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Assessing the impact of a novel strategy for delivering animal health interventions to smallholder farmers

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ABSTRACT

In many countries of the developing world village poultry play a vital role in the rural economy, providing a source of protein and valuable income with relatively small investments. In almost all areas in which village poultry are raised Newcastle disease (ND) is identified as one of the biggest causes of poultry loss, this is often coupled with a lack of knowledge of poultry management practices. Inexpensive and effective vaccines are available that are suitable for use in rural village environments, but in many areas service providers and reliable structures for delivery remain an obstacle to uptake of vaccines. To overcome this, GALVmed has implemented a network for vaccine distribution in which individuals in the villages are trained as vaccinators. The vaccinators purchase ND vaccines from local agro-veterinary stores and sell single doses at market determined prices. Implementation of these networks was preceded by a programme of smallholder sensitisation to increase awareness of diseases and flock management practices. Here we present analysis of the impacts of this scheme on village poultry production. We compare the results of a baseline survey carried out before implementation of the networks, with the results of a survey 16–24 months following implementation. We present results in terms of the uptake of ND vaccine, flock size, consumption of poultry meat, and poultry sales from Gairo district in Tanzania, Mayurbhanj district in India and Banke district in Nepal. In all areas, there was a significant increase in the numbers of flocks that were using ND vaccines, with over 75% uptake in all areas, reaching 98% in India. In all areas flock sizes doubled, the numbers of eggs that were set for hatching and that hatched increased by 25–50% and there was an increase in the frequency with which chicken meat was consumed and chickens were sold. Additionally, farmers reported fewer ND outbreaks, but this is prone to reporting bias and so improvements in production cannot be categorically ascribed to ND vaccination. These results have shown that establishing a market driven approach for the distribution of ND vaccines and community sensitisation on poultry husbandry practices results in a high rate of uptake of the vaccines. The results also suggest a reduction in the number of ND outbreaks and improvements to the livelihoods of rural smallholders.

1. Introduction

In many of the poorest households in rural areas of the developing world poultry play a vital role and have been recognised as making a significant contribution to rural development (Alders and Pym, 2009; Copland and Alders, 2005; Mack et al., 2013). In most developing countries traditional scavenging village poultry form the greatest proportion of the national poultry flock (Mack et al., 2013). Village poultry (usually predominantly comprising domestic chickens (*Gallus gallus*)) are typically kept in flocks of fewer than 50 birds, but flock sizes vary greatly between areas and countries (Guèye, 1998). Birds are typically kept in free-ranging flocks that are owned by known households but are able to mix freely with birds from other flocks. The majority of nutrition is from scavenging and may be supplemented with leftover food, seeds and crops or specialist poultry feed. There may also be some housing, or birds may be left to roost in trees or elsewhere. The investment and input costs are low, making poultry a low risk species to farm (Alders et al., 2010; Conan et al., 2012).

Poultry contribute to the nutritional status of the population by providing a rare source of protein in the form of poultry meat and eggs

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(Bhandari et al., 2016). They are a source of income that can be utilised on an *ad hoc* basis, bartered or sold to pay for school fees, clothes or medicines as needed. In addition they play a key role in the social life of the village – as ceremonial sacrifices, as gifts or to offer meat to greet guests (Gondwe and Wollny, 2007; Kondombo et al., 2003; Thekisoe et al., 2004). The flocks are often managed by women or children, giving women the potential for an independent source of income, and due to their low maintenance requirements poultry can play an important role in sustaining households that are afflicted by HIV/AIDS (Copland and Alders, 2005).

Village poultry production faces a number of constraints such as infectious disease, predation and theft (Aboe et al., 2006; Desta and Wakeyo, 2013; Harrison and Alders, 2010; Olwande et al., 2010). Infectious diseases including fowlpox, Marek's disease, Gumboro (infectious bursal disease) and fowl coryza have high mortality rates, but Newcastle disease (ND) is frequently cited as the infectious disease that is responsible for the greatest proportion of mortality (Aboe et al., 2006; Harrison and Alders, 2010; Otim et al., 2007).

Newcastle disease is caused by infection with the ND virus, a single stranded RNA Paramyxovirus virus of the *Avulavirus* genus. ND viruses can be characterised by the severity of clinical signs and mortality rates among infected birds. The least pathogenic viruses cause subclinical infection, whilst the most pathogenic cause very high mortality, particularly among chicks, where mortality rates can approach 90% and are accompanied by distinctive clinical signs (Alders and Spradbrow, 2001). Among birds that survive there is a period during which the antibody titre is sufficient to protect the bird from further infection. There are a variety of routes of transmission including faecal-oral transmission, transmission through fluid secretions and through corpses of dead birds. Consequently, in an infected village, the disease is characterised by outbreaks in many flocks at the same time. This can be compounded by farmers choosing to sell birds at the start of an outbreak thus spreading infection to neighbouring areas through the movement of latently infected birds (Desta and Wakeyo, 2012; Sambo et al., 2015)

There are a number of both live and inactivated that are licenced and have good efficacy. Thermotolerant live vaccines have been developed that are safe, effective and can be administered by a number of routes including eye drop (Tu et al., 1998) with vaccination once every four months being adequate frequency to protect birds (Alders and Spradbrow, 2001) with clear cost benefits of vaccinating (Henning et al., 2013). However, delivery of ND vaccines to rural village poultry farmers is hampered by the difficulties of ensuring a cold chain and the high-dose formats of many vaccines (Alders, 2014) but a new low-dose tablet format could overcome these difficulties (Lal et al., 2014). This paper describes the impacts on household village poultry flocks of such a vaccine delivery strategy in Nepal, India and Tanzania.

2. Materials and methods

The implementation of this programme was preceded by a sensitisation campaign in which the populations were provided with poultry management related information, details of diseases and the information on the availability of vaccines through poster campaigns, radio broadcasts, video shows, street drama, wall painting and community groups.

The model for product delivery described in this paper is one by which vaccines are distributed to agro-veterinary stores from local distribution hubs, all overseen by local managers. From the agro-veterinary stores, products are either purchased directly by the farmers, or in most cases are purchased by independent vaccinators to sell the products on to farmers. The vaccinators were recruited from among the village population through a process of advertising and interview, and were given 3 days of training in the storage, preparation, administration of the vaccines and maintenance of the cold chain. Thereafter the vaccinators are self-employed but are supported by a local NGO or local distributors with whom they have monthly meetings to discuss issues and monitor sales.

The vaccinators operate as independent businesses, selling vaccines at 100–150 TZS (4–7 US cents) per bird in Tanzania and 2 INR (3 USc) in India, this includes a small profit margin for each vaccine dose that is the vaccinators' fee. As such, the system is entirely farmer funded, the only component that received external funding was the setup, sensitisation and the training of the vaccinators. The first product to be rolled out through this mechanism were ND vaccines in the form of the thermotolerant LaSota in India produced by Hester Biosciences Ltd and I-2 in Nepal and Tanzania produced by the Government of Nepal Central Biological Production Laboratory and the Tanzania Veterinary Laboratories Agency respectively. All vaccines are administered via eye drop. It is the duty of the vaccinators and the distribution chain above them to ensure that the cold chain is maintained, which is also monitored by local managers.

This paper describes the impacts of this programme. This was ascertained through questionnaire surveys that were implemented at initiation of the programme – before the vaccine delivery commenced (baseline) and after 16–24 months (endline). The questionnaires were intended to study the state of health of the poultry systems in the area – the productivity, husbandry practices and income from poultry.

2.1. Questionnaire

The survey was implemented as a questionnaire that comprised a mixture of open and closed questions (the questionnaire is available in Supplementary information S1). The questionnaire was written in English and translated into the local language, with subsequent data entry in English. Prior to survey, the questionnaire was tested and amended in pilot studies. The process of engaging the smallholder and conducting the interview lasted for between 45 and 60 min. Once all interviews were completed, a proportion of survey forms were reviewed by a supervisor. Data were entered into a bespoke database following the completion of each survey.

2.2. Sample sizes

The sample sizes were calculated to give a representative sample of the population with a confidence interval and confidence level of 5%. A further 10% allowance was made to allow for variation within the sample. The actual sample size varied between study areas depending upon the number of poultry-owning households in the study area.

Table 1
Description of the study areas and survey timings.

	Survey area				Survey timings		
Country	Region	Study area	Number of households	Target sample size	Baseline	Endline	Duration (months)
India	Odisha State	Mayurbhanj district	100,000	384	June 2014	October 2015	16
Nepal	Mid-Western Region	Banke district	39,826	381	May 2014	December 2015	19
Tanzania	Morogoro Region	Gairo district	34,000	380	February 2014	February 2016	24