profit.

Figure 16. Price paid by smallholders for one ND vaccine dose



Smallholder income was calculated from the number of poultry sold in the past 4 months multiplied by the poultry value, before being up scaled to an annual level. For the vaccinating group, the expenditure on ND vaccines was factored into the calculations. The monthly revenue of smallholders who vaccinated against ND was statistically significantly larger than the monthly revenue

of non-vaccinating smallholders (Figure 17). Smallholders who vaccinated their poultry made, on average, Rs. 613.33 (USD 9.20 / NRs. 989.25) per month compared to Rs. 386.67 (USD 5.80 / NRs. 623.65) earned by those who did not vaccinate. This suggests that smallholders that vaccinated saw a strong return on their purchase of ND vaccines.

Figure 17. Smallholder adjusted monthly revenue

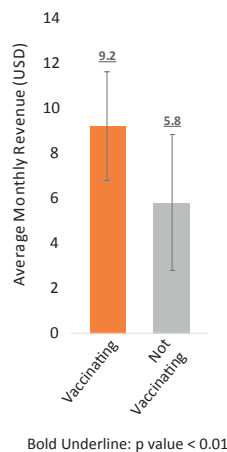
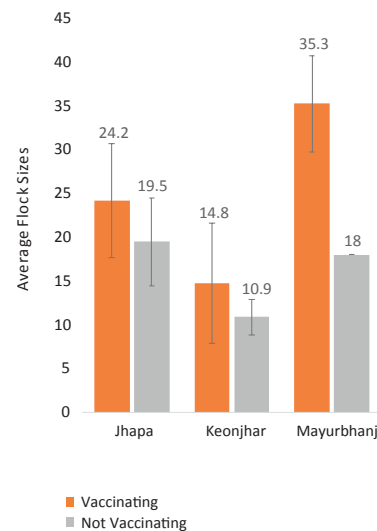


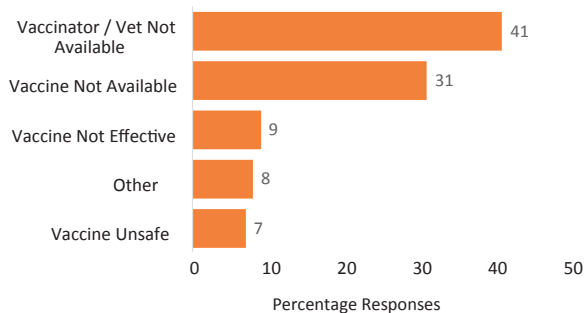
Figure 18. Average flock sizes by location and vaccine use



Smallholders that vaccinated also tended to have larger flock sizes (Figure 18) – a trend that has been seen in at least one other study (De Bruyn et al., 2017). This difference was most pronounced in Mayurbhanj, where vaccinating smallholders had, on average, 35.3 birds compared to 18 birds owned by non-vaccinating smallholders. The relatively smaller flock size differences between vaccinating and non-vaccinating smallholders in Jhapa and Keonjhar could possibly be due to increased offtake through selling or to increased consumption of poultry meat in these areas.

Some of the reasons non-vaccinating smallholders did not vaccinate included unavailability of a vaccinator and unavailability of ND vaccines (Figure 19). Many non-vaccinating smallholders previously used ND vaccines during the pilot projects but stopped vaccinating after the pilot projects ended. This suggests that supply may have dwindled in some areas post-pilot activities. The exception was Jhapa where 14 out of 19 non-vaccinating smallholders (74%) were not previous adopters.

Figure 19. Reasons for non-vaccination



Conclusions

Despite the fact that the GALVmed pilot projects did not build in a long-term commercial partner, the 2016 follow-up study indicates a remarkable degree of sustainability. The vaccine distribution networks that were established in 2011 and 2012 have not only remained but also, through expanding numbers of retailers, spilled over into new areas and thrived.

The results of the 2016 study - compared to the 2010 and 2011 pilot projects - are summarised in the table below:

Table 4. M&E follow-up study results

Component	Pilot project 1	Pilot project 2	Pilot project 3
Site of study	Jhapa, Nepa	Keonjhar, India	Mayurbhanj, India
Duration of original 2011 pilot project (months)	13	18	16
Households participating in 2011 pilot	2,300	7,587	9,160
ND doses sold during pilot	60,000	169,000	265,000
Cost of pilot projects (USD)	44,000	57,000	81,000
Original no. of retailers stocking ND vaccine	1	1	5
Current no. of retailers stocking ND vaccine	4	5	7
Total current annual sales of ND vaccine by above 16 retailers = 2 million doses			
Original no. of vaccinators trained	5	27	66
Current no. of vaccinators working	4	11	26
Avg. no of doses sold per vaccinator per year	1,780	13,480	21,020

The findings suggest that the essential pillars to sustainability have been:

- Rural retailers making reasonable profits through ND vaccine sales.
- Vaccinators making reasonable monthly income from ND vaccine sales.
- Smallholders seeing a strong return on their purchase of the ND vaccine.

The ND vaccine was able to pay its way through the system with retailers, vaccinators and smallholders all making a return on their initial investment.

At the time of the follow-up study, the 16 retailers in the sample collectively sold over 2 million doses of ND vaccine per annum on average. Mirroring the retailer sales, the 41 vaccinators in the sample collectively sold almost a further 1.5 million doses on average per annum. Both groups benefitted from adequate sales to warrant the upfront costs necessary for vaccine procurement and storage.

Correspondingly, years after the pilot studies began, 61% of smallholders in the sample reported using ND vaccines. Many of these smallholders started vaccinating during the pilot project years, signifying that ND vaccination has become an ingrained practice over time. Vaccinating smallholders saw a statistically significant advantage over non-vaccinating smallholders in their income from poultry. Flock sizes were generally higher in the vaccinating group suggesting productivity improvements from the use of the ND vaccine.

The fact that smallholders made significant income gains, paid for vaccines, and paid the service fee for vaccinations - with vaccinators earning an average net income of between Rs. 200.00 (USD 3.00 / NRs. 322.58) and Rs. 1,333.33 (USD 20.00 / NRs. 2,150.54) per month for mainly part-time ND vaccination services - suggests that there is a basis for continuing sustainability and profitability in the pilot areas. Also, that key players in the vaccine supply chain (retailers and vaccinators) are realising commercial returns suggests that ND vaccine supply is likely to be maintained.

Particularly noteworthy is that more retailers stocked ND vaccines than prior to the pilot projects and that some of these were new retailers not affiliated with GALVmed. Whether such expansion is driven by retailers, vaccinators or smallholders would be an interesting focus for further study. In this regard, GALVmed's remit is not to undertake these rigorous and costly research studies but rather to use pragmatic approaches, which still yield good data and which can point to areas of potential interest for the research community.

Acknowledgements

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The study was managed on behalf of GALVmed by Laura Higham of Food Animal Initiative (www.fai farms.com). Data collection was undertaken by the Xavier Institute of Social Service (www.xiss.ac.in). The report was written by Katharine Tjasink from Khulisa Management Services (www.khulisa.com).

References

De Bruyn, J., Thomson, P. C., Bagnol, B., Maulaga, W., Rukambile, E., & Alders, R. G. (2017). The chicken or the egg? Exploring bi-directional associations between Newcastle disease vaccination and village chicken flock size in rural Tanzania. *PLoS ONE* 1, 12(11). <https://doi.org/10.1371/journal.pone.0188230>

Appendix 1

Retailer Questionnaire

Target Group	Agroshop
Enumerator	
Date	

Respondent's Data			
Surname		Name	
District			
Village			
Sub_village			
Address			
Mobile phone			
Email			

: General

1.-What is this outlet?

- | | |
|---|------------------------------------|
| <input type="radio"/> Agrovet(sells mixed agricultural supplies) | <input type="radio"/> Market Stall |
| <input type="radio"/> Mixed Pharmacy (human and animal medicines) | <input type="radio"/> Other |
| <input type="radio"/> Veterinary Clinic | |

2.-How many staff work at this outlet?

| _____ | Number of Staff

3.-What type of employee works at this outlet?

- | | |
|--|--|
| <input type="checkbox"/> Shop assistants | <input type="checkbox"/> Community Animal Health Workers |
| <input type="checkbox"/> Pharmacists | <input type="checkbox"/> Veterinary Surgeons |
| <input type="checkbox"/> Animal health Workers / technicians | <input type="checkbox"/> Other |

4.-What animals do you stock livestock products for?

- | | |
|----------------------------------|---------------------------------|
| <input type="checkbox"/> Poultry | <input type="checkbox"/> Pigs |
| <input type="checkbox"/> Goats | <input type="checkbox"/> Cattle |
| <input type="checkbox"/> Sheep | <input type="checkbox"/> Other |

Multiple choice Unique choice Number

5.-What livestock products do you sell?

- | | |
|---|---|
| <input type="checkbox"/> Poultry Vaccines | <input type="checkbox"/> Livestock Supplements |
| <input type="checkbox"/> Other livestock vaccines | <input type="checkbox"/> Farm equipment |
| <input type="checkbox"/> Veterinary Medicines | <input type="checkbox"/> Crop inputs (seeds, chemicals) |
| <input type="checkbox"/> Poultry Feed | <input type="checkbox"/> Other |
| <input type="checkbox"/> Livestock Feed | |

6.-Do you have a fridge on the premises?

- | | |
|---------------------------|---------------------------|
| <input type="radio"/> Yes | <input type="radio"/> Yes |
| <input type="radio"/> No | <input type="radio"/> No |

7.-Typically, how many power cuts do you experience a week?

| _____ | Power cuts / week

8.-Typically, what is the duration of these power cuts?

- Less than 1 hour
- 1 - 3 Hours
- More than 3 hours

9.-What livestock product generates the most income for this outlet?

- | | |
|--|--|
| <input type="radio"/> Poultry Vaccines | <input type="radio"/> Livestock Feed |
| <input type="radio"/> Other livestock vaccines | <input type="radio"/> Livestock Supplements |
| <input type="radio"/> Pet Vaccines | <input type="radio"/> Farm equipment |
| <input type="radio"/> Veterinary Medicines | <input type="radio"/> Crop inputs (seeds, chemicals) |
| <input type="radio"/> Poultry Feed | <input type="radio"/> Other |

10.-Approximately what percentage of the outlet income is generated by this product?

| _____ | Percentage

11.-Have you ever had any association with any of the following organisations: BMPCS, PRADAN, Heifer Nepal or GALVMED

- Yes
- No

12.-Do you sell Newcastle Disease vaccines?

- Yes
- No

: If Question 12 is YES answer this section

13.-What year did you start selling Newcastle Disease vaccines?

| _____ | Year

14.-What Newcastle Disease Vaccines do you stock?

- Thermostable I-2
- Thermostable Lasota
- Regular Lasota
- R2B

15.-What Newcastle Disease Vaccine sells the most?

- Thermostable I-2
- Thermostable Lasota
- Regular Lasota
- R2B

16.-Do you keep Newcastle Disease vaccines in the Fridge?

- Yes
- No

17.-What sizes of Newcastle Disease vial do you stock?

- 100 dose vial
- 200 dose vial
- 500 dose vial
- 1000 dose vial
- Other

18.-Which vial size is the most popular?

- 100 dose vial
- 200 dose vial
- 500 dose vial
- 1000 dose vial
- Other

19.-Do you ever split vials for customers requesting smaller quantities of ND vaccine?

- Yes
- No

20.-Approximately how many 100 dose vials do you sell each month?

| _____ | Vials

21.-Approximately how many 200 dose vials do you sell each month?

| _____ | Vials

22.-Approximately how many 500 dose vials do you sell each month?

| _____ | Vials

23.-Approximately how many 1000 dose vials do you sell each month?

| _____ | Vials

24.-What percentage of the shop income is generated by selling Newcastle Disease vaccines (all vial sizes)?

| _____ | Percentage

25.-Typically, how do you obtain your Newcastle Disease vaccines?

- Buy from nearby town / city
- Vaccine delivered to shop by supplier / distributor
- Vaccine procured directly from vaccine manufacturer
- Other

26.-Do you experience any problems sourcing Newcastle Disease vaccines from suppliers?

Yes

No

27.-If you experience problems sourcing Newcastle Disease vaccines, please explain the problems you have

28.-How much does it cost to buy one vial of Thermostable I-2 Newcastle Disease vaccine? (leave blank if not stocking)

_____ Cost of 100 dose vial

29.-How much does it cost to buy one vial Thermostable Lasota Newcastle Disease vaccine? (leave blank if not stocking)

_____ Cost of 100 dose vial

30.-How much does it cost to buy one 100 dose vial Regular Lasota Newcastle Disease vaccine? (leave blank if not stocking)

_____ Cost of 100 dose vial

31.-How much does it cost to buy one 200 dose vial Regular Lasota Newcastle Disease vaccine? (leave blank if not stocking)

_____ Cost of 200 dose via

32.-How much does it cost to buy one 500 dose vial Regular Lasota Newcastle Disease vaccine? (leave blank if not stocking)

_____ Cost of 500 dose vial

33.-How much does it cost to buy one 1000 dose vial Regular Lasota Newcastle Disease vaccine? (leave blank if not stocking)

_____ Cost of 1000 dose vial

34.-How much does it cost to buy one 100 dose vial of R2B Newcastle Disease vaccine? (leave blank if not stocking)

_____ Cost of 100 dose vial

35.-How much does it cost to buy one 200 dose vial of R2B Newcastle Disease vaccine? (leave blank if not stocking)

_____ Cost of 200 dose via

36.-How much does it cost to buy one 500 dose vial of R2B Newcastle Disease vaccine? (leave blank if not stocking)

_____ Cost of 500 dose vial

37.-How much do you sell one 100 dose vial of Thermostable I-2 Newcastle Disease for? (leave blank if not stocking)

| _____ | Sell Price 100 dose vial

38.-How much do you sell one 100 dose vial of Thermostable Lasota Newcastle Disease for? (leave blank if not stocking)

| _____ | Sell Price 100 dose vial

39.-How much do you sell one 100 dose vial of Regular Lasota Newcastle Disease for? (leave blank if not stocking)

| _____ | Sell price of 100 dose vial

40.-How much do you sell one 200 dose vial of Regular Lasota Newcastle Disease for? (leave blank if not stocking)

| _____ | Sell price of 200 dose via

41.-How much do you sell one 500 dose vial of Regular Lasota Newcastle Disease for? (leave blank if not stocking)

| _____ | Sell price of 500 dose vial

42.-How much do you sell one 1000 dose vial of Regular Lasota Newcastle Disease for? (leave blank if not stocking)

| _____ | Sell price of 1000 dose vial

43.-How much do you sell one 100 dose vial of R2BNewcastle Disease for? (leave blank if not stocking)

| _____ | Sell price of 100 dose vial

44.-How much do you sell one 200 dose vial of R2BNewcastle Disease for? (leave blank if not stocking)

| _____ | Sell price of 200 dose via

45.-How much do you sell one 500 dose vial of R2BNewcastle Disease for? (leave blank if not stocking)

| _____ | Sell price of 500 dose vial

46.-Who are your main customers for Newcastle Disease Vaccines?

- | | |
|--|--|
| <input type="checkbox"/> Commercial Poultry Farmers | <input type="checkbox"/> Private Veterinary Surgeons |
| <input type="checkbox"/> Backyard Poultry farmers | <input type="checkbox"/> Other medicine shops / agrovets |
| <input type="checkbox"/> Community Animal Health Workers / Vaccinators | <input type="checkbox"/> Paravets |
| <input type="checkbox"/> Government Veterinary Surgeons | <input type="checkbox"/> Other |

47.-Which group is responsible for buying the most Newcastle Disease vaccines?

- | | |
|---|---|
| <input type="radio"/> Commercial Poultry Farmers | <input type="radio"/> Private Veterinary Surgeons |
| <input type="radio"/> Backyard Poultry farmers | <input type="radio"/> Other medicine shops / agrovets |
| <input type="radio"/> Community Animal Health Workers / Vaccinators | <input type="radio"/> Paravets |
| <input type="radio"/> Government Veterinary Surgeons | <input type="radio"/> Other |

48.-How many vaccinators / Community Animal Health workers buy Newcastle disease vaccines from this outlet?

| _____ | Number of CAHW/Vaccinators

49.-What are the names of these vaccinators?

| _____ |

50.-What are their contact numbers?

| _____ |

51.-What are the main challenges that you face when selling Newcastle Disease vaccines?

- | | |
|--|--|
| <input type="checkbox"/> Lack of farmer awareness / demand | <input type="checkbox"/> Vaccine too expensive |
| <input type="checkbox"/> Lack of cold chain storage | <input type="checkbox"/> Vaccine has small profit margin |
| <input type="checkbox"/> Difficulties with supplier | <input type="checkbox"/> Vaccine pack size |
| <input type="checkbox"/> Competition from other outlets | <input type="checkbox"/> Other |

: If Question 12 is NO answer this section

52.-Have you ever stocked Newcastle Disease vaccines?

- Yes
 No

53.-If you have stocked Newcastle Disease vaccines, what year did you start stocking them?

| _____ | Year

54.-If you have stocked Newcastle Disease vaccines, what year did you stop stocking them?

| _____ | Year

55.-Why do you not stock Newcastle Disease vaccines?

- | | |
|--|--|
| <input type="checkbox"/> Did not know vaccine was available | <input type="checkbox"/> Vaccine too expensive |
| <input type="checkbox"/> Lack of farmer awareness / demand | <input type="checkbox"/> Vaccine has small profit margin |
| <input type="checkbox"/> Lack of cold chain storage | <input type="checkbox"/> Vaccine pack size |
| <input type="checkbox"/> Difficulties with supplier | <input type="checkbox"/> Other |
| <input type="checkbox"/> Too much competition from other outlets | |

56.-What is your association with BMPCS, PRADAN or GALVmed?

.....

Appendix 2

Vaccinator Questionnaire

Target Group	<input type="text" value="Vaccinator"/>
Enumerator	<input type="text"/>
Date	<input type="text"/>

Respondent's Data

Surname	<input type="text"/>	Name	<input type="text"/>
District	<input type="text"/>		
Village			
Sub_village			
Address	<input type="text"/>		
Mobile phone	<input type="text"/>		
Email	<input type="text"/>		

: General

201.-Gender of Respondent

202.-Age of Respondent

203.-Education Level (general)

- No formal schooling
 Primary School
 Middle School

- Secondary School
 High School or above

204.-How many days of animal health service training did you receive from GALVmed?

205.-How many days of animal health service training have you received from an organisation other than GALVmed?

206.-How many people live in your household?

Multiple choice Unique choice Number

207.-What is your primary source of income?

- Paid work in nearby town / city
- Paid labor
- Animal health services

- Livestock Production
- Small business owner
- Agriculture

208.-How much does this income source provide each month?

|_____| Local Currency

209.-How many chicken do you keep?

|_____| Chicken

210.-How many ducks do you keep?

|_____| Ducks

211.-How many goats do you keep?

|_____| Goats

212.-How many pigs do you keep?

|_____| Pigs

213.-How many sheep do you keep?

|_____| Sheep

214.-How many cattle do you keep?

|_____| Cattle

215.-How many buffalo do you keep?

|_____| Buffalo

216.-How many other livestock do you keep? (number of additional animals)

|_____|

217.-What year did you first train as a vaccinator?

|_____| Year

218.-How often do you receive vaccinator refresher training?

- Once a year
- Once every two years
- Once every three years
- Never

219.-Do you currently provide animal health services to your community?

- Yes
- No

220.-What is your average monthly income from providing animal health services?

|_____| Local Currency

221.-How many days per month do you spend providing animal health services?

| _____ | Days per month

222.-How many hours per day do you typically spend providing animal health services?

| _____ |

223.-Do you currently sell Newcastle Disease Vaccines?

Yes

No

: If Question 23 is YES answer this section

224.-How many Newcastle Disease vaccines have you administered in the past 4 months?

| _____ | Vaccines

225.-Where do you buy Newcastle Disease vaccines from?

Agrovvet Shop

Another vaccinator

Local Market

Other

226.-What type of Newcastle Disease vaccine do you buy?

Thermostable

Not Thermostable

227.-What vial size (number of doses) do you typically buy from your supplier?

100 Dose Vial

200 Dose Vial

Other

228.-How much does a 100 dose vial cost (leave blank if you do not buy)

| _____ | Local Currency

229.-How much does a 200 dose vial cost(leave blank if you do not buy)

| _____ | Local Currency

230.-If you typically buy any other size (not 100 or 200 dose vials), what size is this?

| _____ | Doses

231.-If you typically buy any other size, how much does this cost?

| _____ | Local Currency

232.-Typically, how many doses do manage to sell from a vial?

| _____ | Doses

233.-Do you administer dewormer to poultry?

- Yes
- No

234.-If you charge for dewormer & Newcastle disease vaccination together, how much do you charge for administering one dose of vaccine & dewormer?

|_____| Local Currency per Bird

235.-If you charge for dewormer & Newcastle disease vaccination separately, how much do you charge for administering one dose of vaccine?

|_____| Local Currency

236.-If you charge for dewormer & Newcastle disease vaccination separately, how much do you charge for administering one dose of dewormer?

|_____| Local Currency

237.-Typically, how much would you charge to vaccinate & deworm 10 birds?

|_____| Local Currency

238.-Are you always paid in cash?

- Yes
- No

239.-Do you accept non-cash payment?

- Yes
- No

240.-On average, how many days per month do you spend performing Newcastle Disease vaccinations?

|_____| Days per month

241.-On average, how many hours per day do you spend performing Newcastle Disease vaccinations?

|_____| Hours per day

242.-On average, how many chickens do you vaccinate per month?

|_____| Chicken vaccinated per month

243.-On average, how many households do you visit per month?

|_____| Households visited per month

244.-On average, how many new households / customers do you visit each month?

|_____| New households visited per month

245.-On average, how many villages do you visit each month?

|_____| Villages visited per month

246.-On average, how many individual hamlets do you visit each month? (leave blank if not applicable)

|_____| Hamlets visited per month

247.-On average, how long do you spend travelling between Newcastle Disease customers each day?

|_____| Hours

248.-How do you travel between villages /households for Newcastle Disease Vaccinations?

- Do not travel
- Bicycle (Pedal)
- Motorbike / Scooter
- Bus
- Walk
- Other

249.-On average, how much do you spend on travel each month, to vaccinate chickens?

|_____| Local Currency

250.-If you travel to administer Newcastle Disease Vaccinations, do you travel with anyone else?

- Yes - family member
- Yes - friend
- Yes - another vaccinator
- Travel alone

251.-Do you compete with other people performing Newcastle Disease vaccinations in the same areas as you?

- Yes
- No

252.-What are the difficulties working as a Newcastle Disease vaccinator?

- Work long hours
- Safety
- Customers inaccessible
- Travelling between households
- Finding new customers
- Demand for vaccine very high
- Demand for vaccine very low
- Lack of willingness to buy vaccinations
- Free government vaccines offered in area
- Vaccine supply not always available
- Cost of Buying the ND vials upfront

: If Question 23 is NO answer this section

253.-What year did you stop working as a vaccinator?

|_____| Year

254.-In total, what is the total number of Newcastle Disease vaccines you sold before you stopped working as a vaccinator?

|_____| Doses

255.-Did you enjoy your work as a vaccinator?

- Yes
- No

256.-How many days per month were you working as a Newcastle Disease vaccinator before you stopped?

|_____| Days per Month

257.-How many hours per day were you working as a Newcastle Disease vaccinator before you stopped?

|_____| Hours per day

258.-Why did you stop working as a vaccinator?

.....

Smallholder Questionnaire

Target Group	Farmer
Enumerator	
Date	

Respondent's Data	
Surname	<input type="text"/>
Name	<input type="text"/>
District	<input type="text"/>
Village	
Sub_village	
Address	
Mobile phone	<input type="text"/>
Email	<input type="text"/>

: General

101.-Gender of Respondent

- Male
- Female

102.-Age of Respondent

| | Years old

103.-What is the highest level of education in your household?

- No education
- Primary School
- Middle School
- Secondary School
- High school or above

104.-How many women live in your household?

| | Women

105.-How many men live in your household?

| | Men

106.-How many boys live in your household?

| | Boys

Multiple choice Unique choice Number

107.-How many girls live in your household?

| _____ | Girls

108.-What is the main source of household income?

Paid work in nearby town / city

Agriculture

Paid labor

Other

Livestock Production

109.-Does your household make money from keeping livestock?

Yes

No

110.-If yes, how much does your household earn from livestock on average, per month?

< 500 Rs / month

1000 -2000 Rs / month

500 - 1000 Rs / month

>2000 Rs/ month

111.-Does your household make money from crop agriculture?

Yes

No

112.-How many chicken do you own?

| _____ | Chicken

113.-How many ducks do you own?

| _____ | Ducks

114.-How many goats do you own?

| _____ | Goats

115.-How many pigs do you own?

| _____ | Pigs

116.-How many sheep do you own?

| _____ | Sheep

117.-How many cattle do you own?

| _____ | Cattle

118.-How many bufflao do you own?

| _____ | Buffalo

119.-How many other livestock do you keep? (number of additional animals)

120.-Does your household make money from keeping poultry?

- Yes
- No

121.-If yes, how much does your household earn from poultry on average, per month?

- < 500 Rs / month
- 500 - 1000 Rs / month
- 1000 - 2000 Rs / month
- >2000 Rs / month

122.-Does your household own a poultry house?

- Yes
- No

123.-Approximately how many poultry did you sell in the past 4 months?

|_____| Birds sold

124.-What is the value of poultry at time of sale?

|_____| Local Currency

125.-Approximately how many poultry eggs do you sell each week?

|_____| Eggs sold

126.-Who spends the most time each day looking after the poultry?

- Adult Male
- Adult Female
- Boys
- Girls
- Other

127.-Do you buy feed specifically for your poultry?

- Yes
- No

128.-How much do you spend on poultry feed each month?

|_____| Local Currency

129.-What is the value of non-poultry specific feed (for example rice) used to feed the poultry each month?

|_____| Local Currency

130.-How many of your poultry have died from predators in the past 4 months?

|_____| Birds Died

131.-How many of your poultry have been lost to theft in the past 4 months?

|_____| Birds Stolen

132.-How many of your poultry have died from disease in the past 4 months?

|_____| Birds died

133.-How many poultry have died form other sources (not sold or slaughtered)?

|_____| Birds died

134.-How many of your poultry have died from Newcastle Disease in the past 4 months?

|_____|

135.-Approximately how much did you spend on animal health services in the last 4 months? (vet fees, medicines, vaccines etc) for all animals?

|_____| Local Currency

136.-Approximately how much did you spend on animal health services in the last 4 months? (vet fees, medicines, vaccines etc) for goats?

|_____| Local Currency

137.-Approximately how much did you spend on animal health services in the last 4 months? (vet fees, medicines, vaccines etc) for poultry?

|_____| Local Currency

138.-Have you borrowed any money in the past 12 months for poultry-related products or services?

Yes

No

139.-Have you heard of Newcastle Disease?

Yes

No

140.-Are you currently vaccinating your poultry against Newcastle disease?

Yes

No

141.-Does the vaccinator vaccinate your poultry via the eyes?

Yes

No

: If question 40 is YES complete this section

142.-How many birds were vaccinated against Newcastle Disease in the past 4 months?

|_____| Birds vaccinated

143.-When did you start vaccinating against Newcastle disease?

|_____| Year

144.-How much do you pay for Newcastle Disease vaccine (price per bird)

145.-How much have you spent on Newcastle Disease vaccines in the past 4 months?

|_____| Local Currency

146.-Do you have to travel to access the vaccine?

- Yes
- No

147.-What is the name of the vaccinator who vaccinates your poultry against Newcastle disease? (leave blank if not known)

|_____| Name

148.-Is this the only vaccinator providing Newcastle Disease Vaccinations in your local area?

- Yes
- No

149.-What is the biggest problem about using the vaccine?

- | | |
|--|---|
| <input type="checkbox"/> Vaccine not always available | <input type="checkbox"/> Vaccine not always effective |
| <input type="checkbox"/> Vaccine is expensive | <input type="checkbox"/> Vaccine can be unsafe to chicken |
| <input type="checkbox"/> Need to travel to buy vaccine | <input type="checkbox"/> Other |
| <input type="checkbox"/> No one to administer vaccine | |

: If question 40 is NO complete this section

150.-Have you heard of the Newcastle disease vaccine?

- Yes
- No

151.-Have you used the Newcastle Disease vaccine in the past?

- Yes
- No

152.-If you have used Newcastle Disease vaccine in the past, when was the last time you used the Newcastle Disease Vaccine?

|_____| Year

153.-If you have used Newcastle Disease vaccine in the past, why did you stop using it?

- | | |
|---|---|
| <input type="checkbox"/> Vaccine not available | <input type="checkbox"/> Vaccine not effective |
| <input type="checkbox"/> Vaccine costs too much | <input type="checkbox"/> Vaccine is unsafe to chicken |
| <input type="checkbox"/> Vaccine not easily accessible | <input type="checkbox"/> Other |
| <input type="checkbox"/> Vaccinator / vet not available | |

154.-If you have NOT used Newcastle Disease vaccine in the past, have you ever been offered to buy the vaccine from a vaccinator or other animal health professional?

- Yes
- No

155.-If yes, please explain why you did not buy the vaccine

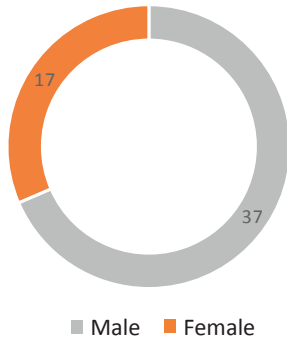
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Appendix 4

Vaccinator Characteristics

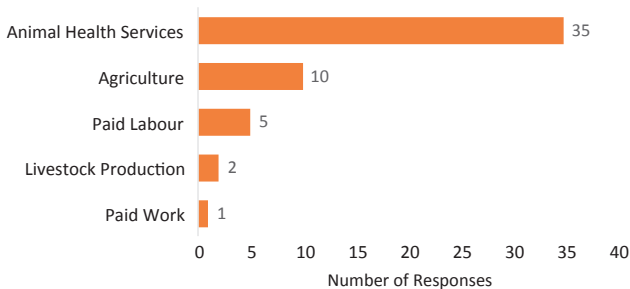
There were many more male than female vaccinators in the sample (Figure A 4.1). This is consistent with other GALVmed studies and could potentially partly be explained by vaccinator travel and safety concerns, mentioned earlier in this report.

A 4.1. Vaccinator gender



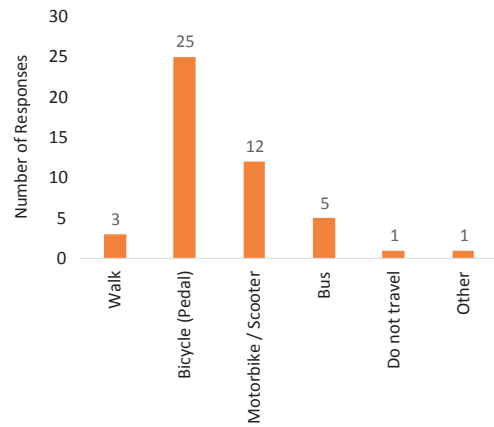
Animal health services was the main source of income for two-thirds of the vaccinators (Figure A 4.2). Agriculture and paid labour were the main source of income for nearly a third of the sample.

A 4.2. Vaccinator main source of income



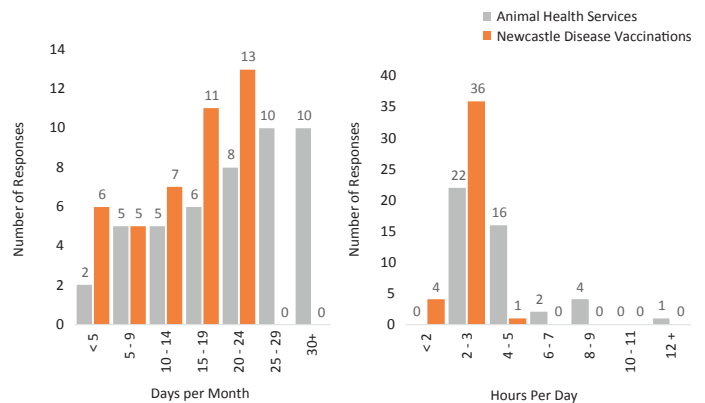
Many vaccinators reported travelling to smallholder households by bicycle (Figure A 4.3). This is unsurprising given that travelling from household to household takes up much of a vaccinator's time. Vaccinators in Jhapa were more likely to use a motorbike than vaccinators in Keonjhar or Mayurbhanj were. This could relate to the fact that vaccinators in Jhapa also spent a considerable amount of time providing animal health services in addition to ND vaccination activities. Some vaccinators in Keonjhar reported making use of public transport services.

A 4.3. Vaccinator mode of transportation



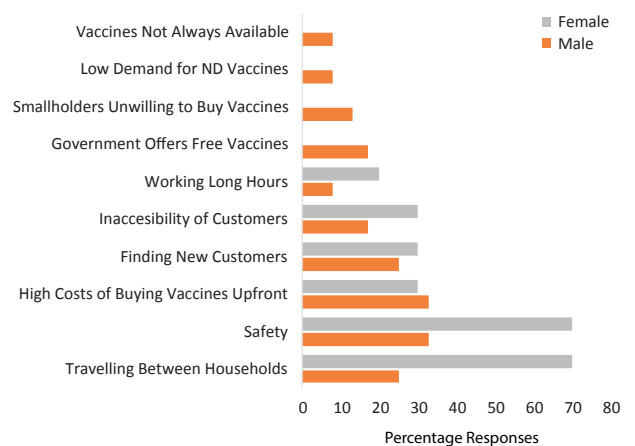
The surveyed vaccinators spent between 2 and 3 hours a week on ND vaccinations, indicating that this work was mainly supplementary to the vaccinators' main income. There is some variance in the number of days spent on ND activities (Figure A 4.4).

A 4.4. Vaccinator monthly time commitments



Some of the key challenges vaccinators faced in selling ND vaccines included safety concerns, upfront costs associated with purchasing ND vaccines, travelling between houses, and finding new customers. Female vaccinators were more likely than males to find safety and travelling particularly challenging (Figure A 4.5).

A 4.5. Challenges facing vaccinators



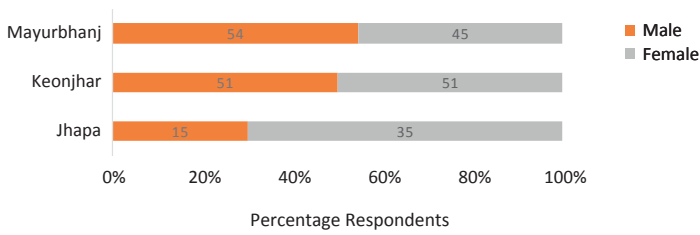
⁵ For example, the GALVmed Vaccinator Performance Study, 2018

Appendix 5

Smallholder Characteristics

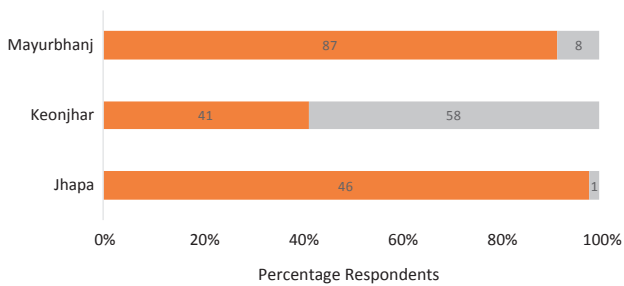
Of the smallholders surveyed in the follow-up study, half (54% in Mayurbhanj and 50% in Keonjhar) were male in the Indian pilot sites, while only a third (30%) were male in Jhapa (Figure A 5.1).

A 5.1. Smallholder gender



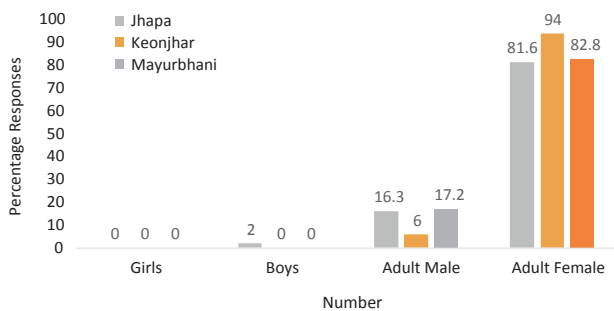
For most smallholders surveyed in the sample (92% in Mayurbhanj and 98% in Jhapa), poultry was a source of income. The exception was Keonjhar where only 41% of smallholders made an income from poultry (Figure A 5.2).

A 5.2. Percentage smallholders earning an income from poultry



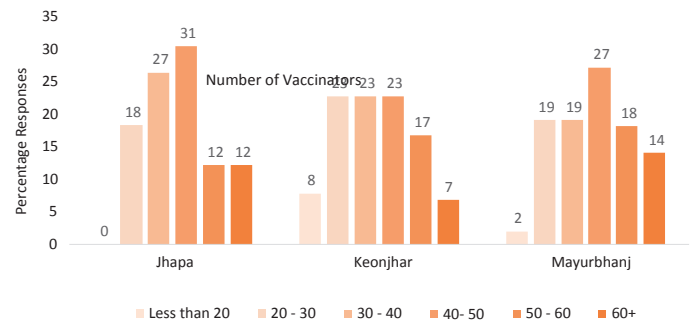
Adult female smallholders spent the most time looking after poultry. This trend was strong and consistent across the study locations (Figure A 5.3).

A 5.3. Household members responsible for looking after poultry



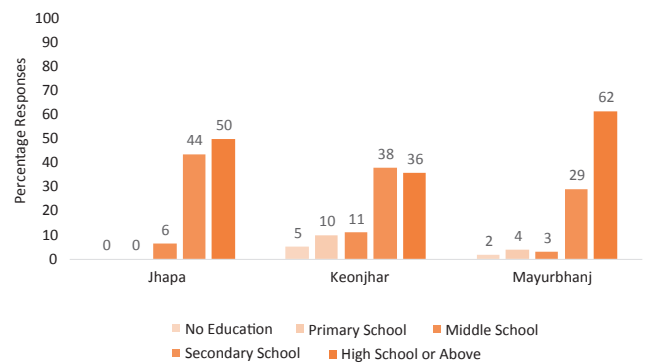
Approximately three quarters of smallholders in Jhapa (76%) and Keonjhar (77%), and two thirds of smallholders in Mayurbhanj (67%), were below 50 years of age (Figure A 5.4).

A 5.4. Smallholder age



Smallholders in the sample were generally well educated with 94% of smallholders in Jhapa, 74% of smallholders in Keonjhar and 91% of smallholders in Mayurbhanj having a secondary education or higher (Figure A 5.5).

A 5.5. Smallholder education





Protecting Livestock – Improving Human Lives

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