



## ASSESSING CONSTRAINTS TO NEWCASTLE DISEASE VACCINE (I<sub>2</sub>) ADOPTION AMONG SMALLHOLDER LOCAL CHICKEN FARMERS IN PLATEAU STATE, NIGERIA

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### ABSTRACT

This study examined the constraints to Newcastle disease vaccine adoption among local chicken farmers in Plateau State, Nigeria. A multistage simple random sampling technique was used to select 369 farmers across the three agricultural zones. Data were collected through the administration of questionnaire and analysed using Garrett's ranking method. The results indicated that inadequate veterinary extension services with a mean score of 65.53 pose the greatest challenge, followed by mistrust in regulatory bodies and vaccinators (59.30), and the availability of vaccine substitutes with score of 59.30 and 58.89, respectively. The study concluded that inadequate veterinary extension services was the major constraints to adoption of Newcastle disease NDV-I<sub>2</sub>'s among local chicken farmers in the study area. The study recommended that addressing these barriers requires strengthening veterinary extension services through targeted investment in education and farmers' support and promoting awareness of NDV-I<sub>2</sub>'s economic and health benefits and fostering trust in regulatory institutions through transparency and engagement are essential. Finally, improving vaccine supply chains and market regulations will enhance NDV-I<sub>2</sub> availability and reduce reliance on suboptimal alternatives.

**Keywords:** Newcastle, Disease, Poultry, Vaccine, Smallholder, Farmers,

### INTRODUCTION

Agriculture has historically contributed to the economic growth of developing countries (Diallo *et al.*, 2020). The United Nations Sustainable Development Goals, specifically goal two, aim to end hunger, achieve food security, improve nutrition, and promote sustainable agriculture (Elif, 2023). Despite their crucial role in food security and rural development, smallholder farmers often lack access to necessary resources, including technology, which limits their ability to adopt sustainable practices effectively (Hatzenbuehler and Pena-Levano, 2022). Smallholder farmers primarily practice agriculture in these countries, and it is crucial for achieving the second Sustainable Development Goal (Abraham and Pingali, 2020). Thus, developing smallholder agriculture has become a focus in these countries (Bartol, 2022).

Poultry farming in rural developing countries plays a vital role in enhancing food security and economic resilience through diverse benefits, including the direct provision of nutrient-rich products and indirect advantages such as sales, manure, and pest control (Wong *et al.*, 2017). As women and children typically in developing regions drive over 80% of poultry production activities (Weil *et al.*, 2021). Furthermore, backyard poultry are often the sole livestock that women have independent control over (Thieme *et al.*, 2014). Research highlights that, women and girls population growth rate according to Worldometer stands at 2.08%. This exponential proliferation of the human populace markedly escalates the demand for sustenance and vital nutrients requisite for growth and development. This phenomenon places the poultry industry at a pivotal crossroads, as it is compelled to meet the escalating requirement for animal-derived protein while simultaneously enhancing the progression of livelihoods.

While domestic avian production possesses significant potential for enhancing household economic stability and nutritional adequacy, it is impeded by losses attributed to recurrent disease outbreaks most especially, Newcastle disease and by suboptimal productivity, particularly during the



dry season when poultry feed resources are limited (Joshi *et al.*, 2021). Disease outbreaks cause considerable illness and death in village poultry systems. Biosecurity measures are hard to implement as chickens free-range and the mingling with other birds, increasing infectious risks. Vaccination programmes also face difficulties due to limited veterinary services, challenges in maintaining a cold chain, and unreliable vaccine production and distribution in resource-limited settings (Ouma *et al.*, 2023). This issue is exacerbated by the excessive use of drugs, leading to resistant pathogens and unintended drug residues in chicken meat and eggs (Falowo and Akimoladun, 2019). Newcastle disease has been identified as a major constraint to the development of poultry farming. Its impact is more catastrophic in emerging countries where traditional poultry farming is dominant and represents an important source of income and animal protein for households. Due to inadequate preventive measures in rural areas (Bogale *et al.*, 2017), ND outbreaks can result in up to 100% morbidity and mortality in unvaccinated poultry and wild birds, causing considerable economic losses, estimated at USD 2 billion annually (Global Alliance for Livestock Veterinary Medicines, 2020). The Newcastle disease virus (NDV), or Avian *Paramyxovirus-1* (APMV-1), is the causative agent, belonging to the *Avulavirus* genus and *Paramyxovirus* family (Absalón *et al.*, 2019; Dimitrov *et al.*, 2017). Vaccination prevents ND by inducing immunity (Nadeem, 2019). According to Nandi and Shet (2020) the discernible benefit of vaccination is the ward-off of medical expenditure (the economic costs of treatment, such as physician fees, drugs and hospitalization expenses, and associated travel costs and wage loss) of caregivers. Effective immunity against ND requires repeated vaccination (Zhu *et al.*, 2021).

Although Newcastle disease (ND) is recognised as a significant limitation within the majority of rural poultry systems, it is imperative to comprehend the foundational elements and particular health challenges in order to guide more comprehensive interventions. This research investigates on assessing constraints to the practice of Newcastle disease vaccine (NDVI<sub>2</sub>) adoption among local chicken farmers in Plateau State, Nigeria.

## METHODOLOGY

### Study Area

The study was conducted in 9 Local Government Areas, which are representatives of the Northern, Central and Southern Agricultural Zones of Plateau State, Nigeria. The State is located in the North – Central Zone of Nigeria. The State has Seventeen Local Government Areas with Jos town as the headquarters. The state lies between longitude of 8°30' and 10°3'N, latitude 7°3' and 13°37'E with a land mass covering 30, 913sq kilometres. The state has an estimated population of 4,717,300 (City Population Projected, 2022).

### Sampling Techniques and Sample Size

The sampling techniques used for this study was a multi-stage sampling procedure. The first stage involves the stratification of the study into the already existing three (3) agricultural zones. The second stage involved purposive selection of three (3) Local Government Areas (LGAs) from each of the three zones of Plateau State on the basis of intensity of production/rearing of local chicken. The third stage was random selection of two (2) districts each from the LGAs. The fourth stage was the selection of two (2) communities/villages from each of the district making a total of 36 communities/villages. In the final stage, simple random technique was used to get a sample size at a proportion of 8% from the list of 4,610 that was provided by the Village heads/Community animal health workers (CAHWs) to give sample size of 369. The meaning of all the thirteen kinds of constraint was explained to the respondents and the constraint that was ranked first provided the most significant constraint while the thirteenth ranked provided the least significant constraint.

### Method of Data Collection

Data were collected through the administration of questionnaires to the randomly selected respondents from the study area. The survey instruments collected data on constraints faced by local chicken farmers in their adoption of Newcastle disease vaccine (I<sub>2</sub>).



### Method of Data Analysis

Data were analysed using Garrett's ranking technique. Anticipated information related to the problems faced by the farmers in local chicken vaccination practice was gathered. Constraints were identified in the practice of NDV-I<sub>2</sub> vaccination and farmers were asked to rank the glitches proposed to them. Garrett's Ranking Technique provided the change of orders of constraints and advantages into numerical scores. The leading advantage of this technique over simple frequency distribution is that the constraints are arranged based on their severity from the respondent's point of view. Hence, the same number of respondents on two or more constraints may have been given different rank. Garrett's formula for converting ranks into percent is as below:

$$\text{Percent position} = 100 (R_{ij} - 0.5) / N_j \quad \dots\dots\dots (1)$$

where:

$R_{ij}$  = Rank given for  $i^{\text{th}}$  constraint statement by  $j^{\text{th}}$  individual;

$N_j$  = Number of constraints statement ranked by  $j^{\text{th}}$  individual.

The percent position of each rank was converted into scores referring to the table given by Garrett and Woodworth (1969). The total score was then calculated for each constraint by adding the scores of each respondent. This total score was then divided by the total number of respondents whose scores were collected.

The Garrett ranking technique has been used to analyse various factors influencing various production by respondents. The respondents were asked to rank the 13 constraints identified for the purpose of this study as 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, ..... and 13<sup>th</sup> in order to know their preference in the selection of the most severe constraint to the least.

### The Percent Position and Garrett Value

The Garret ranks were calculated by using appropriate Garret Ranking formula. Based on the Garret ranks, the garret value was calculated. The Garret tables and scores of each constraint in the table 2, and multiplied to records scores in table 1, finally by adding each row, the total Garret score was obtained.

**Table 1:** Percentage Position and Garret Value

	$100 (R_{ij} - 0.5) / N_j$	Calculated Value (CV)	Garret Value (GV)
1	$100(1 - 0.5) / 13$	3.89	84
2	$100 (2 - 0.5) / 13$	11.03	64
3	$100 (3 - 0.5) / 13$	19.39	67
4	$100 (4 - 0.5) / 13$	27.15	62
5	$100 (5 - 0.5) / 13$	34.25	58
6	$100 (6 - 0.5) / 13$	41.97	54
7	$100 (7 - 0.5) / 13$	50.00	50
8	$100 (8 - 0.5) / 13$	58.03	46
9	$100 (9 - 0.5) / 13$	65.75	42
10	$100 (10 - 0.5) / 13$	72.85	38
11	$100 (11 - 0.5) / 13$	80.61	80
12	$100 (12 - 0.5) / 13$	88.97	26
13	$100 (13 - 0.5) / 13$	96.11	16

Field Survey, 2024.

## RESULTS AND DISCUSSION

The Table 2 shows the preference and ranking of constraints affecting the practice of NDV-I<sub>2</sub> by local chicken farmers in the study area. From the 369 respondents, inadequate veterinary extension service was ranked first by 73 respondents, second ranked by 65 respondents, third ranked by 38 respondents while the least ranked was by 0 respondent. Similarly, mistrust of regulatory agencies and vaccinators was first and second ranked by 14 respondents respectively, third ranked was by 13 respondents, while the last ranked (13th) was by 15 respondents. The calculation of Garret value and ranking of the constraints assessed by the farmers in the study area are as showed in the table 3.



Infectious poultry diseases have significantly reduced the productivity in the poultry sub-sector, which had negatively affected local chicken farmer's livelihoods and wellbeing, and as well as public health food safety and security. The results from Table 3 highlighted various constraints faced by smallholder local chicken farmers. The study identifies the top five major challenges encountered by the respondents: inadequate veterinary extension services (65.53%) which was ranked first. The results showed that there is high inadequate presence of veterinarian extension officers in the rural areas. They may have had contacts with agricultural extension agents. However, the contact made may not be on ND vaccine as this could have exposed them to necessary ND vaccine training activities and the technical skills required for the use of this technology by the smallholder local chicken farmers. This may be as a result of lack or inadequate subject matter specialist or due infrastructural decay. This finding is in agreement with the submission of the Food and Agricultural Organisation (FAO, 2014), which opined widespread lack of resources and infrastructure that resulted to limited veterinary extension services in rural areas. This limited engagement with extension services is a significant constraint to effective vaccine uptake.

Mistrust of regulatory agencies/vaccinators (59.30%) was ranked second. This result is in agreement with the findings of Waithanji *et al.* (2015) where they found that if vaccine products cause diseases, it will certainly cause a mistrust about such vaccine thereby leading to rejection. Also, during epidemics, distrust in vaccine is predominant in local communities across Nigeria. This may be due to the newness of the technology in the rural settings.



**Table 2:** Showing Respondent's Preference and Ranking of Constraints of ND Vaccine (I<sub>2</sub>) Adoption by Farmers

Constraints	Respondent's Ranked Constraints												
	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>th</sup>	4 <sup>th</sup>	5 <sup>th</sup>	6 <sup>th</sup>	7 <sup>th</sup>	8 <sup>th</sup>	9 <sup>th</sup>	10 <sup>th</sup>	11 <sup>th</sup>	12 <sup>th</sup>	13 <sup>th</sup>
Absence of cold chain	42	49	34	54	29	25	29	27	24	21	17	15	3
Complexity of technology	11	35	37	45	48	54	31	29	19	17	22	16	5
Distance to vet shop/vaccination point	32	48	46	25	32	34	27	32	19	23	22	28	1
No access to credit	6	6	15	24	27	35	48	55	45	41	32	34	1
Inadequate vet extension service	73	65	38	49	37	24	27	19	13	13	7	4	0
Availability of high dosages	51	41	48	31	30	32	27	13	32	18	17	28	1
Availability of substitutes	58	32	49	31	25	30	16	24	18	32	24	26	4
Non-availability of markets	23	26	42	37	53	34	32	22	32	27	26	14	1
ND vaccine effectiveness	21	7	4	9	13	17	22	24	38	47	76	87	14
Farmer's income	15	20	17	18	16	36	42	47	48	40	40	27	3
Mistrust of regulatory agencies/vaccinator	14	14	13	21	20	16	35	30	30	51	53	57	15
Cost of ND vaccine	21	26	25	25	39	32	33	45	47	36	24	14	2
Conflicts	2	0	1	0	0	0	0	2	4	3	9	19	329

**Source:** Field Survey, 2024



**Table 3:** Ranking of Constraints Affecting Adoption of NDV-I<sub>2</sub>

Constraints	Rank Given by the Respondents													Total	%	Rank
	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>	5 <sup>th</sup>	6 <sup>th</sup>	7 <sup>th</sup>	8 <sup>th</sup>	9 <sup>th</sup>	10 <sup>th</sup>	11 <sup>th</sup>	12 <sup>th</sup>	13 <sup>th</sup>			
Absence of cold chain	3528	3626	2278	3348	1682	1350	1450	1242	1008	798	561	390	43	21,304	57.73	5 <sup>th</sup>
Complexity of Tech.	924	2590	2479	2790	2784	2916	1550	1334	798	646	726	416	80	20,033	54.29	8 <sup>th</sup>
Distance vet shop/ vac point	2688	3072	3082	1550	1856	1836	1350	1472	798	874	726	1150	16	20,467	55.86	7 <sup>th</sup>
No access to credits	504	384	1005	1488	1566	1890	2400	2530	1890	1558	1056	884	16	17,171	46.53	12 <sup>th</sup>
No adequate vet. ext service	6132	4160	2546	3038	2146	1296	1350	874	546	494	560	1040	0	24,182	65.53	1 <sup>st</sup>
Avai of high distance	4284	2624	3215	1922	1740	1728	1350	598	1344	684	1360	728	16	21,593	58.51	4 <sup>th</sup>
Avai of substitute	4872	2048	3283	1922	1450	1620	800	1104	756	1216	1920	676	64	21,731	58.89	3 <sup>rd</sup>
No availability of market	1932	1664	2814	2108	3074	1836	1600	1012	1344	1026	2080	364	16	20,870	56.56	6 <sup>th</sup>
ND Vaccine effective	1764	448	268	558	754	918	1100	1104	1596	1786	6080	2262	224	18,862	51.11	11 <sup>th</sup>
Farmer's income	1260	1280	1139	1116	928	1944	2100	2162	2016	1520	3200	702	48	19,415	52.61	10 <sup>th</sup>
Mistrust of regu. agencies / vaccinators	1176	896	871	1302	1160	864	1750	1380	1280	1938	4240	5586	32	21,885	59.30	2 <sup>nd</sup>
Cost of ND vaccine	1764	1664	1675	1550	2219	1728	1650	2070	1974	1368	1920	364	32	20,028	54.22	9 <sup>th</sup>
Conflicts	168	0	67	0	0	0	0	92	168	114	720	494	5264	7,087	19.20	13 <sup>th</sup>

Tech = Technology, Vac = Vaccination, Vet = Veterinary, Ext = Extension, Avai = Availability, Regu = Regulatory.

**Source:** Field Survey, 2024





This can be likened to the development of Covid-19 vaccine where people were hesitant to be vaccinated because of mistrust in government and the regulatory agencies and the vaccines as well. Kapoor *et al.* (2014) established that when an innovation is perceived as low-risk by end-users, its adoption is more probable. Similarly, Freimuth *et al.* (2017) opined that mistrust in vaccines, the regulatory agencies responsible for vaccine development, and healthcare professionals administering vaccines significantly affect vaccine uptake. Likewise, MacDonald and SAGE (2015) posited that trust or distrust in government can also exert an emotional influence on vaccines and vaccination programmes. Evidence of vaccine mishaps have affected the acceptance rates of vaccination programmes by local communities and residents. One specific case in view, was a failed unethical clinical drug trial by U.S-based Pfizer in Kano State, Nigeria where one hundred children were given an experimental oral antibiotic after a meningitis outbreak in 1996 which led to the death of eleven (11) children with a long legal battle for compensation (TheCable, 2024).

Availability of substitutes (58.89) was ranked third among the constraints affecting farmers' intentions to vaccinate their chickens, thereby hindering the uptake of the ND vaccine-I<sub>2</sub> in the rural communities examined in this study. These substitutes, which are both plant and chemical-based, are readily accessible within the local communities. This noticeable shift is likely driven by considerations of sustainability, comprehensiveness, cost-effectiveness, accessibility, and the environmental benefits associated with the use of medicinal plants and traditional practices within these communities. These results align with the research conducted by Campbell *et al.* (2018), which indicated that the reliance on traditional medicine serves as a barrier to ND vaccination among smallholder chicken farmers in Tanzania. Furthermore, the results are consistent with the work of William *et al.* (2022), which reported that 44.4% of respondents utilise herbal treatments for their flocks that include aloe vera, neem, pawpaw, moringa leaves, and ashes. Similarly, research by Simiyu *et al.* (2022) in Kenya found that women poultry farmers also employ substances such as aloe vera, neem, tobacco, pepper, and various other trees to address Newcastle disease (ND). It is noteworthy that individuals who depend exclusively on herbal medicine may lack awareness of Newcastle disease (Campbell *et al.*, 2018).

The availability of higher dosages (58.51%) of vaccines was ranked as the fourth most significant factor. This may be attributed to the characteristics of smallholder farmers who typically maintain a limited number of birds or flocks. Consequently, they may feel discouraged from utilising such vaccines, as purchasing a vial containing 50 or 100 doses of NDV-I<sub>2</sub> would result in a waste of resources due to their small flock size. This observation aligns with the qualitative findings of Waweru *et al.* (2023), which indicate that the packaging of ND vaccines in quantities that exceed the needs of most farmers negatively affects vaccine uptake.

The absence of a cold chain (57.73%) was identified as the fifth-ranked constraint. This may be largely attributed to the significant lack of electricity supply in rural areas, a shortage of ice packs necessary for maintaining the optimal temperature of vaccines, and inadequate temperature monitoring and control during transportation to rural settlements. This situation can be largely ascribed to the limited resources available to these farmers, rendering them unable to bear the costs associated with the requisite refrigeration services vital for storing commercially available vaccines. The findings of this study are consistent with the work of Dairo and Osizimete (2016), who identified a chronic power supply instability as a significant obstacle to effective vaccine supply chain management in Nigeria. Similarly, research conducted by Onyeka *et al.* (2014) in Anambra State highlighted the insufficient availability of ice packs as a critical factor hindering the maintenance of the cold chain necessary for successful polio immunization efforts. In contrast, Muhammad and Bala (2017) pointed out that the NDV-I<sub>2</sub>, characterized as thermostable, can endure elevated temperatures, making it particularly well-suited for deployment in rural areas with limited cold chain infrastructure.

Additionally, the impact of conflict incidents is significant; if a conflict event occurs around the time of ND vaccination, the chances of farmers getting their local chicken vaccinated diminish because both vaccinators and farmers struggle to congregate thus, leading to destruction of vaccination infrastructure which hinders vaccine transportation and storage. Conflict events that took place before the ND outbreak have a more pronounced effect on vaccination than those that occur



several months after the outbreak as it fosters fear and mistrust among community members, leading to reluctance to participate in vaccination activities. Conflict can increase the likelihood of the disease thus, leading to increased mortality rate among chickens, leading to crucial economic losses for farmers which should have motivated farmers to seek vaccination. However, the study's results indicated that conflict, as assessed by the respondents, occupies the lowest rank among the constraints identified. According to this study's results, conflict did not hinder respondents' practices concerning ND vaccination, contrary to the researcher's expectations. Although some respondents reported displacement due to various crises in the study area and this resulted to farmer's limited access to markets, making it difficult to sell their chickens and products. The findings of Alexander (2020) contradict this study's results, as his research demonstrated that displacement due to conflict and humanitarian crises posed significant challenges to delivering vaccination services.

## CONCLUSION AND RECOMMENDATIONS

The study concluded that inadequate veterinary extension services was the major constraint to adoption of Newcastle disease vaccine among local farmers in the study area. Other constraints were mistrust of regulatory agencies / vaccinators and availability of vaccine substitutes to mention a few. In view of the above the study recommends the following;

- i. The need for stakeholders to strengthening veterinary extension services at the local government areas through targeted investment in training and education; and offering on-one-on mentorship and support to farmers in order to address specific concerns.
- ii. They should be an increased engagement of various communities by veterinary service providers on vaccine's value and effectiveness; creating awareness on the importance of chicken vaccination in order to boost the uptake at the rural settings.
- iii. Promoting awareness of NDV-I<sub>2</sub>'s economic and health benefits to local chicken farmers and fostering trust in regulatory institutions and local vaccinators through transparency and engagement are essential.
- iv. Efforts should be made to improve vaccine supply chains and market regulations that will enhance NDV-I<sub>2</sub> availability and reduce reliance on suboptimal alternatives should be put in place.

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