Comparing smallholder poultry husbandry practices between adopters and non-adopters of Newcastle Disease vaccine in India

A GALVmed Monitoring and Evaluation Study

GALVmed

Protecting Livestock – Improving Human Lives

Strategic context

Is there a relationship in smallholder farming between the use of a key animal health input and the wider use of other essential inputs and husbandry practices? The study examined this basic question by looking for any relationship between the use of the Newcastle disease (ND) vaccine by smallholder poultry farmers and other poultry inputs and practices that are considered important in a smallholder setting. The information from this study could be useful for GALVmed in two important areas:

i) Informing a strategy for market development: should market development initiatives for improving animal health be accompanied by wider husbandry extension activities, or does this occur 'naturally' to any extent?

ii) Understanding impact: when comparing the productivity of adopters and non-adopters of an essential animal health input, is any observed difference likely to be significantly influenced by the usage of other products and practices?

These questions are important for GALVmed and represent an area where many contrasting opinions and anecdotal observations are offered. This study is a first step in bringing quantitative evidence to the debate. However, it does not address any aspects of causation behind the possible relationships; this is therefore a potential area for future studies.

Executive summary

- This study was set up to establish whether there are measurable differences in observable husbandry practices between Newcastle disease vaccinating and non-vaccinating poultry-keeping households in India.

- Differences were evaluated using a questionnaire survey of smallholder chicken farmers. The questionnaire was implemented in the smartphone app ODK Collect and included 90 different questions. Certain questions were only asked if they were relevant; this was determined by responses to previous questions. The questions addressed all aspects of poultry management and uses of ND vaccines (questionnaire in Appendix 1).

- The study was implemented during March and April 2017 in the Churchu, Dadi and Mandu blocks of Jharkhand District in India. Four hundred and five chicken-farming smallholders were surveyed in these areas.

- Villages were identified within two groups: those that had access to vaccines via community vaccinators and those that did not have access via community vaccinators. Upon analysis of the data, the respondents fell into three categories:

  - **Non-adopters,** who had never vaccinated their chickens against ND and comprised 225 respondents (55.6%).

  - **Bad adopters,** who had vaccinated their chickens against ND, but during 2016 had not vaccinated, or had only vaccinated on one occasion. This comprised 60 respondents (14.8%).

  - **Good adopters,** who had vaccinated their chickens on at least two occasions during 2016. This comprised 120 respondents (29.6%).

- There were significantly fewer ND outbreaks among the adopters.

- The good adopters' chicken flocks were significantly larger (median 16 chickens) than the bad adopters' (14 chickens) and non-adopters' (ten chickens) flocks. Almost all chickens were indigenous breeds; there were relatively few exotic or cross-bred chickens.

- The observed differences in husbandry were relatively few and were primarily a direct result of the work of the community vaccinators. Good adopters were more likely to also use dewormers and vaccinate against fowl pox. They also spent more on medicines, vaccines and dewormers generally; this higher level of spending remained after sums spent on ND vaccines were deducted.

- Good adopters spent a greater amount of money on poultry feed, but there were no detectable differences in the types of feed that are administered. Only three gave mineral supplementation and, contrary to expectations, a greater proportion of the non-adopters (29.8%) and bad adopters (30.0%) than good adopters (15.0%) were giving commercial feed. Likewise, there were no differences in poultry housing except that non-adopters were more likely to use poultry housing whilst adopters were more likely to house their chickens in the family home.

- There were no clear ambitions with regard to the future of chicken flocks. Moving into farming other species was not frequently cited as an ambition, nor was spending revenue from chicken sales on livestock. This suggests that farmers did not wish to move into farming other species after farming chickens However, there is evidence that the good adopters had larger goat flocks and were more likely to own pigs and buffalo.

- In this study, we speculate on the reasons behind the apparent lack of change in husbandry, particularly when compared to the changes that were seen in a parallel study in Tanzania. One component of the explanation may relate to the flock sizes in India. For such small flocks it is less economically viable to invest in improved husbandry practices: any purchase such as a bag of feed or mineral supplements becomes an investment and is more cost-effective if there are a greater number of chickens. Hence, these smallholders are highly dependent on community vaccinators to provide interventions. These vaccinators overcome the problems of economies of scale by buying feed supplements and other inputs in bulk and splitting these between farms.

Contents

Background

There is a fundamental question when considering the beneficial impact of vaccination for major diseases such as Newcastle disease (ND) – to what extent are observed gains attributable to improved husbandry practices and to what extent are they attributable to the reduced incidence of disease? This study attempts to bring a new level of understanding to this question by ascertaining whether there are measurable differences in observable husbandry practices between vaccinating and non-vaccinating poultry-keeping households.

The objective of the study was to collect quantitative comparative data to assess the adoption of improved inputs and management practices following vaccination against Newcastle disease in India. The study was a comparison of ND vaccine adopters versus non-adopters, where adopters had reported using ND vaccines and non-adopters did not use vaccines.

Materials and methods

Hypotheses

The premise of the study is that smallholders that vaccinate against Newcastle disease (ND) will also adopt improved husbandry practices such as improved feeding, housing and measures to prevent disease. The primary hypotheses are:

- H_0 (Null hypothesis). There are no differences in the husbandry practices of adopters of ND vaccines and those of non-adopters of vaccines.
- H_1 (Alternative hypothesis). There are significant differences in the husbandry practices of adopters of ND vaccines and those of non-adopters of vaccines.

Study design

The study took the form of a single questionnaire survey, which was implemented in areas that have had supply chains for ND vaccines for at least two years. The study compared households that have access to vaccines and choose to purchase them (adopters) with households that either do have access to vaccines, or do not have easy access to vaccines through village-level supply chains, and choose not to vaccinate (non-adopters).

The study was implemented in Jharkhand State in India – in the Churchu and Dadi blocks of Hazaribagh District and Mandu Block in Ramgarh District (Figure 1). These blocks were selected because the partner organisation the Society for Upliftment of People with People's Organisation & Rural Technology (SUPPORT) has been implementing GALVmed's ND vaccination programmes in this area for over two years. The study partner SUPPORT knows the terrain well and in particular which villages have been vaccinating against ND through community vaccination programmes and which have not.

***Figure 1**. Study areas in India. The red area is the two intervention districts of Ramgarh and Hazaribagh and the white area is Jharkhand State.*

Sample size

The sample size calculations were based on a mean flock size of 13 chickens among non-adopters and 20 chickens among adopters, with 15% of non-adopters and 42% of adopters owning poultry houses; this is based on Bessell et al, 2017. With a significance level (alpha) of 95% and a power (1-beta) of 90%, the minimum sample size was 124 (62 smallholder flocks in each group). However, given that the analysis is of a range of indices that are relatively unknown, this was increased to 200 in each group (400 in total). The survey was divided up so that 20 flocks were sampled in each of the 20 villages.

Survey team

The survey was implemented in the field by SUPPORT, under the direction of the organisation's CEO Mr BS Gupta and with a field team supervised by Mr Amit Tete. The survey team were employees of SUPPORT and comprised Mr Mohammad Azharuddin, Mr Gyandeep Purbey, Mr Pritam K Saul, Mr Jaynandau Raul and Mr Dhananjay Kr Arun.

Questionnaire

The questionnaire was developed in paper form in English in consultation with GALVmed. This was then further developed in consultation with Mr Tete prior to translation into Hindi script by Mr Tete. The questionnaire was then further tested in a three-day training and piloting session at the offices of SUPPORT in Mandu. It was then imported into the Android app ODK Collect. The questionnaire was organised into the following sections:

1. Respondent details.
2. Questions about how often meat and eggs are consumed.
3. Details of the size and composition of the flock, causes of loss in the flock, constraints on growing the flock, and ambitions for the flock.
4. Details of other species that are owned by the smallholder.
5. Knowledge, history and practices of vaccinating against ND.
6. Details of other treatments that are used.
7. Details of poultry housing.
8. Details of chicken feeding.
9. Details of chickens and eggs that were consumed and sold in the past three months, broken down by indigenous and exotic chickens.
10. Income received for the sale of chickens, where the chickens are sold and how the revenue is used.

Five Intex Cloud Q11 Android smartphones were purchased in India. This model was selected because of its cost (around 80 USD each), its screen size, its Global Positioning System (GPS) and the currency of the Android operating system. The ODK Collect app was loaded and a version of the questionnaire in English with the Hindi script translation uploaded to the devices. The ODK Collect app also recorded the GPS coordinates of the surveyed household as well as the start and end time of the questionnaire. During training in the office of SUPPORT in Mandu and field testing in the village of Gargali in Mandu Block in February/March 2017, the questionnaire was tested and further revised.

At the end of each survey day, the data were uploaded to a Google-hosted server by connecting the survey smartphones to a wireless internet hub. The completed forms coming in were monitored by Mr Paul Bessell.

Implementation

Responsibility for surveying each village was assigned to one of the five surveyors with oversight by Mr Tete. There were some technical challenges with the in-built GPS in some of the survey smartphones and this made it difficult to use the system at times. Addressing this problem was incorporated into the daily fieldwork protocol followed by the surveyors (see below, in text taken directly from the protocol):

1. Ensure that smartphones are fully charged and that you have them on your person.
2. Check whether the GPS is working by using the form 'Get coordinates'.
3. Contact the village vaccinator or other person with a list of chicken-farming households in the village.
4.. From the households on the list sample every nth until the sample size of 20 is filled. So, if there are 150 households in the village then sample every 7th household.
5. The enumerator visits each household and introduces himself and confirms whether the household owns chickens.
6. Ask if the person would be kind enough to answer a short questionnaire of around 20 minutes. If the person accepts then administer the questionnaire.
7. If the person refuses to participate or is not there, or does not own chickens, then try neighbouring households.
8. Complete the questionnaire, remembering to be mindful for inconsistent answers and language differences.
9. At each household try to get GPS coordinates, but if after two minutes you do not have coordinates then 'Cancel' and move on in ODK.
10. Once the survey is complete, ensure that you select the option of 'Save form and exit'.
11. If the household does not vaccinate against Newcastle disease then offer some advice on the benefits of vaccination and where vaccines can be purchased and at what cost.
12. Thank the householder.
13. Each enumerator should keep a count of how many survey households reported that they vaccinate and how many reported that they did not vaccinate.
14. Monitor the progress and ensure that at least 20 households are surveyed in each village and Amit will address any problems that arise.
15. At the end of the survey day Amit is responsible for ensuring that the data are successfully sent from the phones. The 'Send finalised forms' option in ODK should not have any number after it.

Results

Summary of results

Table 1 *Summary table of results described in this paper. P-values represent the p-values of Fisher's exact test for categorical variables and the Wilcoxon signed rank test for continuous variables*

Outcome	Non-adopters	Good Adopters	Statistical significance
Mean flock size	11.2	17.6	p < 0.001
Keeping improved breeds	3.1%	0%	-
Treating chickens with dewormers	5.3%	92.5%	p < 0.001
Vaccinating against fowl pox	0.4%	73.3%	p < 0.001
Mean investment in medicines or dewormers (three months' expenditure)	0.09 USD	0.19 USD	p = 0.007
Providing supplementary feed	74.2%	83.3%	p = 0.06
Mean expenditure on feed during the previous three months	3.74 USD	4.81 USD	p < 0.001
Using a poultry house	67.6%	26.7%	p < 0.001
Mean number of chickens consumed during the previous three months	1.00	1.85	p < 0.001
Mean number of chickens sold during the previous three months	0.35	1.35	p = 0.001

Vaccine adoption

A total of 405 smallholders were enrolled in 20 villages. Twenty households were enrolled in each village except Gargali where 26 were enrolled and Mandu-Chatti where 19 were enrolled. The distribution of the enrolled villages is shown in Figure 2 and covers an area of approximately 600 km^2.

Figure 2. *The locations of the surveyed villages in Jharkhand.*

Newcastle disease

Sixty-three households (15.6%) claimed to have no knowledge of ND and 180 households (44.4%) reported that they had vaccinated against ND. The majority of households that had been vaccinating for more than two years vaccinated four times during 2016. Many of those that had vaccinated only once or had not vaccinated during 2016 had been adopting ND vaccines for less than one year (Table 2).

Table 2*. For the 180 households that had vaccinated against Newcastle disease (ND), the number of times they vaccinated during 2016 and the number of years that they have been vaccinating.*

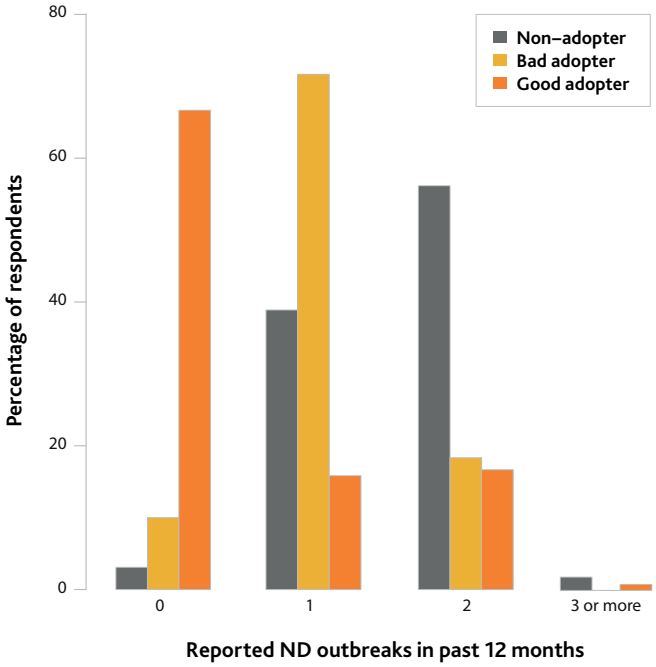
Number of times vaccinated during 2016	Number of years vaccinating against ND			
	<1 year	1–2 years	>2 years	
None	10	1	0	11 (6.1%)
Once	36	12	1	49 (27.2%)
Twice	5	13	13	31 (17.2%)
Three	1	7	1	9 (5.0%)
Four	0	18	62	80 (44.4%)
	52 (28.9%)	51 (28.3%)	77 (42.8%)	180

To account for the differences in the lengths of time that households had been vaccinating, and therefore the potential for adoption of husbandry practices, respondents were reclassified as:

- **Non-adopters,** who had never vaccinated their chickens against ND and comprised 225 respondents (55.6%).
- **Bad adopters,** who had vaccinated their chickens against ND, but during 2016 had not vaccinated, or only vaccinated on one occasion. This comprised 60 respondents (14.8%).
- **Good adopters,** who had vaccinated their chickens on at least two occasions during 2016. This comprised 120 respondents (29.6%).

Adopters of ND vaccines reported significantly fewer ND outbreaks than did non-adopters; non-adopters reported a mean of 1.58 outbreaks per year compared to 1.08 for bad adopters and 0.52 for good adopters (Figure 3). A number of respondents (16.7%) that were good adopters in Figure 3 reported two ND outbreaks during 2016, but it should be noted that these were in one village and there were no deaths associated. Adopters also reported fewer chicken deaths due to ND: non-adopters reported 8.59 per year compared to 5.93 for bad adopters and 0.38 for good adopters.

Figure 3. *Barplot of number of Newcastle disease (ND) outbreaks reported during the past 12 months by ND vaccine adoption.*

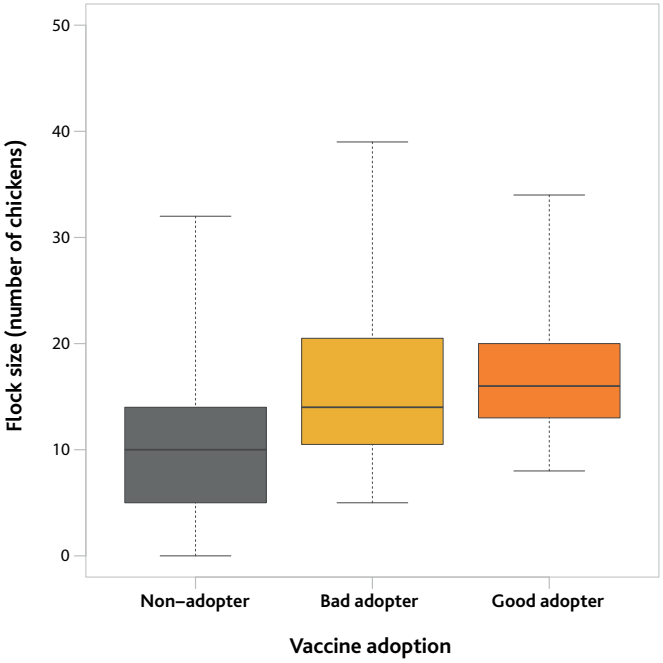


All adopters vaccinated by eye drop, and all bar two households were vaccinated by the community vaccinator; the remaining two households vaccinated themselves. Of those that did not vaccinate, 90.2% cited lack of knowledge of vaccines as the principal reason for not vaccinating. Of the remainder, 14 (6.2%) cited a lack of availability as their reason for not vaccinating.

Chicken flock

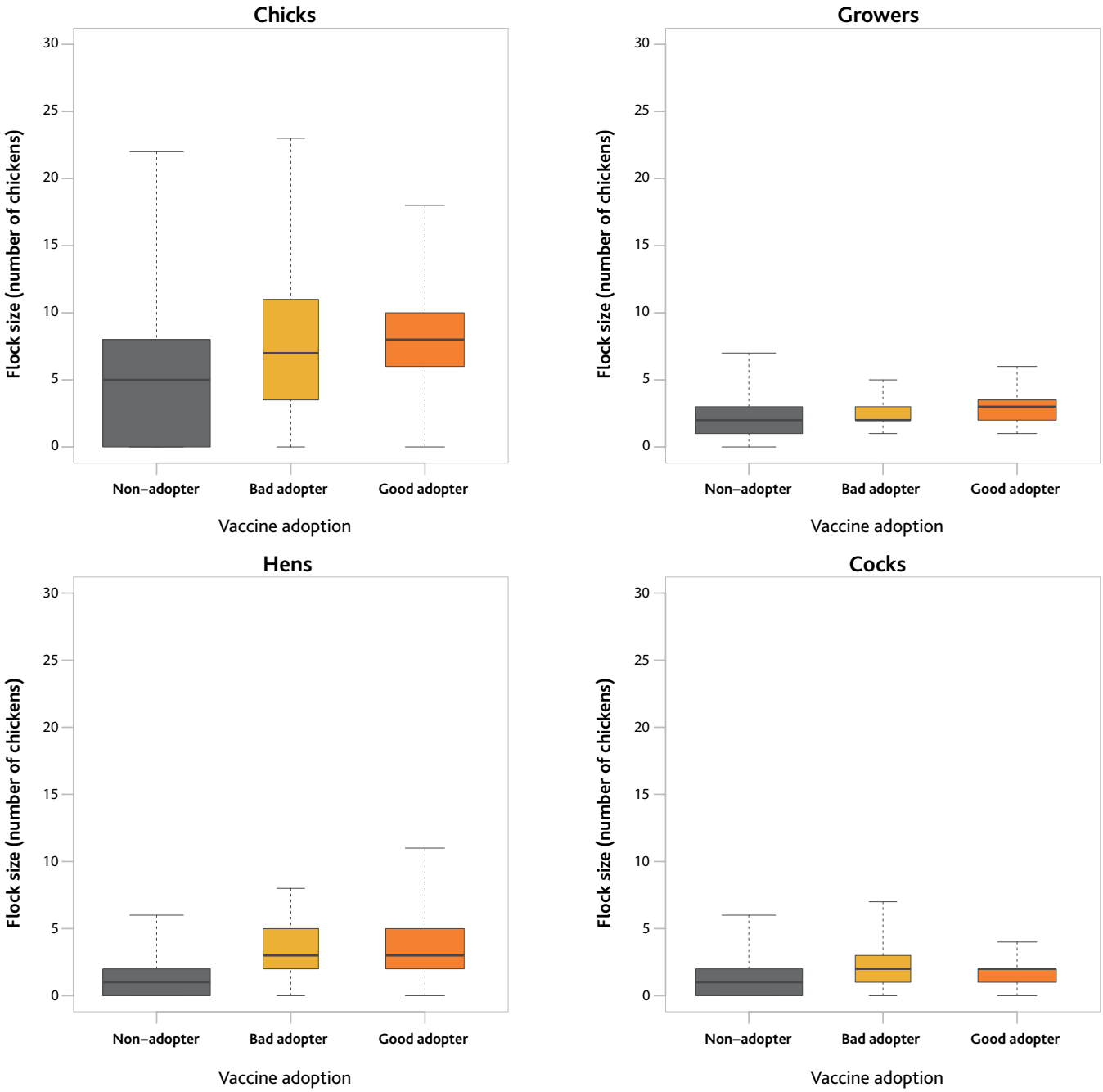
The mean flock size was 14.2 birds (median 13 birds) with significantly greater numbers in flocks of households that had adopted ND vaccination (Figure 4; $F = 25.7$, $p < 0.001$).

Figure 4. *Boxplot of flock size broken down by adoption of Newcastle disease vaccination. The centre line represents the median, and the extremes of the box the 25th and 75th quartiles. The horizontal lines outside of the boxes lines represent twice the interquartile range or the most extreme data point; outliers are excluded.*



The principal difference in the composition of flocks which were vaccinated against ND is that they typically had a greater number of chicks and hens than those that were not vaccinated (Figure 5).

Figure 5. *Boxplot of flock sizes broken down by adoption of ND vaccination and bird type. The width of the box represents the number in that group. The centre line represents the median, and the extremes of the box the 25th and 75th quartiles. The horizontal lines outside the boxes represent twice the interquartile range or the most extreme data point; outliers are excluded.*

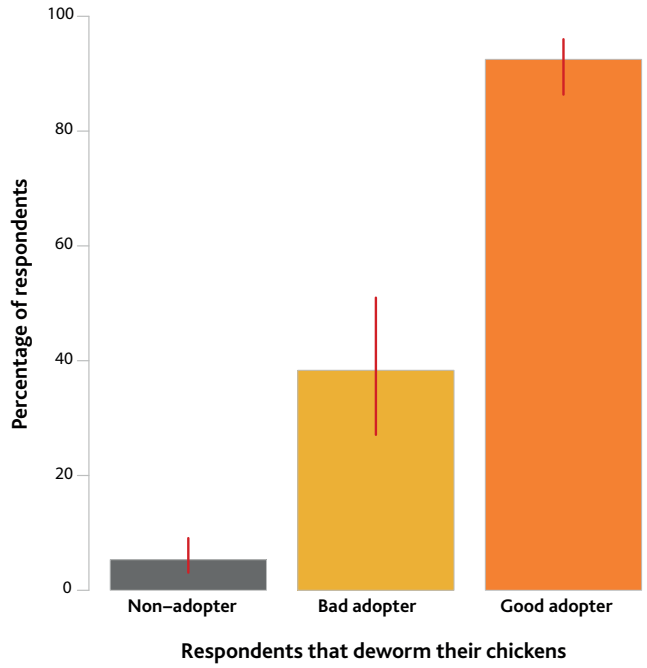


The breeds of chicken that were kept were almost exclusively indigenous. Only four respondents kept exotic or cross-bred chickens and three reported keeping broilers.

Other vaccines and treatments

Nearly all good adopters dewormed their chickens compared to 5.3% of non-adopters (Figure 6; $p < 0.001$).

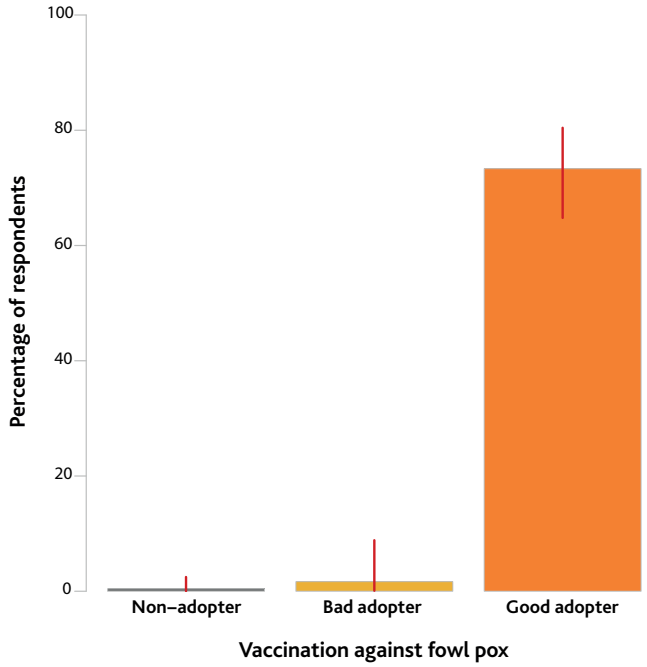
Figure 6. *Barplot of the percentage of respondents that deworm their chickens. Red lines represent the 95% confidence intervals.*



Among the 261 respondents that reported keeping other livestock species, 19.5% reported that they use dewormers on their other livestock.

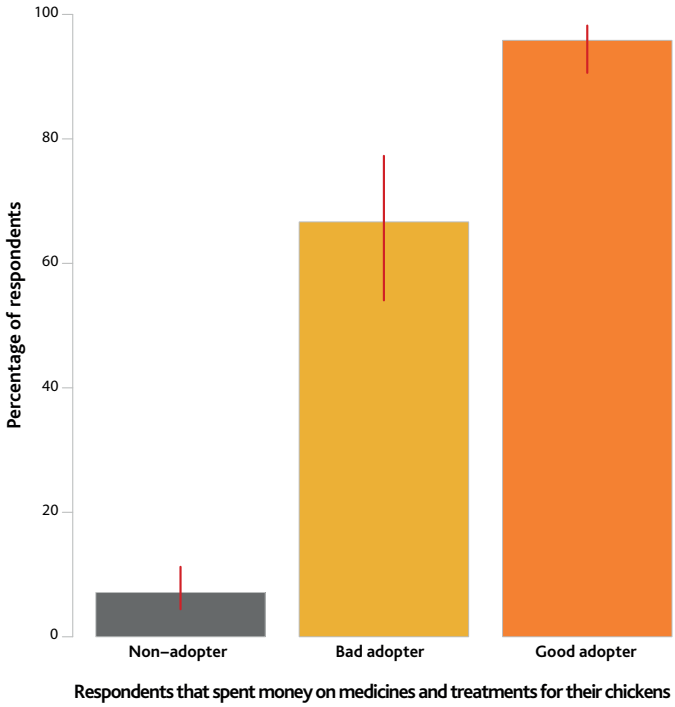
Ninety respondents reported that they use vaccines against diseases other than ND; all 90 vaccinated against fowl pox and one respondent also vaccinated against fowl coryza. It was almost exclusively good adopters that vaccinated against fowl pox (Figure 7; $p < 0.001$).

Figure 7. *Barplot of the use of vaccines against fowl pox. Red lines represent 95% confidence intervals.*



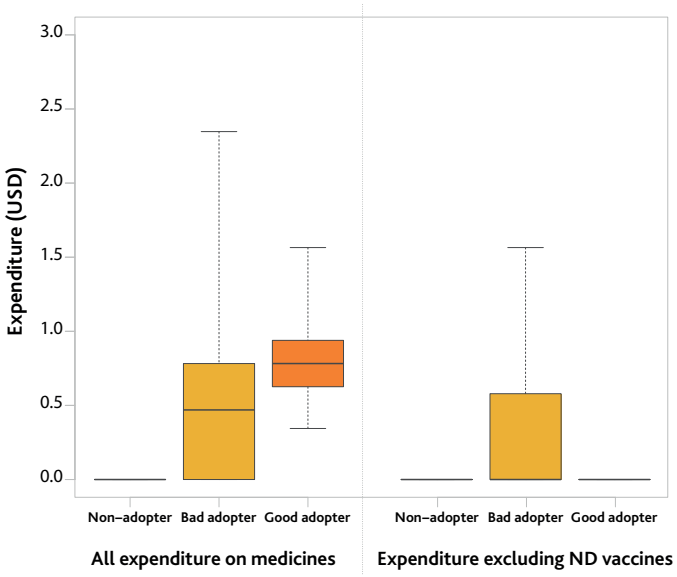
Overall, 42.2% of respondents stated that they had spent some money on medicines, vaccines and dewormers during the past three months; unsurprisingly, this percentage was significantly greater among adopters than among non-adopters (Figure 8; $p < 0.001$).

Figure 8. *Barplot of the percentage of respondents that had spent money on their chickens. Red lines represent the 95% confidence intervals.*



The overall spend on medicines was highest among good adopters; this remains the case after expenditure on ND vaccines are excluded from the analysis (Figure 9). The mean expenditure over the previous three months was 0.09 USD among non-adopters, 0.34 USD among bad adopters, and 0.19 USD among good adopters (Figure 9).

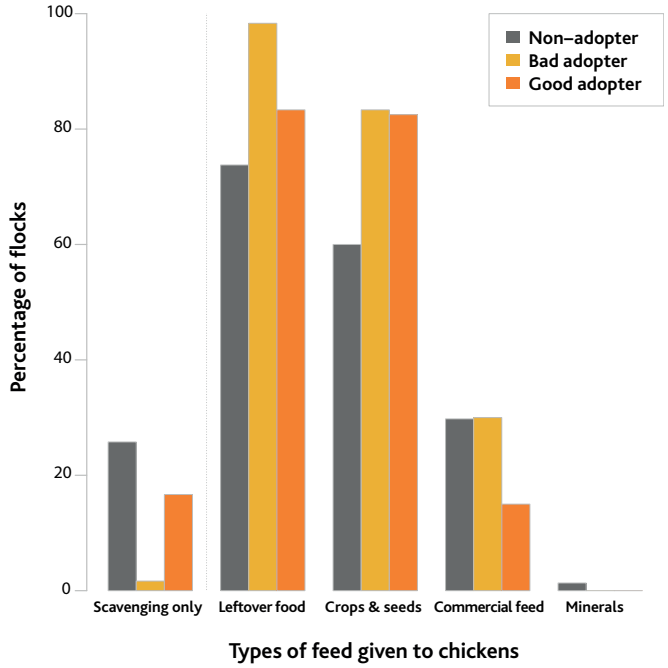
Figure 9. *Boxplot of expenditure on medicines, vaccines and dewormers during the past three months, for all medicines (left) and excluding money spent on dewormers (right). The centre line represents the median, and the extremes of the box the 25th and 75th quartiles. The horizontal lines outside the boxes represent twice the interquartile range or the most extreme data point; outliers are excluded. 'Bad' and 'Good' refer to bad and good adopters respectively.*



Feeding

The majority 326 of respondents (80.5%) allowed their chickens to scavenge but also gave some supplementary feeding (commercial, fodder, or leftovers); for the remainder, their chickens were fed by scavenging only. However, there is no pattern of feeding practice corresponding to the practice of vaccine adoption except that only one bad adopter fed their chickens through scavenging (Figure 10). Only three respondents reported giving mineral supplementation.

Figure 10. *Barplot of the percentage of respondents giving different feeding regimes.*



The majority (89.0%) of respondents that gave their chickens feed did so throughout the year, and the remainder only fed their chickens during the wet season. The majority of adopters spent money on feed, whilst the majority of non-adopters did not; adopters spent a median of 1.56 USD during the past three months (Figure 11). The expenditure per chicken was also greater among adopters when the formula is adjusted to account for outliers (Table 3).

Figure 11. *Boxplot of expenditure on chicken feed during the past three months. The centre line represents the median, and the extremes of the box the 25th and 75th quartiles. The horizontal lines outside of the boxes represent twice the interquartile range or the most extreme data point; outliers are excluded.*

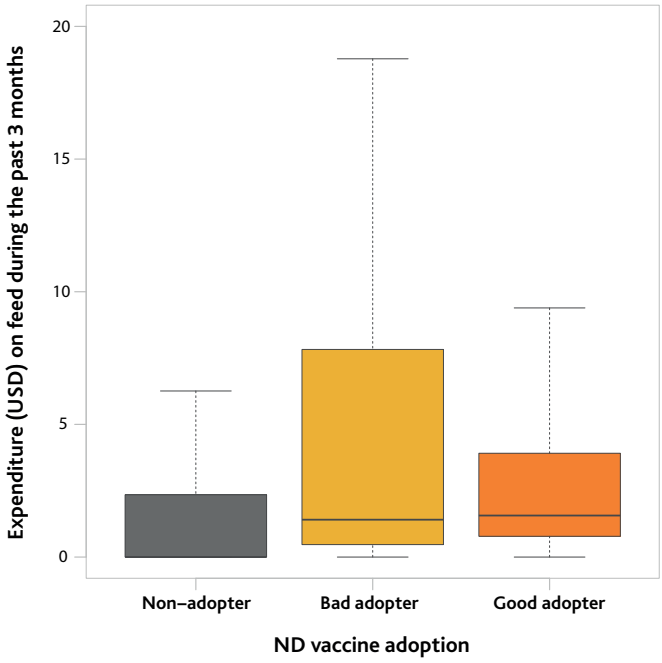


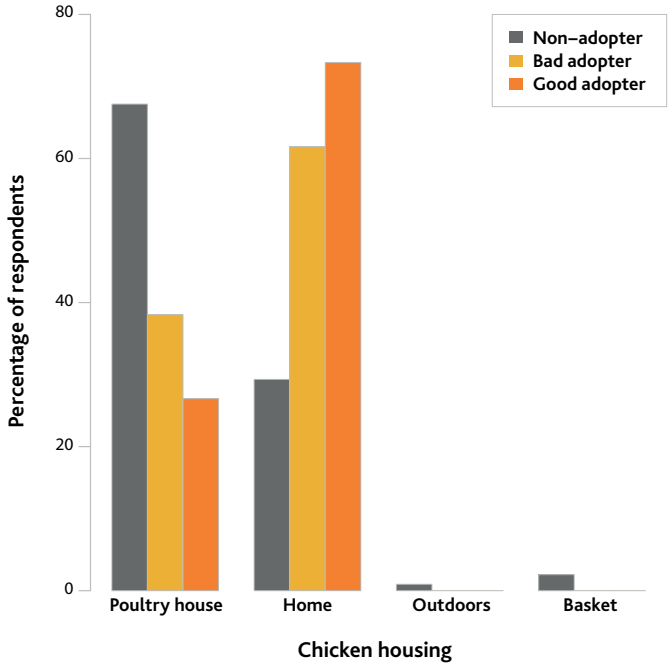
Table 3. *Levels of expenditure on feed during the past three months by the different adoption classes. The adjusted expenditure per chicken is to correct for some outliers; this is calculated by taking the square root of the expenditure over the square root of the numbers and then squaring the result* $((x)/\sqrt{n})2$.

		Expenditure (USD) on chicken feed			
Adoption status	Number of households spending money on feed	Mean spend	Median spend	Spend/ chicken	Spend/ chicken (adjusted)
Non-adopter	104 (46.2%)	3.74	0	0.33	0.12
Bad adopter	50 (83.3%)	5.68	1.56	0.30	0.20
Good adopter	118 (98.3%)	4.81	1.56	0.27	0.19

Housing

Most respondents (51.1%) used some sort of specialised poultry housing. However, adopters were more likely to keep their chickens in the family home whilst the non-adopters were more likely to use some type of poultry housing (Figure 12). Few left their chickens outdoors or in baskets.

Figure 12. *Barplot of the percentage of respondents providing different types of chicken housing. Poultry housing includes separated hen and chick houses/chick cages. 'Home' refers to the family home. Red lines represent the 95% confidence intervals.*



Consumption and sales

The total off-take (the combination of consumption and sales of chickens) was significantly greater among the adopters (Figure 13; $F = 10.8$, $p < 0.001$). There was generally a greater number of adopters that reported any consumption or selling of chickens, with less than 50% of non-adopters using chickens for any of these purposes during the past three months (Table 4). Additionally, the numbers of chickens sold and consumed were greater among the adopters than among the non-adopters (Table 4).

Figure 13. *Boxplot of the off-take of chickens by status of Newcastle disease (ND) vaccination. The centre line represents the median, and the extremes of the box the 25th and 75th quartiles. The horizontal lines outside of the boxes represent twice the interquartile range or the most extreme data point, outliers are excluded.*

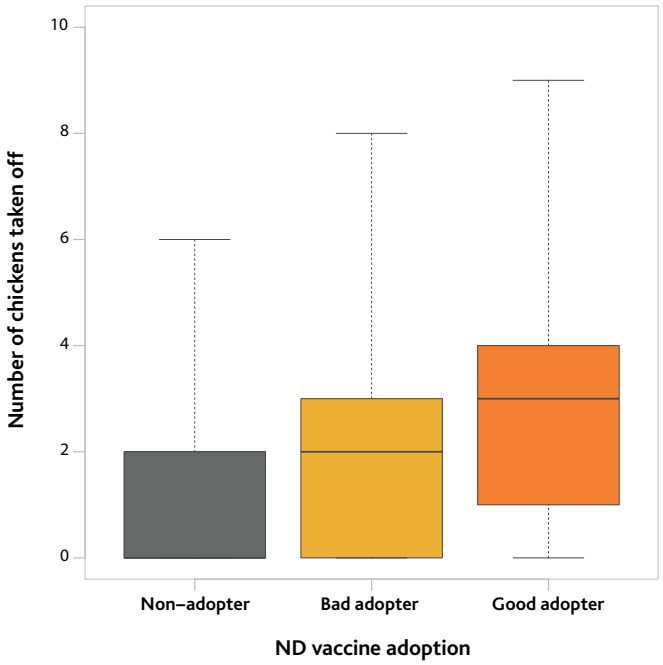


Table 4. *Breakdown of chicken off-take by different categories of Newcastle disease adoption during the past three months. The 'respondents' column relates to the number that had reported off-take in that particular category.*

	Adoption status	Mean number	Median number	Number/chicken	Respondents
Off-take	Non-adopter	1.36	0	0.121	105 (46.7%)
	Bad adopter	4.68	2	0.249	41 (68.3%)
	Good adopter	3.20	3	0.182	98 (81.7%)
Consumption	Non-adopter	1.00	0	0.089	101 (44.9%)
	Bad adopter	2.60	2	0.138	39 (65.0%)
	Good adopter	1.85	2	0.105	85 (70.8%)
Sales	Non-adopter	0.35	0	0.03	40 (17.8%)
	Bad adopter	2.08	0	0.11	11 (18.3%)
	Good adopter	1.35	0	0.08	57 (47.5%)

Adopters achieved greater prices for selling cocks, but otherwise there was no strong trend in the values obtained for adopters compared to non-adopters (Table 5).

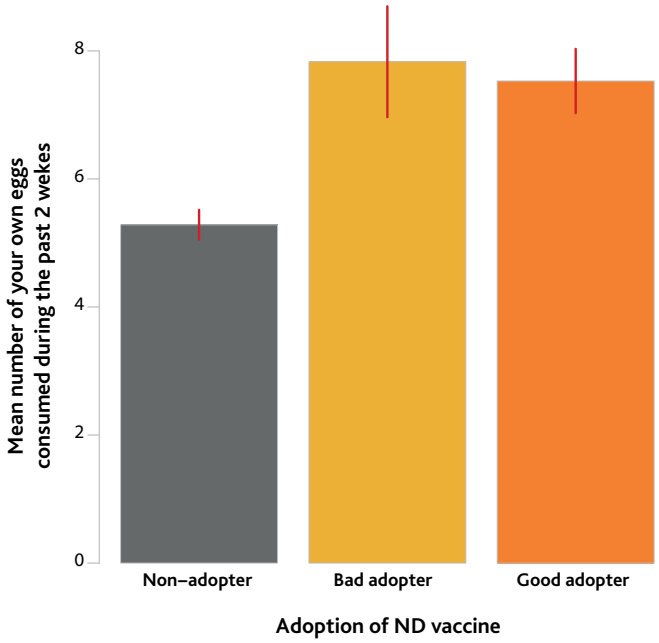
Table 5. *Responses to the question of "Estimate the value that you expect to receive for selling…". Broken down by adoption of Newcastle disease vaccination.*

	Mean value (USD) realised (number of respondents)		
	Non-adopter	Bad adopter	Good adopter
Chicks	- (0)	- (0)	1.56 (4)
Growers	- (0)	- (0)	5.09 (4)
Hens	4.01 (13)	4.43 (6)	4.05 (22)
Cocks	4.67 (33)	4.69 (10)	6.57 (40)

The greatest proportion of chickens that were sold were bought locally in the village; 97.1% of respondents sold chickens in this way. Sometimes, respondents sold at the market (45.7%); middleman vendors were rarely involved (3.8%).

There were relatively few reported sales of eggs. Only 12 respondents reported selling eggs during the past two weeks; this totalled 86 eggs. However, 248 respondents (61.2%) reported consuming their own eggs during the past two weeks; this totalled 1,598 eggs and represented 56.4% of non-adopters, 88.3% of bad adopters and 56.7% of good adopters (Figure 14). Of those that had consumed their own eggs, the non-adopters consumed 5.28 eggs, compared to bad adopters who consumed 7.83 eggs and good adopters who consumed 7.53 eggs. The difference between adopters and non-adopters was significant (Kruskal-Wallis chi-squared, $p < 0.001$).

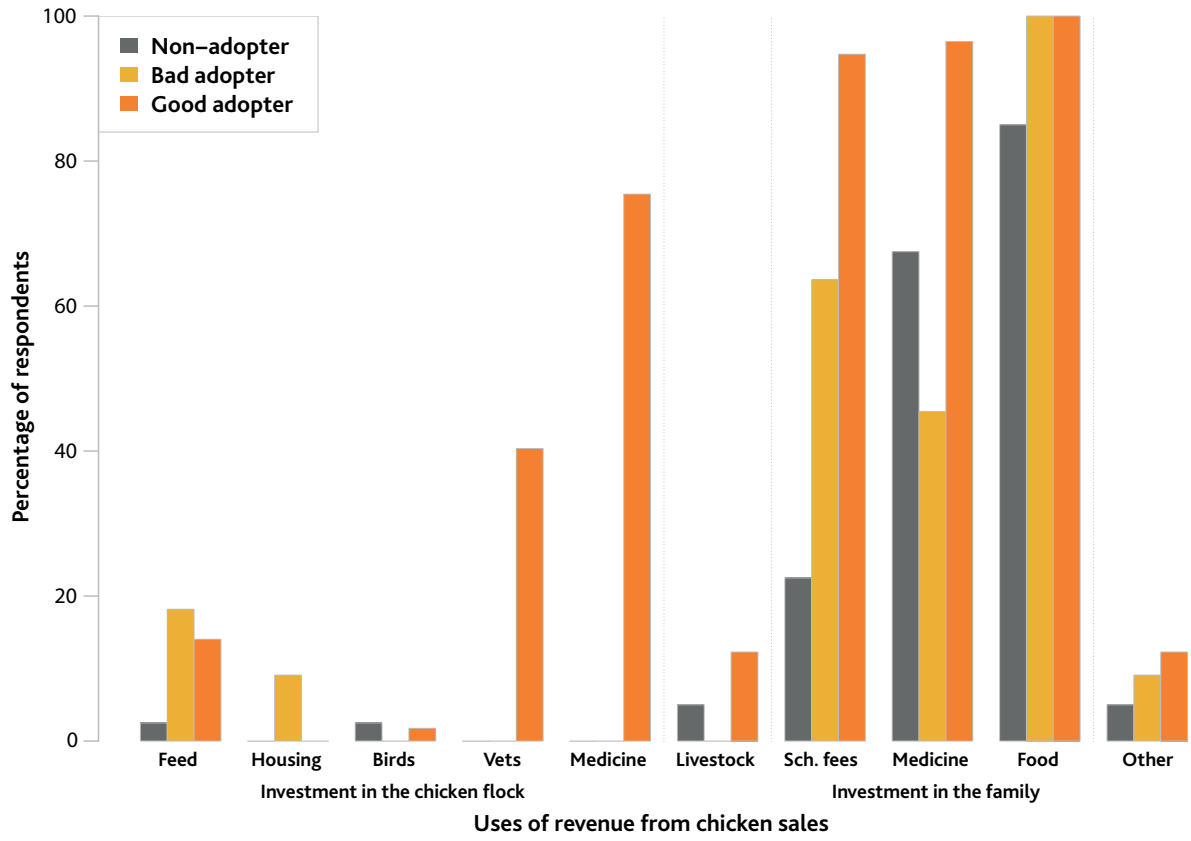
Figure 14. *Barplot of the numbers of eggs consumed during the past two weeks by respondents that reported consuming eggs. The red lines represend standard erorrs around the mean.*



Uses of revenue

One hundred and eight respondents reported using the revenue from sales. Of these respondents, 40 were non-adopters, 11 bad adopters and 57 good adopters. Uses of revenue were similar irrespective of the ND vaccination group, but good adopters were more likely than other respondents to spend on feed and medicines (including vaccines). Few spent money on other livestock (Figure 15).

Figure 15. *Barplot of the percentage of respondents reporting different uses of the revenues from sales. Note that the responses are not mutually exclusive and are only for the 108 respondents that reported sales of chickens.*



Secondary results

Other livestock

The good adopters were typically less likely to farm species other than chickens – buffalo, cattle, goats and pigs. A small number (seven respondents) reported farming pigeons. Twenty-two respondents reported farming ducks and three reported farming sheep. Out of all 551 respondents, 19.3% farmed buffalo, 37.5% cattle, 46.7% goats, and 15.6% pigs (Figure 16). Good adopters kept a greater number of buffalo and pigs than did non-adopters and bad adopters. Those that were good adopters also kept fewer of each non-chicken species (Figure 17).

Figure 16. *Barplot of the percentage of respondents that farmed species other than chickens.*

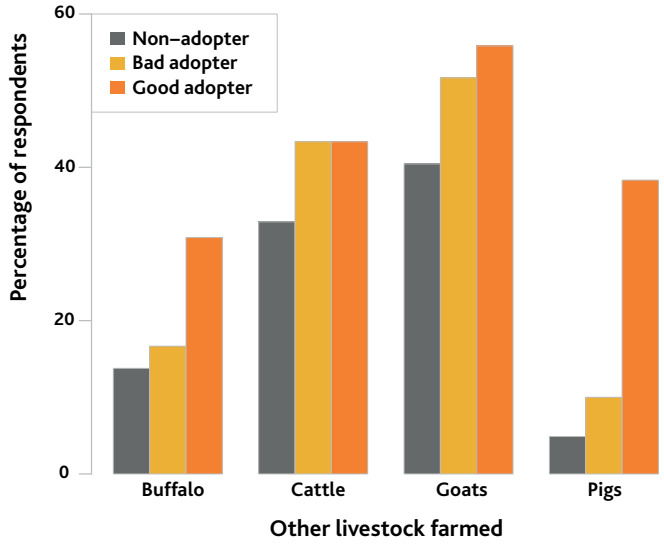
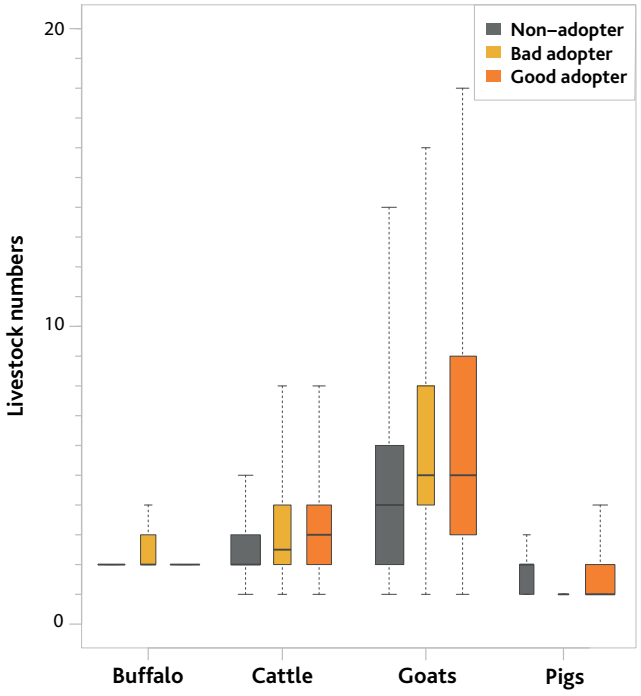


Figure 17. *Boxplot of the numbers of other livestock reported by respondents by status of Newcastle disease vaccination. The centre line represents the median and extremes of the box the 25th and 75th quartiles. The horizontal lines outside of the boxes represent twice the interquartile range or the most extreme data point; outliers are excluded. Those that did not farm a particular species are excluded from the analysis for that species, and so the baseline is 1.*



Respondent characteristics

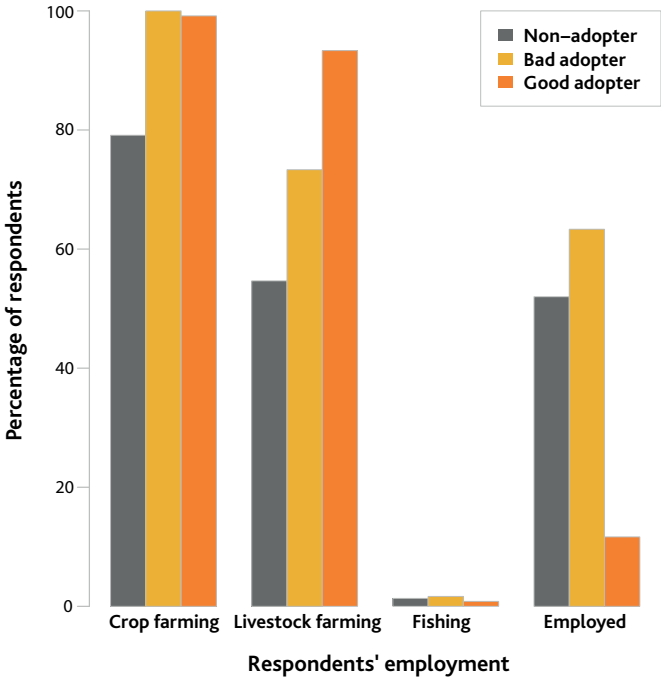
The respondents were 228 females (56.3%) and 176 males (43.5%); for one respondent, the gender had not been entered. Similar proportions of both male and female respondents fell into the three categories of adoption (Table 6).

Table 6. *Breakdown of the adoption of Newcastle disease vaccination by gender. Percentages relate to the percentage of that gender.*

Adoption status	Female	Male
Non-adopter	127 (55.7%)	97 (55.1%)
Bad adopter	31 (13.6%)	29 (16.5%)
Good adopter	70 (30.7%)	50 (28.4%)

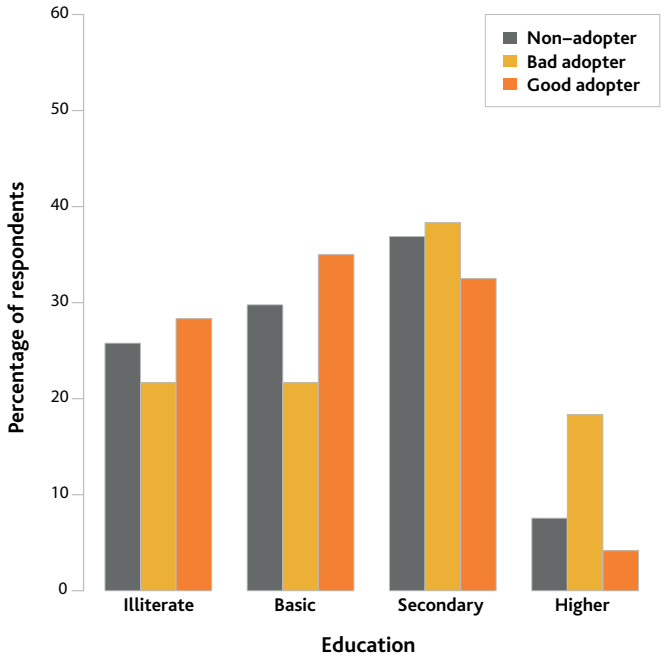
For the primary sources of household income, 95.6% nominated crops, and 87.8% livestock; these were not mutually exclusive. Only 15.2% had employment elsewhere and nine respondents named fishing as a primary source of income. Interestingly, all adopters bar one cited crop farming as a source of employment and all long-term adopters also cited livestock farming. Only 14 good adopters cited employment elsewhere as a source of income (Figure 18). This could indicate that vaccination has enabled households to specialise in farming and not have to seek employment elsewhere, or it could be an artefact of the study design.

Figure 18. *Barplot of the sources of income by vaccine adoption. Note that a single household can have more than one source of income.*



One quarter of respondents were illiterate, with 30.1% educated, but only to primary school level or below, and 35.8% educated to secondary school level. Thirty-three (8.1%) reported that they had been educated beyond secondary school (Figure 19).

Figure 19. *The education level of the respondents broken down by adoption of Newcastle disease vaccination. Of the respondents, 105 were illiterate, 122 had basic education (to primary school or lower), 145 had secondary education and 33 had higher education.*

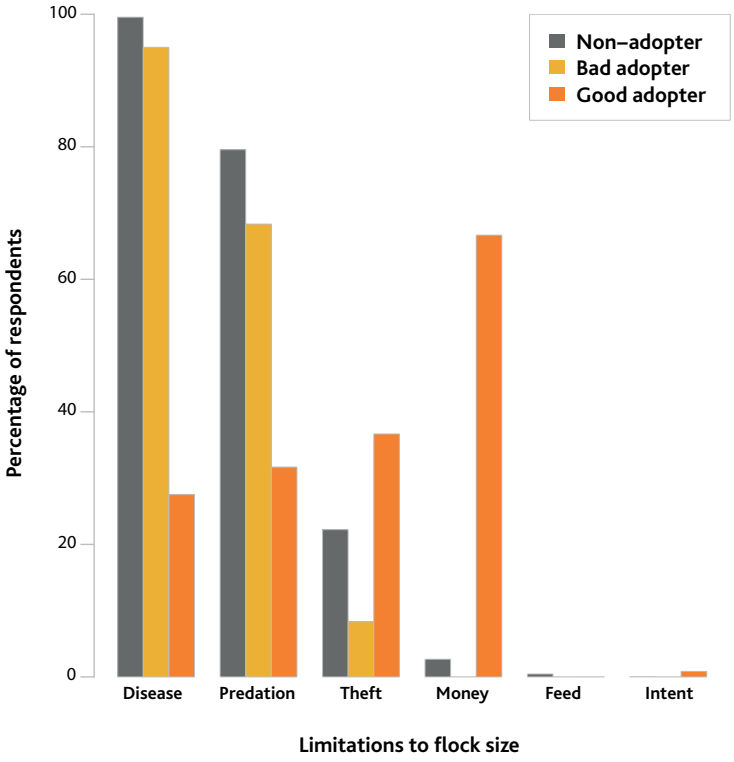


Future ambitions for the flock

In response to the question of "What do you plan to do with your flock in the future?" the majority (390, 96.3%) responded that they wished to grow their flock; 12 (3.0%) reported that they wished to keep their flock the same size, and two wished to move into farming other species.

Among non-adopters and bad adopters, the principal limitations on flock size were disease and predation, whilst among good adopters the limitation was money (Figure 20). This shows that even if one disease problem is solved, people will still not have sufficient money, and any additional revenue coming from the flocks will simply be spent on essential household expenses.

Figure 20. *Barplot of the limitations on flock size. Note that more than one response was allowed to this question, and that the response 'intent' means that there was no intention to grow the flock.*



Most respondents (98.0%) received no assistance to develop their flock, but eight did report that they had assistance from a non-governmental organisation (possibly GALVmed or SUPPORT)

Conclusions

The study identified three different types of adopters of ND vaccines that differ according to coverage by community vaccinators. Some important differences were observed between the three different categories:

- **Non-adopters** were typically in villages that had no coverage by community vaccinators. These farmers therefore had no direct access to ND vaccines and were not sensitised to their existence.
- **Bad adopters** were either in villages that had only recently (in the past year) been covered by community vaccinators, or they did not regularly comply with vaccination rounds.
- **Good adopters** had complied with at least two rounds of ND vaccination during 2016.

Most adopters typically vaccinated four times during 2016, providing they had access to the vaccines for the whole of that year. This is because households are very dependent on community vaccinators for the supply of vaccines and other products and so will typically vaccinate whenever the community vaccinator visits (usually every three months). This is something of a contrast to Tanzania where the delivery of vaccine was less readily delivered by community vaccinators and as a result, flocks were vaccinated less regularly. Accordingly, in India, adopters had fewer ND outbreaks, fewer chicken deaths attributed to ND and consequently larger flock sizes – around 50% larger.

Relatively few differences in husbandry were observed. Some specific points were:

- The adopters spent more on medicines and were more likely to use dewormers and fowl pox vaccines; this may be because community vaccinators also sell dewormers and fowl pox vaccine. This greater expenditure remains the case after the expenditure on ND vaccines has been taken into account.
- Around 25% of non-adopters and good adopters fed their chickens by scavenging only, but almost all bad adopters provided some supplementary feeding.
- Adopters spent more than non-adopters on poultry feed. Use of mineral supplements was very low among all groups.
- Adopters were more likely than non-adopters to keep their poultry in the family home, whilst non-adopters more frequently used poultry housing. It is possible that this is an artefact of the way in which the questions were asked and the survey was structured.
- Among adopters, the principal limitation on growing the flock size was money; for non-adopters, the main limitation was disease and predation.
- Most respondents kept only indigenous breeds – few kept exotic breeds.

In addition to the husbandry practices that are described above, respondents that vaccinated:

- Were typically employed only in farming crops, livestock and chickens; non-adopters were more likely to be employed elsewhere. This could be because improved livestock production meant that the adopters had no need to seek employment elsewhere and could focus on farming for income.
- Were more likely to also keep other livestock species – in particular buffalo and pigs, but there was also greater ownership of goats.
- Owned flocks that were around 50% larger, with an increase in the proportion of hens, as opposed to cocks, in their flocks compared to the flocks of non-adopters.
- Sold and consumed more chickens and consumed more eggs than did non-adopters.

These findings are consistent with the results from GALVmed's previous studies.

The chicken farmers in the study area are highly dependent on community vaccinators for delivering improved husbandry and management. The study found that where community vaccinators supply vaccines or dewormers, the farmers will take them up. However, it also observed that there is no particularly strong evidence in this area of ND vaccination resulting in improved husbandry unless it is delivered by the vaccinators.

Part of the lack of investment in husbandry is due to the relatively small flock sizes in the study area. Many investments – a vial of vaccine to administer yourself, mineral supplements, or even a bag of commercial feed – are not hugely cost-effective when a farmer owns only 16 chickens. However, this is an opportunity for community vaccinators – they can sell mineral supplements, or even commercial feed by buying in bulk and reselling in smaller packets. The example of feed shows that community sensitisation benefits farmers for just a relatively short period: farmers are sensitised about the importance of supplemental feeding and adopt it for a period, but this lapses after a time and some revert to just feeding their chickens by scavenging. If the feed itself could be delivered by vaccinators then any change in practice would be more sustainable.

A further difference between our studies is that in Tanzania there is a large amount of capital tied up in chicken flocks whereas this is not the case with the smaller flocks in India. In Tanzania, where flocks are often around 50 chickens, farmers are able to use the capital value of their flock by selling some of their chickens to raise money for building poultry houses and other buildings.

Lessons learned

- Data collection using the ODK Collect app was successful. It resulted in a clean dataset that was georeferenced and had a number of checks on data quality. It also gave a great deal of flexibility in structuring the questionnaire to only ask relevant questions. Furthermore, the app gave the project manager the ability to monitor the study as it progressed.
- Improvements could be made to the use of the ODK Collect app, and more validation steps could be included. Furthermore, these were some issues in the use of GPS in the field. These phones were previously untested; in future it would be preferable to pre-check phones in advance.
- The wording of some of the questions could have been improved to remove ambiguity. There were two days of questionnaire development in the classroom, and one day in the field, but a second day in the field would have strengthened the end result.
- There was potentially a design flaw in the sampling framework, where one enumerator was assigned to each village. It is possible that despite the pre-testing of questionnaires, different enumerators were interpreting and asking the same question in different ways. This possibly led to some clustering of responses in villages depending on the enumerator that was assigned to that particular village. It would be logistically more challenging to have more than one enumerator visiting each village, but it would overcome some of these potential flaws.

Acknowledgements

This study is based on research funded in part by the Bill & Melinda Gates Foundation and with UK aid from the UK Government through GALVmed. The findings and conclusions contained within are those of the authors and do not necessarily reflect positions or policies of the Bill & Melinda Gates Foundation or the UK Government.

The study was managed on behalf of GALVmed by Paul Bessel of EPI Interventions, prbessell@gmail.com. Data collection in India was undertaken by Society for upliftment of People with People's Organisation and Rural Technology (SUPPORT), www.supportjharkhand.org. A special thanks goes to the community vaccinators for their assistance.

Reference

Bessell, P.B., Kushwaha, P., Mosha, R., Woolley R., Al-Riyami, L., Gammon, N., 2017. Assessing the impact of a novel strategy for delivering animal health interventions to smallholder farmers. *Preventative Veterinary Medicine,* 147, 108–11

Appendix 1

Questionnaire

Respondent details

Respondent last name	
Respondent first name	
Respondent gender	○ Female ○ Male
Block	○ Churchu ○ Dadi ○ Mandu
Village	
Address	
Respondent education	Select ONE: ○ Illiterate ○ Literate without formal schooling ○ Literate below primary school ○ Primary school ○ Middle or secondary school ○ High school ○ Diploma or certificate course ○ Graduate ○ Postgraduate or above
Is the respondent responsible for looking after the chickens?	○ Yes ○ No
Who takes care of the poultry?	Select ALL that apply: ☐ Adult female(s) ☐ Adult male(s) ☐ Young boys in the house ☐ Young girls in the house
What are the primary occupations / sources of income for the household?	Select ALL that apply: ☐ Farming own crops ☐ Farming own livestock ☐ Fishing ☐ Employed elsewhere

This section is about meat and egg consumption

Approximately how frequently do you eat chicken meat?	Select ONE: ○ More than twice per week ○ Twice per week ○ Once per week ○ Twice per month ○ Once per month ○ Less than once per month ○ Never
Approximately how frequently do you eat eggs?	Select ONE: ○ More than twice per week ○ Twice per week ○ Once per week ○ Twice per month ○ Once per month ○ Less than once per month ○ Never
Approximately how frequently do you eat other meat?	Select ONE: ○ More than twice per week ○ Twice per week ○ Once per week ○ Twice per month ○ Once per month ○ Less than once per month ○ Never

Details of chickens owned

Total cocks	
Total hens	
Total growers	
Total chicks	
Total chickens (all ages)	
What breeds of chicken do you keep?	Select All that apply: ☐ Indigenous ☐ Cross breed ☐ Pure exotic ☐ Don't know
What is the principal cause of loss in your flock?	Select ONE: ◯ Newcastle disease ◯ Other disease ◯ Predation ◯ Theft ◯ Run away ◯ Poor management ◯ Other (Specify):
What do you plan to do with your flock in the future?	Select ONE: ◯ Grow the flock ◯ Keep the flock the same size ◯ Maintain the flock but farm other species ◯ Shrink the flock size ◯ Sell the flock ◯ Not considered ◯ Don't know
What is the main reason for not growing your flock?	Select ONE: ◯ Lack of availability of feed ◯ Disease ◯ Predation ◯ Theft ◯ Lack of money to invest in the flock ◯ Lack of space ◯ Do not wish to grow flock ◯ Other (Specify):

Other species farmed

Does the smallholder own any other species?	◯ Yes ◯ No

*If '**Yes**' then list all that are farmed:*

Number of buffalo	
Number of cattle	
Number of goats	
Number of sheep	
Number of pigs	
Number of turkeys	
Number of ducks	
Number of Pigeons	

*If '**No**' then:*

Why do you not own any other species?	Select ALL that apply: ☐ Lack of space ☐ Lack of grazing ☐ Lack of money ☐ Disease ☐ I do not wish to own other species

History of Newcastle disease in the flock

Has the respondent heard of Newcastle disease?	○ Yes ○ No

*If '**Yes**' then:*

Estimate the number of Newcastle disease outbreaks in your flock during the past year	
Estimate the number of deaths due to Newcastle disease during the past year	
Have you ever vaccinated your chickens against Newcastle disease?-	○ Yes ○ No

*If '**Yes**' then:*

How many months since you last vaccinated against Newcastle disease?	
For how long have you been vaccinating against Newcastle disease?	Select ONE: ○ Less than 1 year ○ Between 1 and 2 years ○ More than 2 years
During 2016, how many times did you vaccinate your chickens against Newcastle disease?	Select ONE: ○ Not at all ○ Once ○ Twice ○ Three times ○ Four times
How is the Newcastle disease vaccine administered?	Select ONE: ○ Eye drop ○ Injection ○ Drinking water ○ Feed
Who normally vaccinates your chickens?	Select ONE: ○ Farmer themselves ○ Community vaccinator ○ Government extension officer ○ CBO / NGO ○ Other (specify):
What is the cost (in INR) of vaccinating your flock against Newcastle disease?	

*If '**No**' then:*

Why do you not vaccinate against Newcastle disease?	Select ONE: ○ I do not know about vaccines ○ Newcastle disease is not a problem ○ Vaccines are too expensive ○ Vaccines are not easily available ○ Vaccines do not work ○ Vaccines have bad effects ○ Poor management ○ Other (Specify):

Other treatments that you use for your animals

Over the past 3 months estimate your total expenditure (in INR) on medicines, vaccines and dewormers for your chickens	
What other vaccines do you use?	Select ALL that apply: ☐ Fowl pox ☐ Fowl coryza ☐ Gumboro ☐ None
Have you used dewormers on your chickens during the past year?	○ Yes ○ No
Have you used dewormers on any other animals during the past year?	○ Yes ○ No

This section relates to poultry housing

Do you have poultry housing for your chickens during the night time?	◯ Yes ◯ No

*If '**Yes**' then:*

What types of housing do you use?	Select ALL that apply: ☐ Single house ☐ Separated hen and chick houses ☐ Cage for chicks ☐ In the main house with people

*If '**No**' then:*

Where do your chickens pass the night time?	Select ALL that apply: ☐ Nesting on the ground ☐ Roost in a tree ☐ In the main house with people ☐ Other ☐ Don't know

This section relates to feeding the chickens

How are your chickens fed?	Select ONE: ◯ Poultry feed only ◯ Scavenging & poultry feed ◯ Scavenging only

*If **poultry feed** is given then:*

What feed do you give your chickens?	Select ALL that apply: ☐ Commercial feed (purchased) ☐ Crops and seeds (non-purchased) ☐ Leftover food ☐ Mineral and vitamin supplements ☐ Other (Specify):
During which season are your chickens fed?	Select ONE: ◯ All year ◯ Dry season only ◯ Wet season only
Over the past 3 months estimate your total expenditure (INR) on chicken feed	

This section relates to how you use your chickens

To the best of your memory, estimate for the past 3 months:	
The number of your own chickens that were consumed	
Were any chicks sold?	○ Yes ○ No
*If **yes** then:* Number of chicks sold	
Were any growers sold?	○ Yes ○ No
*If **yes** then:* Number of growers sold	
Were any hens sold?	○ Yes ○ No
*If **yes** then:* Number of hens sold	
Were any cocks sold?	○ Yes ○ No
*If **yes** then:* Number of cocks sold	
Estimate the number of chickens that were gifted	
To the best of your memory, estimate for the past 2 weeks:	
Estimate the number of your own eggs that were consumed	
Estimate the number of eggs that were sold	

This section relates to financial aspects of farming

Estimate the value (INR) that you expect to receive for selling:	
1 chick	
1 grower	
1 hen	
1 cock	
1 egg	
Where are your chickens sold?	Select ALL that apply: ☐ Market ☐ Locally in the village ☐ Vendor / middleman ☐ Other (Specify):
Estimate the travel distance (in km) to the nearest market	
Have you received any support to help build your flock?	Select ALL that apply: ☐ NGO ☐ Microfinance ☐ Other loan – non-microfinance ☐ Other (Specify):
How do you spend the income from sales?	Select ALL that apply: ☐ Poultry feed ☐ Purchasing poultry housing ☐ Purchasing chickens ☐ Veterinary services ☐ Medicines for livestock ☐ Purchasing other livestock ☐ School fees ☐ Medical fees for family ☐ Food ☐ Other (Specify):

Photo credit: Sephi Bergerson/GALVmed

GALVmed

Protecting Livestock – Improving Human Lives