Approaches to Meet the Demand for Newcastle Disease Vaccine for Backyard Poultry Sector in India

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Disclaimer

The opinions expressed are solely those of the authors and do not constitute in any way the official position of GALV med.

List of Abbreviations:

ASCAD	Assistance to States for Control of Animal Diseases
BPL	Below Poverty Line
BPU	Biological Products Unit
BYP	Backyard Poultry
CARI	Central Avian Research Institute
CBOs	Community Based Organizations
CDVO	Chief District Veterinary Officer
CPDF	Central Poultry Development Farm
DADF	Department of Animal Husbandry, Dairying and Fisheries
DAHD	Department of Animal Husbandry and Dairying
DANIDA	Danish International Development Assistance
FGD	Focus Group Discussion
FMD-CP	Foot and Mouth Disease Control Program
IBD	Infectious Bursal Disease
IVRI	Indian Veterinary Research Institute
KVKs	Krishi Vigyan Kendras
LAC	Livestock Aid Centres
LI	Livestock Inspector
MAPWA	Madhya Pradesh Women in Agriculture
MDA	Mewat Development Agency
MDB	Mewat Development Board
MoA	Ministry of Agriculture
MPRLP	Madhya Pradesh Rural Livelihoods Project
NABARD	National Bank for Agriculture and Rural Development
ND	Newcastle Disease
NGO	Non-Government Organizations
NPRE	National Project on Rinderpest Eradication
NREGS	National Rural Employment Guarantee Scheme
OPOLFED	Orissa Poultry Federation
OUAT	Orissa University of Agriculture and Technology
PE	Participatory Epidemiology
PED	Professional Efficiency Development
PRA	Participatory Rural Appraisal
RD	Ranikhet Disease
SA PPLPP	South Asia Pro Poor Livestock Policy Programme
SHG	Self Help Groups
SPF	State Poultry Farms
VAS	Veterinary Assistant Surgeon

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The numerous farmers and poultry owners we interacted with, during the course of our study were very forthcoming with information about problems and issues in backyard poultry enterprise. They were a constant source of deep inspiration and enthusiasm for the study. With this study, we hope to move a step ahead in supporting the rural poultry enterprise.

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Executive Summary

The backyard poultry sector is increasingly being recognized as an important area of intervention for poverty alleviation. Largely reared by landless labourers and small and marginal farmers in tribal belts of India, these birds play an important role in rural livelihoods: they supplement rural incomes; enhance child nutrition by enabling higher egg consumption and have a positive impact on women empowerment since this is largely a women-oriented activity. Because rearing is based on traditional practices with no focus on veterinary and health services, there is high mortality caused by diseases. The Newcastle Disease (ND) is identified as the most fatal disease wiping out entire flocks, severely constraining the growth of this sector. Vaccination is accepted the main way of controlling the losses caused by ND. Specific projects and activities focusing on vaccination of backyard poultry have demonstrated significant decline in mortality, leading to higher incomes from sale of birds as well as higher consumption of eggs and birds resulting from higher flocks. In stark contrast to the backyard poultry sector, ND is well managed by the industrial poultry sector, consisting of broiler and layer farming, which is purely a private sector initiative. This network of private services has not extended its reach to the backyard poultry sector. This sector has also been neglected by government veterinary services that cater mostly to large ruminants.

Given the risk from infection due to ND and the high mortality associated with it, there is a dire need to support the backyard poultry sector by enhancing access to vaccines and exploring service delivery models that are sustainable in rural areas. **In this context, the objective of the current study is two-fold: to estimate the market for ND vaccine in the backyard poultry sector; and to explore options for extending the coverage of ND vaccines to this sector.**

In this study, we depart from the norm of government, donor agencies and NGO-led programmes of poverty alleviation and focus on multi-party models of extending coverage for ND vaccines, where the private sector also plays a major role. In the case of vaccination for backyard poultry birds, the private sector is better placed than the government sector to meet the demand for ND vaccination because of the developed infrastructure serving the industrial poultry sector.

Before undertaking initiatives for enhancing vaccine coverage to this sector, to is important to have a clear understanding of the ground situation. There are several unanswered questions: will the farmers be interested in vaccinating the birds? Are they capable and willing to pay for vaccination? Each farmer has only 5-10 birds, how will they use the vial of 100 doses? How will they administer the vaccine? Similarly, there are several questions about the supply of vaccines by private sector in rural areas: how will the current distribution system cater to the need of rural farmers? How can cold chain be maintained in rural areas? In this context, the study focuses on three key research questions:

i) What is the potential demand for vaccination of backyard poultry?

ii) What is the supply side situation of availability of vaccine for the backyard poultry birds?

iii) What are the possible options for setting up alternate systems for vaccination of backyard poultry birds?

The research methods focussed on specific research questions.

- The study started with a **review of literature** and conducting several **Key Informant interviews** to understand the functioning of the poultry vaccine sector.
- The **demand side analysis**, based on **household surveys**, captured several key aspects of backyard poultry rearing by rural households, including size of flocks, use of income from backyard poultry, prevalence and impact of diseases, extent of mortality and awareness and use of poultry vaccines and veterinary services. Additionally, **Participatory Epidemiology** technique was used to collect detailed information about the incidence of diseases in backyard poultry and identify diseases causing maximum mortality.
- The **supply side analysis** was conducted by undertaking **supply chain analysis** of ND vaccine by private and public sector.
- The findings of the demand and supply analysis enabled us to estimate the "**Market Size of ND Vaccine by Backyard Poultry Sector**".
- For **exploring options for enhancing coverage of ND vaccine to backyard poultry sector, Focus Group Discussions (FGDs)** were conducted with farmer groups to identify best approaches to enhance coverage of ND vaccines. Assessing farmer willingness to pay for vaccines was an important aspect covered in the FGDs.

The study was conducted in Orissa (Mayurbhanj and Keonjhar districts), Madhya Pradesh (Dhar and Jhabua districts) and Haryana (Mewat district). Orissa and Madhya Pradesh were selected because of high backyard poultry population in the tribal belts of these states. Haryana has heavy dominance of backyard poultry population in Mewat, which is one of the least developed districts in the states. The villages were selected to cover high (< 5 km), medium (5-8 km) and low (> 8 km) access to veterinary services based on the distance to government service providers. The households were selected randomly after conducting village census of about 100 households. The village census and village questionnaires were also used to estimate poultry population in the survey villages. The key findings of the study are summarized here.

1. Policy and Institutional Structure for Backyard Poultry

- The literature review helped to understand the policy and institutional infrastructure, which together determine the functioning of the sector.
- Department of Animal Husbandry Dairying and Fisheries (DADF) under the Ministry of Agriculture is the nodal agency responsible for livestock sector- related activities in India.
- Traditionally, the livestock sector policy at the national level has focused on large ruminants. Small ruminants and backyard poultry have largely been neglected; but this is changing with increasing recognition of these sectors for eradicating poverty.
- Orissa has the most well developed livestock sector policy with focus on poultry development, while Madhya Pradesh is relatively neutral. In Haryana, this sector is largely out of the purview of the state policy.
- The institutional infrastructure at the national level comprises of DADF and its counterpart (DAHD) at the state level. DADF is supported by CPDOs (supporting the

breed development and production), IVRI (responsible for livestock health) and CARI (undertaking research in all aspects of avian species).

- At the state level, DAHD is the nodal agency for livestock services which has a network of veterinary services in rural areas. Other institutions include BPUs (for manufacture of vaccines used by the DAHD), and State Poultry Farms (having functions similar to CPDOs).
- The institutional and policy framework at the state level is reflected in the access to veterinary services in rural areas as discussed below.

2. Demand Side Analysis

Poultry enterprise of rural households

- The distribution of land and poultry ownership of sample farmers reveals that an overwhelming majority of poultry owners fall in landless and small and marginal farmers' category – more than 90% in Haryana and Orissa, and about 76% in Madhya Pradesh.
- The average number of poultry birds per household is 5 in Haryana, 8 in Orissa and 3 in Madhya Pradesh.
- The most important use of income from poultry birds was during emergency. In the case of Madhya Pradesh, with 97% households reported use of income from poultry during emergency.
- **A majority of the people responded that the poultry enterprise had decreased or stayed the same, with the exception of Orissa that had seen some increase. The most important reason for decline in poultry enterprise was heavy loss due to disease. Other reasons included lack of veterinary services and lack of training for poultry and severe weather conditions (in Haryana).**
- The poultry rearers reported obtaining 36-72 eggs per bird per year, most of which were used for hatching. The consumption as well as sale of eggs was very low and the income from poultry was mostly from sale of birds, while eggs were used for hatching.
- The sample households across states reported selling 11-16 birds per year. The prices are the highest in Orissa (Rs.243/bird), followed by Haryana (Rs.204/bird) and Madhya Pradesh (Rs152/bird) – a price difference of about Rs.100/bird across states.
- The average annual net returns from poultry (after accounting for feed cost) are about Rs.2925 in Orissa and Rs. 933 in Madhya Pradesh. In Haryana, the income from poultry enterprise was low as the birds were largely consumed at home. This analysis focuses only the monetary returns; the use of birds and eggs for home consumption is not included in the analysis.

Prevalence and impact of diseases

- The households reported heavy losses of birds due to diseases followed by predators and extreme weather conditions.

Reasons for loss of poultry birds
(Percentage of Households)

	Haryana	Orissa	Madhya Pradesh
Diseases	94	99	100
Kill by Predators	90	47	82
Excessive heat or cold	77	28	0
Theft	20	4	1

- New Castle Disease is reported as the most widely prevalent and the most important disease in all the three states, leading to high mortality (based on local disease names and symptoms reported).

Commonly occurring poultry diseases in survey area
(Percentage of Households)

Poultry Diseases	Most Prevalent Disease			Disease Causing Maximum Mortality		
	Haryana	Orissa	Madhya Pradesh	Haryana	Orissa	Madhya Pradesh
Newcastle Disease	98	99	73	97	99	71
Fowl Pox	2	67	0	0	1	0
Other	10	33	35	1	2	1

- **In Haryana and Madhya Pradesh, the households reported losing 7-8 birds on average due to diseases in the past year. In Orissa this number was as high as 20 birds per household. This high mortality is a sure indicator of the need for vaccines and the improvement in flock size and enhanced incomes from the sale of birds.**

Access and use of veterinary services

- The access to government veterinary services (mostly for large ruminants) was quiet high in all states, with about 88%-92% of the households reporting access to services.
- The access and use of service providers decreases with an increase in distance from high to low access villages in Orissa and Madhya Pradesh. The average distance increases from 2 KM to 10 KM and the average time increases from about 30 to 80 minutes. The most common mode of transport to reach the service provider in Orissa is bicycle, whereas farmers in Madhya Pradesh mostly go by foot. In Haryana, several modes of transportation are available.
- The vaccination and treatment services of the government veterinary department mostly served the large ruminants. Small ruminants were covered to some extent while poultry birds were out of the purview of government veterinary services.

Ground Situation of use of veterinary services for vaccination and treatment
(Percentage of Households)

	Haryana	Orissa	Madhya Pradesh
Vaccination			
Cattle	55	65	36
Small ruminants	0	26	17
Poultry	0	23	0
Treatment			
Cattle	33	66	77
Small ruminants	4	37	45
Poultry*	15	15	1.5

**Note: Poultry vaccination and treatment is largely through purchase of medicines from medicine store, not through veterinary services*

- **There was no vaccination of birds in Haryana and Madhya Pradesh. Vaccination of birds was taking place in Orissa only, where 25% of sample households reported vaccinating them. In Haryana and Orissa, about 15%-20% of the farmers were giving medicines in an attempt to save the birds, incurring an annual expenditure of Rs.100-200. This is an important finding, since it implies that the farmers are already incurring expenses to save the birds, indicating that they will also be willing to pay for vaccines if they see the impact on reducing mortality.**
- In Haryana and Madhya Pradesh, 80%-90% of the respondents said the major reason for not vaccinating and treating the birds was **lack of awareness** about availability of poultry vaccines, while this was only 25% in Orissa.

Reasons for not vaccinating and treating birds
(Percentage of Households)

Reasons for not vaccinating birds			
	Haryana	**Orissa**	**Madhya Pradesh**
Not aware of vaccinations	91	24	86
It is not common to treat poultry birds in this area	58	24	4
Govt. vets/paravets not available for vaccinating poultry birds	74	38	18
Vaccine are not available	8	4	1
Vaccines are costly	2	20	0
Vaccine are difficult to administer	1	0	0
Reasons for not treating birds			
Not Aware that poultry birds can be treated	63	29	74
It is costly to treat birds	6	35	0
Diseases do not harm productivity	4	6	0
Govt. vets/paravets not available for treating poultry birds	49	15	9

Access to medicines and vaccines

- Medicine stores were the dominant source of poultry medicines and vaccines because of the well-established network of service providers catering to the industrial poultry sector.
- In Haryana, farmers purchase medicines for poultry from medicine stores, while there is hardly any purchase of poultry vaccine. In Orissa, the medicines for poultry are sourced from government veterinary units as well as medicine stores, while vaccines are mostly procured from medicine stores. In Madhya Pradesh, there is almost no use of vaccines or medicines for poultry. The average distance to medicine stores is about 6 km in Haryana and Orissa, while it is about 12 km in Madhya Pradesh.

3. Supply Side Analysis - Private and Government Supply Chains for ND Vaccine

The two co-existing supply chains are that of the private and the public sector. While the private sector chain focuses on supplying to the industrial broiler and layer sector, the government chains focus on vaccination for the indigenous birds. The government vaccine production largely caters to vaccination of birds at state poultry farms and birds supplied to beneficiary farmers under poverty alleviation programmes. While the coverage of the commercial sector is about 100%, the coverage of backyard poultry birds is negligible.

Private sector supply chain for ND vaccine

- There are three main ND vaccine manufactures in the country focusing on production of poultry vaccines, accounting for about 90% of the market for poultry vaccines (~INR 2,200 million). They cater largely to the industrial poultry sector.
- The private sector chain comprises manufacturers and their network of distributors and dealers at the state level, while the final link is the retailer (medicine stores) spread in urban as well as rural areas of the state. Vaccines were available in the rural stores in Orissa while the rural outlets in Haryana and Madhya Pradesh did not stock poultry vaccines because of lack of demand. However, they mentioned if there is a demand, stocking vaccines would not be a problem.
- The cold chain is well managed by private sector. They use thermocol and gel packs along with appropriate means of transportation, including flight carriers and refer vans for long distances across country, and buses and trucks for inter-state transport.
- Representatives of the private sector mentioned three main constraints in catering to the backyard poultry sector – lack of farmer awareness regarding poultry vaccines, difficulty in managing cold chain in rural areas because of power cuts, and ownership of 2-5 birds per household, whereas the smallest vial size is for 100 doses.
- Representatives at all level in the private sector chain were keenly interested in extending reach to the backyard poultry sector.

Government sector supply chain for ND vaccine

- The government supply chain caters mostly to the needs of the state poultry farms and to a very small extent, the backyard poultry sector. Despite low coverage, government officials and veterinarians at all levels in the chain realized the immense importance of vaccination for the backyard poultry sector.

- The government sector production comprises of a state-level Biological Products Unit, manufacturing vaccines for all species as required for use by the government veterinary services. There are 19 BPUs in the country of which 16 are involved in manufacture of poultry vaccines. BPUs in Orissa and Madhya Pradesh were involved in manufacture of poultry vaccines, while the BPU in Haryana had stopped production of poultry vaccines.
- The government chain represents the administrative set up of the veterinary services. The state and district level DAHD looks after the administrative issues while veterinarians and paravets serving at the block level and local units are responsible for providing veterinary services.
- The veterinary staff reported limited availability of vaccines, problems with managing the cold chain at the block and local level units because of non-availability or old non-functional refrigerators and power cuts.
- Three main reasons for poor coverage of backyard poultry birds are lack of farmer awareness, inadequate infrastructure for cold chain management along in rural areas and very limited manpower with one vet or paravet managing about 25-30 villages. Additionally, poultry birds are owned by tribal population staying in hilly and far-flung areas. The roads are unapproachable and unsafe after dark, while the poultry vaccinations are conducted only in the evening when the birds return from scavenging.
- The officials at the state, district and block level in Orissa reported that they do not cover more than 5%-10% of the backyard poultry birds under vaccination, while in Madhya Pradesh this was much lesser. In Haryana, there is no production or administration of poultry vaccines through government veterinary services.

4. Market Size for ND Vaccine in the Backyard Poulty Sector

- Based on the primary and secondary data collected for the study, we can estimate the market size of the demand for ND vaccine.
- The flock size at the household level was 8, 5 and 3 in Orissa, Haryana and Madhya Pradesh, respectively.
- There are on average 1,390, 2,376 and 875 backyard poultry per village in Haryana, Orissa and Madhya Pradesh, respectively. Out of these, only 10% poultry owners reported vaccinating the birds in Orissa, while in Haryana and Madhya Pradesh, there was no vaccination.
- From the supply chain analysis of the public sector, the district level officials also reported that not more than 5%-10% of the birds were vaccinated in Orissa, while in the other two states the level of vaccination was almost negligible.
- Based on these estimates it is quite reasonable to assume that at least about 90% of the country's 153 million backyard birds are yet to be covered by vaccination. **Assuming 2 doses of ND vaccines per bird (LaSota given in the first week and R2B at the age of 8-10 weeks) the requirement of vaccines for this sector will be about 260 million doses or 2.6 million vials of 100 doses.** This amounts to an additional revenue generation of Rs.72 million (assuming the prevailing average retail price of Rs.40 and Rs.15 for 100 dose vial of R2B and LaSota).

5. Exploring Options for Vaccination of Backyard Poultry

- Focus Group Discussions (FGDs) conducted with farmer groups revealed that the farmers were very keen on saving the birds and reducing mortality. Payment for vaccination did not come up as an issue in any of the FGDs. The major constraint in vaccination of birds was lack of awareness about the benefits and use of vaccines. If farmer awareness were raised through extension programmes, they would take the initiative to vaccine the birds.
- The farmers were sceptical about the ability of the government veterinary services to cover the backyard poultry birds. The farmers reported that some local person should be trained in poultry vaccination to enhance coverage of vaccines. Some farmers also reported they would undertake the vaccination on their own when they had the relevant information and were confident enough to do it.
- The FGD participants were willing to co-ordinate with their neighbours to make effective use of the 100 dose vial and to share the cost.
- It is also important to mention that on knowing about poultry vaccines all the farmers eagerly expressed interest in knowing about vaccination of goats to reduce mortality.

6. Suggestions for Way Forward

This study emphasized the critical importance of addressing the issue of ND vaccines for backyard poultry birds. Vaccination will potentially reduce mortality leading to higher incomes for the economically vulnerable masses along with enhancing child nutrition in India's poorest households. A very important finding from the study is that all the stakeholders are keenly interested in enhancing coverage of ND vaccine for the backyard poultry, which is a very positive sign for initiating action on this front.

The major challenges in enhancing coverage of vaccines in backyard poultry are: lack of information about diseases, lack of service providers, inadequate infrastructure for maintaining cold chain in rural areas and non-availability of vaccines in these areas. Combined effort by all stakeholders is critical to overcome these challenges. The government can be involved in enhancing farmers' information though mass campaign by using various means of communication. The NGOs and donor agencies can be involved in implementing pilot projects to demonstrate the impact of vaccination. The private sector can ensure availability of vaccines in rural areas along with focus on spreading awareness through their network of dealers and distributors. Care should be taken to put in place a system, where adequately trained personnel are available for monitoring and guidance for administering vaccines.

The next step will be to bring together all the stakeholders to share the findings, and develop a strategy for enhancing coverage of ND vaccine to this sector, identifying specific roles for the key-players.

> "We must recognize that the conversion of the BOP is essentially a developmental activity. It is not about serving an existing market more efficiently. New and creative approaches are needed to convert poverty into an opportunity for all concerned. This is the challenge."
>
> — C K Prahlad, *Fortune at the Bottom of the Pyramid*, 2006

1. THE CONTEXT

With the recognition of backyard poultry as an important tool for poverty alleviation, several studies have been conducted in recent years to understand the ground situation of backyard poultry, reared largely in the interior areas and tribal belts of the country (Kornel, 2008; Ahuja et.al, 2008; Kumtaker and Kumtaker, 1999). The findings of these studies emphasize on poverty mitigating impact of backyard poultry enterprise, by supplementing rural incomes and enhancing children's nutrition by egg consumption from birds in the backyard, along with positive influence on 'women empowerment'. The major constraints to backyard poultry enterprise are losses from mortality due to diseases and predators, as the birds are reared on traditional practices with no focus on veterinary and health services. Newcastle Disease[1] (ND) is the most feared disease, and it virtually wipes out village flocks (Rangnekar and Rangnekar, 1999). Vaccination is the main and only way to control the losses due to ND. In fact, backyard poultry based initiatives focusing on health and veterinary services have shown significant decline in mortality, leading to higher incomes as well as higher consumption of eggs and birds resulting from larger flocks (SA PPLPP, 2009, 2010).

In stark contrast to the backyard poultry sector, ND is well managed by the industrial poultry sector, comprising of broiler and layer farming, which is purely a private sector initiative. This is because the birds in the industrial poultry sector are reared in a scientific manner, based on standard rearing practices with due diligence to the required vaccines, feed, supplements etc. The strong network of 'support services', including supply of chicks, medicines, vaccines and feed, along with strong extension support, has resulted in a dramatic growth of this sector. Unfortunately, this network of private services has not extended its reach to backyard poultry sector. Backyard poultry has also been ignored by the government network of veterinary

[1] ND is an infectious disease and the entire flock is infected in about 2-12 days or an average of five days. After infection, mortality is almost certain, though it may be variable and manifests in other symptoms reducing productivity.

services', which caters mostly to large ruminants. A major issue of concern for this neglected sector, which provides support to millions of rural households having highly vulnerable livelihood is the decline in population in recent years. According to the livestock census of 2003 and 2007, the number of backyard poultry birds declined from 238 million in 2003 to 153 million in 2007. Over the same period, their share in total poultry population has also declined from 50% to 30% while the total number of poultry birds in the country increased from 458 million to 503 million[2].

Given the risk from infection due to ND and high mortality associated with it, there is a dire need to support the backyard poultry sector by enhancing access to vaccines through sustainable service delivery models. **In this context, the objective of the current study is two-fold: to estimate the market for ND vaccine in the backyard poultry sector and explore options for extending coverage of ND vaccines to this sector.**

The traditional approach in poverty-related initiatives is to identify interventions by the government sector, donor agencies and NGOs. South Asia Pro Poor Livestock Policy Programme (SA PPLPP) has documented several such initiatives as good practices in mitigating poverty. Two initiatives focusing on health and veterinary services for backyard poultry merit discussion (SA PPLPP, op. cit.). First, in Chhattisgarh, the Bastar Integrated Livestock Development Project (BILDP), implemented by the state government (initially supported by the Danish International Development Assistance (DANIDA), has about 1500 village facilitators trained in providing health and veterinary services for backyard poultry, serving about 37,000 farmers across four districts of Bastar region. This intervention has led to the decline of mortality rate from 80%–90% to 20%–30%, contributing to higher food security and poultry based incomes. Second, through a joint initiative of Bangladesh's Department of Livestock Services and NGO, BRAC, about 20,000 women poultry vaccinators have been trained providing services to all 50 districts of Bangladesh through 1,260 of its branches. The programme reached out to over 2.47 million women poultry farmers. Consequently, the mortality rate declined from an average of 40% to 15%, resulting in an increase in the average income from sales of birds from

[2] The census of 2003 and 2007 has different categorization of birds and cannot be compared directly. Though not exact estimates, the numbers are indication of the trend of population of backyard poultry birds.

TK 400 (~ INR 250) to TK 2919 (~INR 1750) and increase in family consumption of eggs from 43 to 186 and meat from 1.6 to 16.7 chicken per year.

These models have been successful only in specific geographies. The need of the hour is to bring about such changes in a vast country like India. This is the challenge! To explore more broad based options to serve these underserved markets we depart from the norms and explore creative multi-party models for extending the coverage of ND vaccines for the backyard poultry sector. It is increasingly being recognized that the involvement of several actors is necessary to develop such successful models on the ground. Many successful models of multi-party approaches are emerging; public-private partnership are gaining momentum; private sector is tying up with NGOs to enter the rural markets which has traditionally not been their domain; government agencies are also tying up with NGOs for project implementation.

Going against conventional wisdom, private sector-led models of social development are playing an increasingly important role in rural development. C K Prahlad (2006) in his book titled "Bottom of the Pyramid" referring to the poorest masses of the society, puts forth the concept that opportunity exists at the Bottom of the Pyramid (BOP) and can be capitalized through innovative approaches leading to profits as well as social development. While the private sector is initiating action on this front, the development and government projects are gearing up to support such initiatives. Many donor-funded projects focus on developing marketing linkages and supporting enterprise development, with heavy involvement of private sector. Besides, private sector models are 'demand driven'; catering to specific needs of the rural markets and hence are more financially sustainable in the long run, unlike many development activities that phase out as the project ends.

Many innovative models have emerged catering to the needs of the rural markets. These innovations are very fascinating from the business perspective because a successful social initiative can catapult a company to international fame. The example of 'Kegg Farms' involved in supplying improved birds to rural households has received several accolades for social entrepreneurship (Ahuja et al, 2008).

In the case of vaccination for backyard poultry birds, private sector is better placed than the government sector to meet this demand because of the well-developed infrastructure catering to requirements of the industrial poultry sector. Because of limited activity by the government veterinary services in the area of backyard poultry sector, many changes will have to be brought about to meet the vaccine demands of this sector. Bringing about changes in the government system is a slow process and it will vary from state to state depending on the relative level of activity of the government-run veterinary services. Also, private sector has a vested interest in the disease management of the backyard poultry sector because, the outbreaks in the backyard poultry sector can bring the industrial poultry sector to a grinding halt, as was the case when 'bird flu' broke out in West Bengal's Birbhum district in January 2008. Because of these reasons, we see an important role for private sector in meeting the demands of the backyard poultry sector. However, it is well recognized that there is a very significant role for all agencies to bring about such far-reaching changes. The government policies can support such initiatives by creating conducive business environment, as well as exploring options for public private partnerships. Donor agencies, along with NGOs, can be involved in undertaking several such pilot projects across the country to show the impact of successes that can give momentum for more such activities.

For undertaking any new initiative, it is important to have a clear idea about the ground situation. The private sector is well informed about the operations of industrial poultry sector, but there is little information about the actual practices of treatment and vaccination in the backyard poultry sector. Several questions arise - Will the farmers be interested in vaccinating the birds? Is there ability and willingness to pay for vaccination? Considering that each farmer has only 5-10 birds, how will they use the vial of 100 doses? How will they administer the vaccine? Similarly, there are several questions about the supply of vaccines by private sector in rural areas - How will the current distribution system cater to the need of the rural farmers? How can cold chain be maintained in rural areas?

The three key research questions addressed in the study are as follows:

- What is the **potential demand** for vaccination of backyard poultry?
- What is the **supply side situation** of availability of vaccine for the backyard poultry birds?

- What are the **possible options** for setting up alternate systems for vaccination of backyard poultry birds?

This study will undertake an in-depth analysis of these issues. The findings from the ground will help us get a clear picture of the backyard poultry rearing; the economics of backyard poultry; the losses due to diseases; the availability of veterinary services or the lack of it; the need for veterinary services for poultry; and the farmers' willingness to pay for these services. These findings will be useful to all the actors interested in investing in the developmental activities, focusing on backyard poultry. The study provides concrete evidence for the policymakers to adapt the policies, projects and activities to the needs of this sector. The private sector players will have information to cater to the specific demands of this sector, while the donor groups and agencies can plan targeted projects and activities to make a meaningful impact on livelihoods.

The three states covered under the study are Haryana, Orissa and Madhya Pradesh. Orissa and Madhya Pradesh have high population of backyard poultry – 10 million and 3 million, respectively. These states have high tribal population involved in backyard poultry rearing, and are also relatively less developed states. Comparatively, Haryana is a developed state with much fewer backyard poultry birds (0.2 million), but these birds are largely concentrated in Mewat, which is the most under developed district in the state.

The rest of this report is organized as follows. The next section presents the research methodology used to address the research questions along with details of sampling and data collection and analysis. Section 3 presents the background of policies and institutional framework for backyard poultry sector. Section 4 gives a comprehensive picture of the ground situation of backyard poultry including importance of poultry in rural livelihoods, prevalence and impact of diseases and availability of veterinary services, medicines and vaccines for the sector. Section 5 presents a detailed analysis of the supply and distribution of ND vaccine in the country. Based on the findings of the ground situation and extent of coverage of backyard poultry, Section 6 focuses on the potential demand of vaccines. In Section 7, we explore options to satisfy this potential demand through 'Focus Group Discussion' with farmer groups. Finally in Section 8, we summarize the key findings and present recommendations for the way forward.

2. STUDY DESIGN

2.1 Research Methods

Background information for the study was collected through literature review and key informant survey. The literature review was mostly done by web search including studies focusing on situation of backyard poultry, market situation of poultry vaccines production in India along with a review of literature on initiatives focusing on vaccination for backyard poultry.

Several Key Informant (KI) interviews were conducted to develop a comprehensive understanding of the situation of backyard poultry sector before implementing the formal research techniques. KI interviews were conducted with poultry farmers in study areas and supply chain participants of the private as well as government sector ND vaccine supply chain. Extensive interviews were conducted with poultry rearers in study areas to understand the practices followed for backyard poultry rearing. In the private sector, interviews were conducted with ND vaccine manufacturers, distributors, dealers and retailers (medicine stores in rural areas) to understand the functioning of the private sector supply chain for ND vaccine. The participants of the government vaccine supply chain included officials of the Department of Animal Husbandry, at state, district and block levels; The Central Poultry Development Farms and State Poultry Farms; Government vaccine manufacturers and service providers including veterinarians and paravets in rural areas.

After collecting the background information, specific research techniques related to research questions were employed in the study. **The demand side analysis** was based on '**household surveys'**. The objective of the household survey was to understand the details of backyard poultry enterprise, including size of flocks, income from backyard poultry, prevalence and impact of diseases, extent of mortality and awareness and use of poultry vaccines and veterinary services. Given the nature of the study, there was special focus on understanding the situation of poultry diseases in the backyard poultry sector. '**Participatory Epidemiology'** technique, involving discussion with farmer groups, was used to collect detailed information about the incidence of diseases in backyard poultry, understand the mortality associated with various diseases, identify diseases causing maximum mortality and prepare a seasonal calendar of disease incidence.

The supply side analysis was conducted by undertaking **supply chain analysis** of ND vaccine by private and public sector. The analysis included mapping of supply chains, identifying the key actors and functions carried out by these key actors, scope, scale and size of operations at each level, costs and revenues at each level, cold chain management, issues at each level in the chain, and potential for initiating/strengthening ND vaccine through the chain in order to enhance coverage for backyard poultry birds.

Finally, for **exploring options for enhancing coverage of ND vaccine to backyard poultry sector, Focus Group Discussions (FGDs)** were conducted with farmer groups to identify the specific partners for strengthening the existing supply of ND vaccines and/or exploring options of supply including non-existent linkages. The focus of the FGDs was to identify best approaches for interventions by understanding the pros and cons of various options, the practical issues involved for each alternative and the approaches to address these problems.

2.2 Sampling

In each of the study states, two districts with highest population of backyard poultry were selected. Within these districts, the study was conducted in two blocks based on the same criteria. Following this, three villages were selected in each block, and 20 poultry-keeping households were selected in each village.

In identifying the villages, the main criterion was the availability of government veterinary services. Because currently the government veterinary network is the main service provider in rural areas, it was important to understand the extent of coverage of backyard poultry sector or the lack of it. With the help of veterinary officers at the district level, the villages in the block were categorized as high, medium and low availability of veterinary services. High availability village was the one with close proximity to the government veterinary hospital or dispensary, within a radius of 5 km from the service provider. Medium availability village was within the range of 5-8 km from the service provider, whereas the low availability village was more than 8 km away from the service provider in a remote area. One village from each category was randomly selected for the study. This categorization was useful to understand the difference of availability in services across the spread of villages, especially for villages in the far-flung areas.

For the selection of households, census of about 100 households was conducted in the selected villages. Through the census we collected information on ownership of large and small ruminants and backyard poultry birds and the vaccination of these animals[3]. Out of these 100 households, 20 households having poultry population were selected randomly for the survey. For example, if the census showed that 60 households own poultry birds, then, every third household was selected for the survey.

The selected blocks for Orissa are: Bangriposi and Jashipur in Mayurbhanj district and Patna and Jhumpura blocks in Keonjhar district. The blocks selected for Madhya Pradesh are Tirla and Bagh in Dhar district and Meghnagar and Thandla in Jhabua district. Mewat is the only district in Haryana with significant population of backyard poultry birds in all the five blocks. Four blocks with highest backyard poultry population in Mewat were taken up for study – Firozpur Jhirka, Nagina, Nuh, and Taoru. See Annex 1 for a map of the study locations. The key development indicators of the identified districts are presented in Annex 2. Review of the key development parameters reflects the relative backwardness of the identified areas. The study blocks in Madhya Pradesh have high population of Scheduled Castes and Scheduled Tribes[4], while Mewat has dominant Muslim population.

2.3 Data Collection and Analysis

A set of three questionnaires was used to collect the quantitative information for the survey. First, the village questionnaire was used to get background information about the village, focusing on livestock ownership and access to veterinary service providers. Second, the census questionnaire was used to get information about the land and livestock ownership, based on which the poultry owning households were selected for survey. Information about with extent of vaccination coverage for various species was also collected through the census questionnaire. Finally, the household questionnaire was used for collecting detailed information from the selected households.

[3] This information will also be used to understand the size of poultry flock at the village level and the extent of vaccination for the same.

[4] The terms "Scheduled castes and Scheduled tribes" (SC/ST) are the official terms used in Indian government documents to identify former "untouchables" and tribes. These are the historically disadvantaged communities.

The data from the household survey was analysed using quantitative methods including 'descriptive statistics' and 'inferential statistics'. While the 'descriptive statistics' helped to understand the socio-economic characteristics of poultry owners, the 'inferential statistics' provided information about the extent of farmers' use of veterinary services for large and small ruminants of backyard poultry; the economics of backyard poultry; and focus on livestock health and disease management and prevention.

For the supply chain analysis, detailed information was collected for the public and private sector chains. The quantitative aspects focused on volumes and margins, while the qualitative aspects captured the backward and forward linkages, cold chain management, and constraints and suggestions for enhancing coverage to backyard poultry sector.

Widely used methods of qualitative analysis were employed to analyze data from Participatory Epidemiology study and Focus Group Discussion. The field notes were transcribed in detail and the data was organized into themes. These themes were used for detailed analysis by interconnecting ideas and developing a comprehensive analysis of the situation. This detailed description of themes is represented in the qualitative narrative. This qualitative data analysis was further used for interpretation of the data to identify the lessons learnt. A major strength of the study is that the different methods of data collection will help to validate the findings from the ground leading to more robust analysis.

3. POLICIES AND INSTITUTIONS FOR BACKYARD POULTRY SECTOR

3.1 Policy Framework

The functioning and performance of any sector is determined by the policy initiatives and institutions supporting the sector. We present an overview of the policies and institutional framework related to the backyard poultry sector to lay the ground for detailed analysis of the ground situation of backyard poultry in the next section. Department of Animal Husbandry and Dairying and Fisheries (DADF) under the Ministry of Agriculture (MoA) are the nodal agency for livestock sector development in the country. Traditionally, the activities of DADF have been heavily biased towards large ruminants. In recent years, with increasing recognition of the role of small ruminants and backyard poultry in supporting rural livelihood-specific projects, focusing

on the development of these sectors is being initiated by both government sector and other agencies. Governments have re-focused their aim to improve the living conditions of the poor people, and backyard poultry is the key sector for interventions aimed at poverty alleviation.

Backyard poultry has not been a major part of the planning process. Departing from the norm, the Government of India strongly recommended the development of backyard poultry sector in the 11th Five Year Plan (Planning commission, 2006). The government had decided to launch a centrally sponsored scheme for poultry development to be implemented through NABARD (National Bank for Agriculture and Rural Development) with a total outlay of Rs.1500 million (USD 33 million) during the 11th Five Year Plan. The scheme has three components namely: (i) Assistance to State Poultry Farms, (ii) Rural Backyard Poultry and (iii) Poultry Estates. (http://planningcommission.nic.in/plans/planrel/11thf.htm).

The scheme through its 'Assistance to State Poultry Farms' component aims at strengthening existing state poultry farms to enable them to provide inputs, mainly in terms of providing improved stocks suitable for rural backyard rearing. The 'Rural Backyard Poultry Development' component is expected to cover the Below Poverty Line[5] section of society to primarily enable them to gain supplementary income and nutritional support. Entrepreneurship skills are expected to be improved through pilot component of 'Poultry Estates' which is largely meant for educated, unemployed youth and small farmers with some margin money, for making a profitable venture out of various poultry-related activities through a scientific and bio-secure cluster approach. Though several schemes have been announced, the implementation is slow.

Recently, the DADF has prepared a concept paper for holistic development of backyard poultry sector. The new initiative addresses the weakness of the above mentioned schemes by emphasizing cluster development, developing backward and forward linkages, enhancing

[5] Below Poverty Line (BPL) is an economic benchmark and poverty threshold used by the government of India to indicate economic disadvantage and to identify individuals and households in need of government assistance and aid. The poverty line is the level of income below which one cannot afford to purchase all the resources one requires to live. As per the Government of India, poverty line for the urban areas is Rs.358 per month and for rural areas Rs.539 per month, i.e. people in India who earn less than Rs. 10 per day. As per GOI, this amount will buy food equivalent to 2200 calories per day, medically enough, to prevent death. This actually translates to Rs.3650 per year or US$ 75 per year.

outreach activities and mobilizing Self Help Groups to support the activities (http://dahd.nic.in/poultryconcept.htm).

The policies at the national level give directions to state policies. The state policy is further influenced by various parameters including the socio-economic characteristics, livestock population etc. The state level policy has a direct impact on the veterinary services at the grass root level. We will briefly review poultry-related polices in the study states to understand the emphasis on backyard poultry in each of the states.

Livestock sector policy in Orissa is closely guided by national directives. The state has declared poultry as an important agriculture activity, and has taken lead in formulating livestock development policy with special focus on poultry, and a specific one on backyard poultry sector. Orissa State Livestock Sector Policy (2002) document mentions some key activities related to the backyard poultry sector: breeding policy to develop breeds with desirable traits such as high egg production and weight gain with minimal input; enhancing supply of chicks for backyard units; and strengthening vaccination and extension support for the backyard poultry sector. Districts with high poultry population have been selected for poultry activities including Koraput, Mayurbhanj, Ganjam, Keonjhar, Sundargarh and Balasore. The districts selected for our study - Mayurbhanj and Keonjhar are among those selected for undertaking intense poultry-related activities.

In Madhya Pradesh, along with development of cattle and buffalo, the livestock and poultry programme also refers to the growth and development of rural backyard poultry in the state. The government also supports the sector by supporting initiatives in this sector. Many successful models of backyard poultry have been developed by number of CBOs (Community Based Organizations), NGOs (Non-Government Organizations) supported by government as well as International Donor initiatives like Madhya Pradesh Rural Livelihoods Project (MPRLP) and Madhya Pradesh Women in Agriculture (MAPWA). Such initiatives have provided very significant inputs, to influence government programmes to focus on Rural Backyard Poultry sector. There are many initiatives on backyard poultry sector in Madhya Pradesh, but there is no documentation of a detailed policy as in the case of Orissa. Haryana is one of the developed states of the country, and Mewat is the only district with dominant backyard poultry population.

As such, backyard poultry is not an important part of the livestock sector policy in Haryana. It is evident that among the study states, Orissa has a strong policy document with emphasis on backyard poultry.

3.2 Institutions Involved in Backyard Poultry Sector

Following the pattern of policy discussion, we discuss institutions involved in backyard poultry at the national and state level.

Institutions at the National Level: Figure 3.1 presents a diagrammatic representation of the institutions for backyard poultry at the national level. The nodal agency for livestock sector development is the Department of Animal Husbandry Dairying and Fisheries (DADF) under the Ministry of Agriculture (MoA). Its counterpart is the state Department of Animal Husbandry and Dairying (DAHD) under the state MoA[6]. There three main agencies under the DADF responsible for activities related to the poultry sector at the national level: Central Poultry Development Organization (CPDOs), Central Avian Research Institute (CARI) and Indian Veterinary Research Institute (IVRI). The mandate of these organizations is described below.

- **Department of Animal Husbandry Dairying & Fisheries (DADF)** is responsible for matters relating to livestock production, preservation, protection and improvement of stocks. Dairy is a major part of the activities of the department and it also focuses on matters pertaining to fishing and Fisheries Development Board. The Department advises the State Governments and Union Territories in the formulation of policies and programmes for livestock development. The main focus of activities is on development of required infrastructure in states for improving animal productivity; preservation and protection of livestock through provision of health care; strengthening of central livestock farms (cattle, sheep, goat and poultry) for development of superior germplasm for distribution to states. The directives at the central level influence the activities of the state level Department of Animal Husbandry (DAHD) under the state Ministry of Agriculture (http://dahd.nic.in).

[6] The state Department of Animal Husbandry and Dairying (DAHD) has somewhat varying names across states, here we use the term commonly to represent the state nodal agency for livestock.

- **Central Poultry Development Organizations (CPDOs):** The four regional centres of the Central Poultry Breeding Farms under the Ministry of Agriculture, Government of India, are located at Orissa (Eastern), Mumbai (Western), Chandigarh (Northern) and Bangalore (Southern). These organizations have two main functions: first, to support the state governments in the respective regions in backyard poultry development programmes. This is done by supply of chicks for hatching eggs, chicks of indigenous breeds, and parent stock to help the state government supply the birds to the beneficiary farmers through the schemes and programs for backyard poultry. Second, they are also conducting training programs for the beneficiary farmers identified by the states. Additionally, there are ongoing activities focusing on diversification to other species such as duck, turkey, Japanese quail and Guinea fowl etc.
- **Central Avian Research Institute (CARI)**: The Central Avian Research Institute (CARI) is an institute of the Indian Council of Agricultural Research (ICAR). Its mandate is to undertake basic, applied and adaptive research in all disciplines relating to production of diversified poultry; to impart specialized training/post graduate education in Poultry Science (PSC) leading to diplomas, and post-graduate and doctoral degrees; to transfer the proven technologies to the end users and to provide consultancy services for poultry related projects. (www.icar.org.in/**cari**/index.html).
- **Indian Veterinary Research Institute (IVRI):** IVRI is one of the premier research institutions dedicated to livestock research and development of the country. The key mandate is research, development, education, consultancy and technology transfer. The research programmes of the institute are mainly in the area of animal health. The mandated areas of research activities are animal health, animal genetic resources, livestock improvement, and livestock products technology. The institute undertakes basic, advanced and applied research through externally funded projects. The focus of IVRI is all livestock including poultry (http://ivir.nic.in).

Figure 3.1 Institutions for Backyard Poultry – National Level

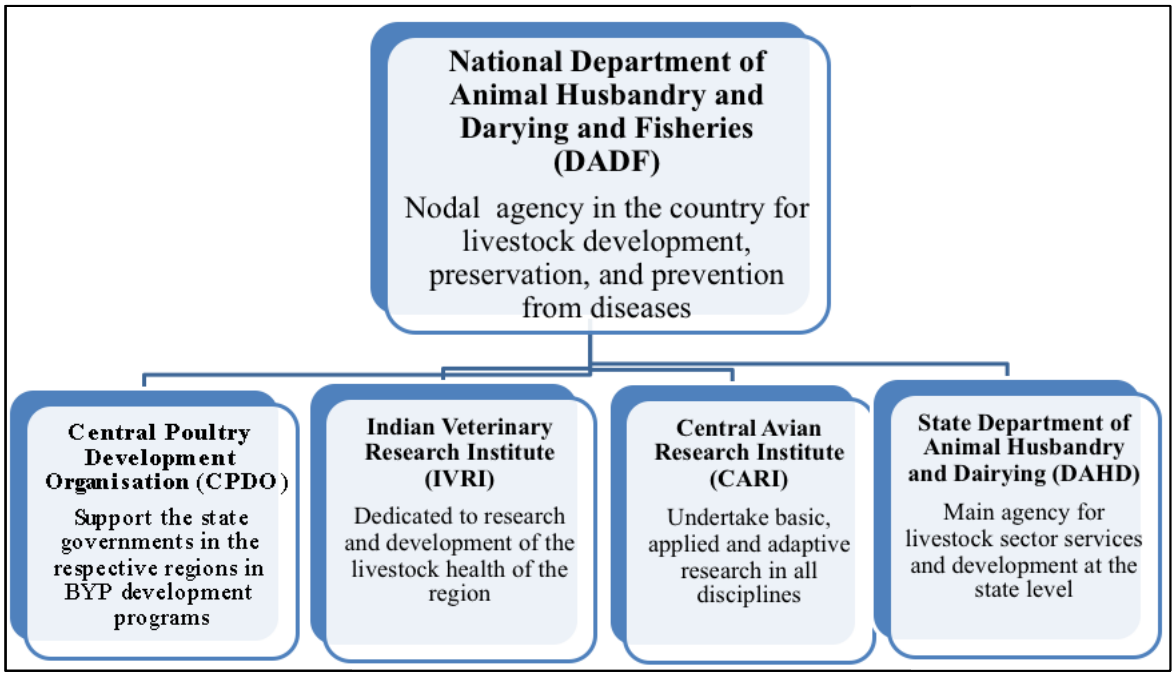
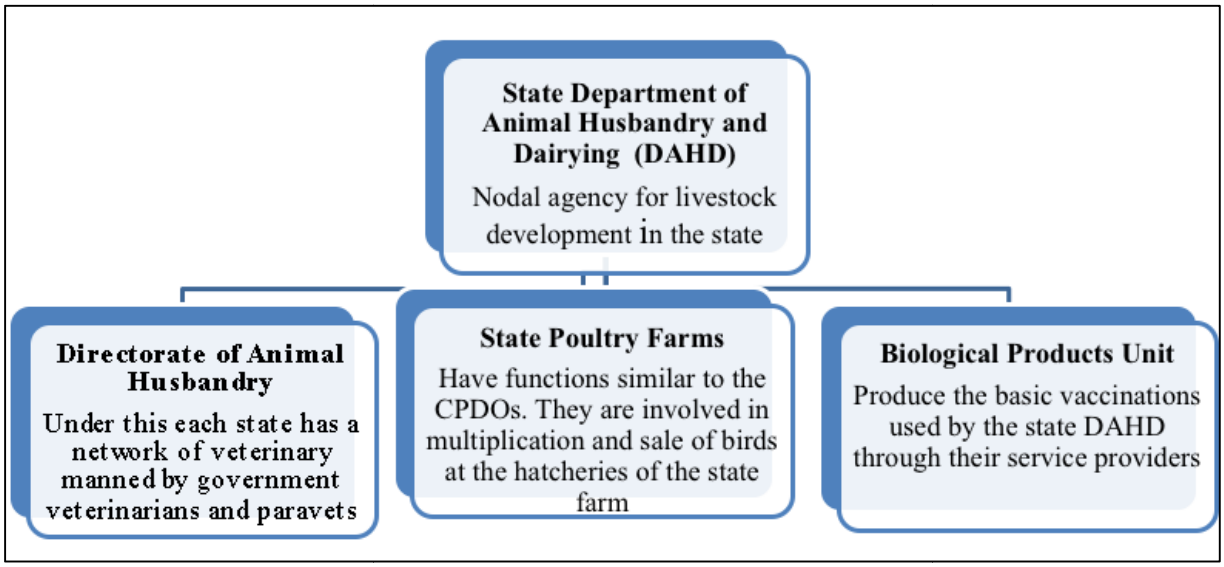


Figure 3.2 Institutions for Backyard Poultry – State Level



Institutions at the State Level: The state (DAHD) is the main agency responsible of livestock sector development in the state. Other supporting agencies for poultry are state poultry farms and Biological Products Unit. Their main functions are described below.

- **Directorate of Animal Husbandry at State Level:** Under the Directorate of Animal Husbandry, each state has a network of veterinary services through the veterinary dispensaries and Livestock Aid Centres (LACs) manned by government veterinarians and paravets. Because of the large and widespread livestock population, it is not possible for the government veterinarians to reach out to all the farmers, especially in the far-flung areas. To address this issue, the state DAHD in some states is involved in training local youth to provide services as paravets[7]. Oftentimes, these paravet training programs are conducted in collaboration with NGOs involved in the livestock sector. These are the local youth with a minimum level of education (matriculate or higher secondary) who are given short term training to provide AI services and veterinary first aid to livestock in their vicinity. Because DAHD is responsible agency for providing veterinary services, they play a key role in deciding the specific training programs, content duration, criteria for selection of local youth for training, monitoring of paravets and other issues regarding the paravet training program. The trained paravets charge the farmers a small fee, but are available for providing the basic veterinary services in the rural areas. They are called by various names in the country – 'gausevak' (meaning servant of the cattle) or 'gopalmitra' (meaning friends of the cattle) etc. With the existing infrastructure, there is a network of livestock service providers in the rural areas. However, traditionally the emphasis has been on services for large ruminants, and in the recent years on small ruminants to some extent, while poultry has largely been out of the purview of government veterinary services.

- **State Poultry Farms:** The state poultry farms have functions similar to the CPDOs. They are involved in multiplication and sale of birds at the hatcheries of the state farm. They are directly in touch with the veterinary units at the district level who supply the birds to

[7] These training programs focus on specific livestock health issues, such as AI, small ruminants, poultry health etc. depending on the livestock population in the state. As such the duration also varies. For example, the training for poultry health workers is for 6 days, while it is about 4 months in the case AI and first aid for large ruminants.

beneficiary farmers. They are also involved in carrying out training and extension activities for the farmers.

- **Biological Products Unit:** In most of the states, there is a Biological Products Unit (BPU), producing the basic vaccines used by the state department of Animal Husbandry through their service providers. These BPUs produce vaccines in the volumes requested by the state DAHD. The cost of production is born by DAHD. These biological institutes are operational in 19 states. However, only 16 of these are involved in production of poultry vaccines. Usually, they do not sell vaccines for commercial purposes, but will sell to other state governments depending on the demand and supply situation. The selected states of Haryana, Madhya Pradesh and Orissa each have a BPU for vaccine production, but BPU in Haryana is not involved in vaccine production for backyard poultry.

With this background, we present the findings from the ground to understand how the policy framework and institutional infrastructure addresses the needs of the livestock owners.

4. SITUATION OF BACKYARD POULTRY – FINDINGS FROM THE GROUND

This section discusses the findings of the household survey on poultry rearing. Following the sample profile, we discuss the details of poultry enterprise in rural households, the prevalence and impact of diseases, availability and use of veterinary services and availability of medicines and vaccines.

4.1 Sample Profile

Table 4.1 presents the descriptive statistics of the sample households from the three states. The number of respondents in Haryana and Madhya Pradesh each was 240 and 220 in Orissa. The average family size ranged between six and seven across the three states and almost all the households were male headed. Illiteracy rate of the head of the households, that is, where the heads had no schooling was quiet high at about 75%-80% in Haryana and Madhya Pradesh, while the same was very low in Orissa at about 25%. Hindus dominated the sample in Madhya Pradesh and Orissa, and Muslims in Haryana.

In Orissa and Madhya Pradesh, more than 90% of the poultry owners had land, whereas in Haryana more than 50% of the households were landless. In accordance with the land ownership, agriculture was the primary occupation for 80% households in Madhya Pradesh and 36% in Haryana. The situation in Orissa is a bit surprising; agriculture is not the primary occupation despite high land ownership as many households are involved in alternate livelihood activities such as handicrafts, government jobs, etc. In Haryana, about 42% of the sample households were involved as agriculture and non-agriculture labour, while in Orissa and Madhya Pradesh this share was about 21% and 13%, respectively.

The average landholding size of the sample household was between 1.3 to 1.7 hectares, which falls in the small and marginal farmer category according to the census of India. About 80%-90% of the households in all the three states own large ruminants. In Haryana, more than 70% of the households had two buffaloes on average, while about 10% of the households have cattle with an average herd size of five animals. In Orissa and Madhya Pradesh, 50%-60% of the households owned two cattle on an average. In Madhya Pradesh also about a quarter of the households reported buffalo ownership. In Orissa and Madhya Pradesh more than 70% of the households own small ruminants while in Haryana, this share was 44%.

The average value of the small and large ruminants is Rs.17,000 to 18,000 in Orissa and Madhya Pradesh, whereas in the case of Haryana this is about Rs.55,000 emphasizing the importance of dairy enterprise in this region. The average size of poultry flock per household is eight in Orissa, five in Haryana and about three in Madhya Pradesh. In Madhya Pradesh, a majority of the sample lived in mud houses, while this was only 40% in Orissa and 10% in Haryana. From the livelihood perspective, the sample reflects the worst situation for Madhya Pradesh where the rural households are largely dependent on agriculture with limited sources of alternate income.

Table 4.1 ***Descriptive Statistics***

	UNIT	Haryana	Orissa	Madhya Pradesh
Details of the Sample Households				
No. of respondents	No.	240	251	240
Average age of the head of household	Years	41.71	46.08	41.03
Headed by male	%	96.3	96.8	98.3
Head of HH with no education	%	79.5	24.7	74.1
Average family size	No.	6.78	5.54	7.15
Religion (Hindus)	%	6.25	96.8	100
Occupation				
Does the HH own land	%	47.5	92	92
Agriculture as primary occupation	%	36	41.8	80
Agri/non-agri labour as primary occupation	%	42.9	21.5	13.3
Land Livestock and Household Assets				
Average land owned	Hectares	1.6	1.3	1.7
Median of land owned	Hectares	2.5	1.6	3
Rain Fed Land	%	7	97	87
Households that own large ruminants	%	80	84.8	92
Avg. No. of Cattle	No.	5.1	1.5	1.7
Avg. No. of Bullock	No.	1.0	2.1	2.2
Avg. No. of Buffalo	No.	1.7	1.8	1.8
Households that own small ruminants	%	43.8	77.3	75
Avg. No. of goats	No.	2.8	4.8	3.1
Average value of small and large ruminants	Rs.	55,373	17,543	18,496
Average size of Poultry flock	No.	5.4	8.2	3.2
Farmers living in mud houses	%	10	40.2	95.8
Farmers living in concrete houses	%	22	55	3.8
Farmers living in mixed houses	%	67.9	4.38	0.83

The distribution of land and poultry ownership reveals that overwhelming majority of poultry owners fall in landless and small and marginal farmers' category – more than 90% in Haryana and Orissa and about 76% in Madhya Pradesh (Table 4.2). This finding further reinforces the pro-poor aspect of interventions in this sector for poverty alleviation programmes.

Table 4.2 ***Distribution of Land and Poultry Birds***

	Haryana		Orissa		Madhya Pradesh	
	Percentage of farmers	Percentage of poultry birds	Percentage of farmers	Percentage of poultry birds	Percentage of farmers	Percentage of poultry birds
Landless	55.4	53.3	8.2	11.2	27.7	26.8
Marginal	22.1	21.7	57.3	58.2	17.9	20.9
Small	14.5	16.3	31.2	26.7	30.6	30.5
Medium/large	10.1	6.7	3.3	4.0	23.8	21.8

4.2 Poultry Enterprise in Rural Households

The importance of poultry in rural livelihoods is clearly evident from the reasons for rearing poultry. In all the three states, the two dominant reasons for keeping poultry birds are that poultry can be sold immediately for cash and eggs and meat can be used for home consumption (Table 4.3). The most important use of income from poultry birds is the sale of poultry birds during times of emergency. Poultry birds are like a moving bank in the house, which can be encashed immediately when the need arises. Other important uses were purchasing groceries and use for children's education. Despite the importance of poultry enterprise, it had either decreased or stayed the same across regions. About 60% of the households across states stated that the main reason for this decrease was heavy loss due to diseases. Other two important reasons were lack of veterinary services and lack of training for poultry. Severe weather condition was an important reason for decline in poultry enterprise in Haryana. Increase in poultry enterprise was reported largely in Orissa.

Production Performance of Poultry

In a UNFAO study reviewing the poultry sector in India, Das Kornel (2008) presents a comprehensive analysis of poultry situation in rural households. The author reports that eggs are usually obtained in three to four clutches of 10-20 eggs per clutch, with the total number of eggs ranging from 40 to 110 per year. The average mature weight of hens does not exceed 1.5 kg and that of cocks 2.0 kg. The backyard poultry system focuses mainly on meat production rather than the production of eggs. Consequently, most of the eggs produced are used for hatching, with only a few eggs being consumed by the family or sold. The returns are very low from egg sales,

compared to the sale of birds. The situation of poultry production in sample households was quite similar to these findings.

Table 4.3 ***Importance of Poultry in Rural Households***

(Percentage of Households)

	Haryana	Orissa	Madhya Pradesh
Reasons for Poultry Rearing			
Easy activity to be managed by women	43.8	54.3	60.4
Good Livelihood alternative in rural	8.9	33.8	2.5
Low Investment	23.4	6.2	10.0
Eggs and meat can be used for home consumption	81.7	70.0	81.3
Good market for birds	3.8	24.8	3.8
Can be sold for ready cash	79.1	90.0	90.8
Meet nutrition requirements	43.8	4.8	0.8
Traditionally been keeping birds	11.9	14.8	0.4
Use of Income from Poultry Birds			
Children's education	59	53	64
Purchasing Groceries	60	60	75
Emergency Spending	66	71	97
Social Expenditure	34	23	3
Other	14	8	0
Growth of Poultry Enterprise			
Increased	17.4	29.5	9.2
Decreased	58.7	64.3	50.4
Same	23.0	7.6	40.0

Table 4.4 describes the production performance of the poultry birds in the sample households. Average number of clutches is about three-four per year with 12-18 eggs per clutch; amounting to 36-72 eggs per year. The number of eggs used for hatching is about 14 in Haryana and Madhya Pradesh while the same is about 10 in Orissa. Number of eggs hatched is about 10-11 in Haryana and Madhya Pradesh, while it is 7.8 in Orissa. The hatchability rate is 71% in Haryana and 81% in Orissa and Madhya Pradesh.

Table 4.4 ***Production Performance of Backyard Poultry Birds***

	Unit	Haryana	Orissa	Madhya Pradesh
Clutches per year	Number	3.8	2.9	3.1
Eggs laid per clutch	Number	18.1	12.5	15.5
Eggs consumed per clutch	Number	3.8	2.8	1.5
Eggs used for hatching per clutch	Number	14.3	9.6	13.9
Eggs hatched per clutch	Number	10.2	7.8	11.2
Chicks that survive per clutch	Number	6.6	5.9	7.2
Hatchability rate	%	71	81	81

Economics of Poultry Enterprise

The average number of birds sold per household ranges from 11-16 across states. The prices are the highest in Orissa (Rs.243/bird) followed by Haryana (Rs.204/bird) and Madhya Pradesh (Rs.152/bird); that is a price difference of about Rs.100/bird across states. Part of this difference is because of the weight of the bird and partly because of the demand conditions. Mewat region in Haryana and Orissa are traditional meat eating regions, where demand for consumption is high. The average annual expenditure on poultry feed for the flock per household is Rs.2,927 in Haryana, whereas the same is about Rs.1,000 in Orissa and Madhya Pradesh. This is despite the fact that the size of poultry flock is highest in Orissa at about eight birds per household. The median expenditures on feed in Orissa and Madhya Pradesh are even lower at Rs.648 and Rs.396. This is probably a true reflection of the ground situation as the averages can be influenced by extreme values. A possible explanation for the high expenditure on feed in Haryana is that home consumption of birds has more value and hence people do not mind spending on the birds. Overall, the average and median net returns are about Rs.2,925 and Rs.1,512 in case of Orissa and the same is Rs.933 and Rs.697 in Madhya Pradesh. These figures present only the monetary returns; the use of birds and eggs for home consumption is not included here. Also, there is a certain amount of sale during weddings and festivals when the price of birds is much higher. Accounting for these factors will further enhance net returns.

Table 4.5 ***Economics of Poultry Enterprise***

		Haryana	Orissa	Madhya Pradesh
Birds sold per household	Average	11.4	15.9	13.2
	Median	12	12	8
Weight of the bird (KG)	Average	1.7	1.5	1.2
	Median	1.5	1.5	1
Sale price (Rs./bird)	Average	204	243	152.1
	Median	175	180	150
Revenue from sale (Rs./bird)	Average	2326	3872	2008
	Median	2100	2160	1200
Average annual feed expenditure per household (Rs.)	Average	2927	947	1075
	Median	2160	648	396
Average Net Income from Poultry per household* (Rs.)	Average	-601	2925	933
	Median	-60	1512	697

**Note 1:* This does not include the home consumption of birds and eggs*

4.3 Prevalence and Impact of Poultry Diseases

Information about prevalence and impact of poultry disease was collected through two techniques—Participatory Epidemiology (PE) and household survey. PE is a technique used to conduct veterinary epidemiology in a participatory manner with the target communities. Despite being a new technique, PE is attracting interest from veterinary epidemiologist, veterinary investigation officers and researchers, to understand the occurrence and pattern of livestock diseases (www.participatoryepidemiology.info).

The PE exercise was used to collect the relevant information about the incidence and impact of poultry diseases in discussion with a group of poultry owners in the study areas. Participatory epidemiology exercises were conducted in 12 villages of three states (four in each state) in discussion with 194 participants. About 54 of the PE participants were women, which is approximately 28% women participation[8].

The PE was used to provide qualitative information on the poultry diseases in the survey area, prepare a seasonal calendar for the occurrence of these diseases and identify diseases leading to

[8] Despite several efforts it was difficult to get higher participation, especially because of social factors in Haryana and widely scattered houses in Madhya Pradesh.

maximum losses. The household survey complemented the findings from the PE by providing quantitative information about the incidence and impact of poultry diseases.

Findings from PE

The PE participants were not aware of the English names of the diseases, but referred them by local names. They clearly explained the common symptoms of the diseases and emphasized the symptoms that lead to mortality of poultry birds. Across regions, the symptoms described by the poultry keepers indicate towards the major poultry diseases like Fowl Cholera, Marek's Disease, Infectious Bursal Disease (IBD) or Gumboro, Fowl Pox, and Newcastle disease (see Annex 3).

Specific symptoms associated with ND are green and white diarrhoea, twisted neck and discoloration of crown. It can be inferred from the findings that specific symptoms associated with ND cause heavy mortality in birds in all the three states. The farmers also mentioned that it is very difficult to save infected birds. The mortality starts within one to two days after the symptoms are observed. The participants expressed that they incur loss due to heavy mortality in poultry birds as they are more prone to diseases as compared with other livestock.

It has to be mentioned that we cannot indicate the diseases with certainty because there is no system in place for disease surveillance. The backyard poultry birds are not taken to the local veterinarians for treatment or post-mortem. However, the information gathered from the participatory epidemiology was shared with the local veterinarians in the study areas for validating the findings. These local veterinarians agreed with the PE findings about the prevalence of diseases in their area.

The participants in Haryana reported that the birds demonstrated symptoms of illness at the beginning of summer season (during March and April), whereas high mortality of birds occurs during the peak summer months (during June and July). Based on the inputs from participants in Madhya Pradesh, summer and rainy season seems to be the time when poultry birds are more prone to diseases. On the contrary, in Orissa, winter season brings diseases and mortality is high during January and February. The PE group reported that birds die during summer also, but the spread of disease is not very high during that time.

Findings from Household Survey

In all the three states, almost all the poultry keepers reported losses due to disease was the most important factor causing loss of birds, followed by loss due to predators (Table 4.6). Excessive heat or cold was another important reason mentioned in Haryana along with theft of birds.

Table 4.6 ***Reasons for Loss of Poultry Birds***

(Percentage of Households)

	Haryana	Orissa	Madhya Pradesh
Diseases	94	99	100
Kill by Predators	90	47	82
Excessive heat or cold	77	28	0
Theft	20	4	1

Based on the symptoms and local names reported by farmers, Newcastle Disease was widely reported as the most widely prevalent and the most important disease in all the three states (Table 4.7). Fowl pox was widely reported in Orissa while it was not very common in other states. Other diseases reported by some farmers were worms and Marek's Disease.

Table 4.7 ***Commonly Occurring Poultry Diseases in Survey Area***

(Percentage of Households)

Poultry Diseases	Most Prevalent Disease			Disease Causing Maximum Mortality		
	Haryana	Orissa	Madhya Pradesh	Haryana	Orissa	Madhya Pradesh
Newcastle Disease	98	99	73	97	99	71
Fowl Pox	2	67	0	0	1	0
Other	10	33	35	1	2	1

In Haryana, and Madhya Pradesh the disease incidence is most prominent in summer and to some extent in winter (Figure 4.1). In Orissa, the disease incidence is spread throughout the year with peaks during winter and summer. These findings are in line with the findings from PE.

The total figures for loss of birds due to diseases in all sample households were 1642, 4342 and 2002 birds in Haryana, Orissa and Madhya Pradesh, respectively. This comes to average 7-8 birds/HH in Haryana and Madhya Pradesh and up to 20 birds in Orissa (Figure 4.2). This heavy mortality is a sure indicator of the need for vaccines to improve the flock size and enhance incomes from the sale of birds.

Figure 4.1 Seasonal Pattern of Incidence of Diseases

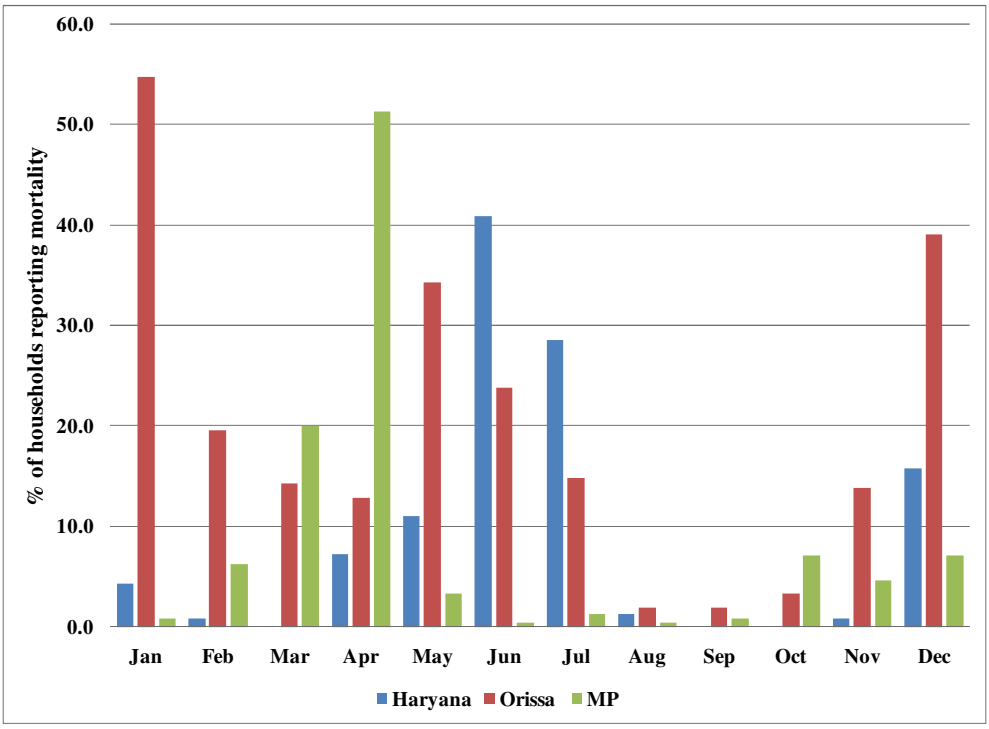
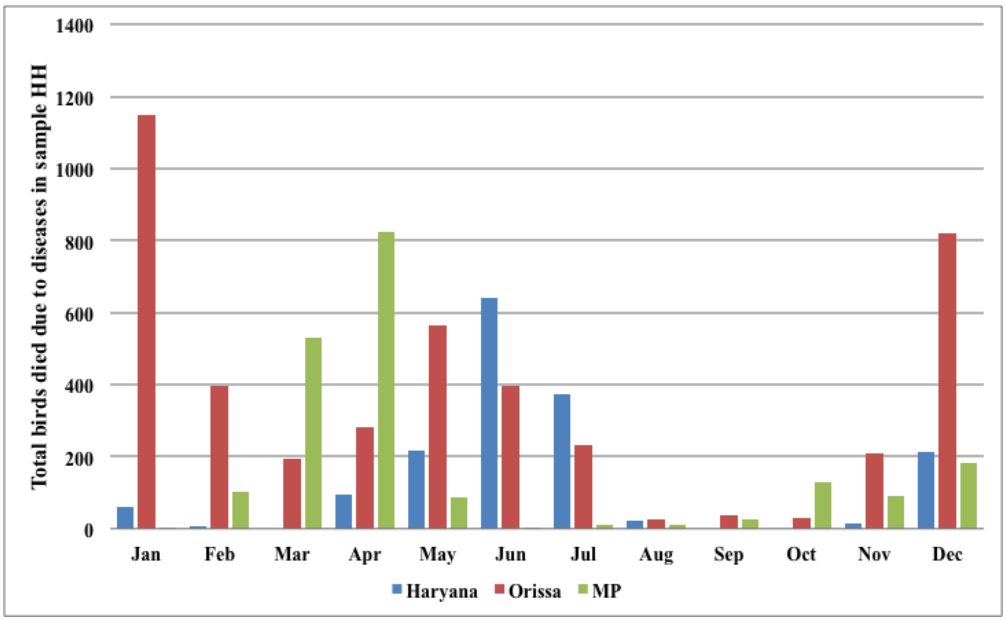


Figure 4.2 Birds that Died due to Diseases in Sample Households



Despite the heavy mortality, use of formal veterinary services for this sector is very low (Table 4.8). About 90% of the respondents in Madhya Pradesh were resorting to home remedy, while the same was about 50% in Haryana and 25% in Orissa. People in Haryana and Orissa also reported going to medicine store for medicines and sometimes approaching the vet and para-vet. Based on the survey, **the average annual cost of medicines for the flock of birds was Rs.181 in Haryana, Rs.96 in Orissa, implying that farmers are already spending a significant amount to save the birds.**

Table 4.8 ***Treatment of Sick Birds***

(Percentage of Households)

	Haryana	Orissa	Madhya Pradesh
Home remedy	47	25	96
Get medicine from the medicine store	19	6	1
Try to contact paravet	13	16	0.4
Try to contact Govt veterinarian	6	6	0
Sell the bird	3	21	1.3
Consume the bird	0	14	0

4.4 Availability and Use of Veterinary Services for Poultry

In this section, we present the analysis of coverage of all livestock to understand the relative importance of poultry in overall veterinary services. The discussion of institutions relating to backyard poultry emphasized that the main service provider for the livestock sector is the government network of veterinary services comprising of veterinary dispensaries and Livestock Aid Centres (LACs) manned by veterinarians and paravets employed by the government. The dispensaries are usually manned by veterinarians and while LACs are manned by paravets. Because of limited manpower in rural areas, the paravets are more widely available than veterinarians. Local youth trained as paravets (also referred to as Gopalmitra or Gausevaks) have also been involved in providing primary veterinary services, especially to reach out to the far-flung areas.

Availability of Service Providers

We discuss the availability of service providers with the relative distances and time taken to reach the service providers depending on the mode of transportation, which is useful information for setting up vaccine supply chains where timing is of critical importance. This is followed by a discussion on the use of veterinary services.

As mentioned in the sampling discussions, the villages were identified as high, medium and low availability of services. The high availability villages are within 5 km of the service provider, medium availability villages are within five to eight km radius of the service provider and the low availability villages are more than 8 km away also including the far-flung villages.

In Haryana and Madhya Pradesh about 70%-75% of the farmers reported availability of a veterinarian, while this was only about 58% in Orissa (Table 4.9). This lack of veterinarians is balanced by high availability of government paravets in Haryana and Orissa with about 85% of the farmers reporting availability. An important point is the significant increase in distance to government veterinarian from 2-3 km in the case of high availability villages to about 12 km for low availability villages in Orissa and Madhya Pradesh. Comparatively, the distance to government paravets is much lower, about 2 km in the case of high availability and 6-8 km in the case of low availability villages, reflecting the higher availability of paravets.

The discussion of distances is more meaningful in the light of actual time taken to reach the service provider depending on the mode of transportation used (Table 4.10). In Haryana, livestock owners used various means of transport, such as bicycle, motorbikes and local transport to reach the service provider within a time range of 20-30 minutes across high, medium and low category villages. In Orissa, bicycles were the most common mode of transport, followed by going on foot. The time taken to reach the service provider ranged from 20-80 minutes across different categories of villages. In Madhya Pradesh, most of the people accessed the services by foot followed by bicycles, with an average time of about 40-70 minutes.

Table 4.9 ***Availability of Veterinary Service Providers***

	Government Veterinarian at Dispensary		Government Paravet		Private Paravet		AI services	
	% of HH	Distance	% of HH	Distance	% of HH	Distance	% of HH	Distance
Haryana								
High	48.8	2.7	85.0	1.0	-	-	-	-
Med	75.0	7.5	78.8	2.9	-	-	-	-
Low	92.5	7.3	87.5	5.6	-	-	-	-
Average	**72.1**	**5.8**	**83.8**	**3.2**	**-**	**-**	**5.4***	**5.6***
Orissa								
High	70.0	3.1	86.3	3.2	33.8	1.5	81.3	3.1
Med	38.1	5.9	82.1	5.9	34.5	3.5	76.3	5.8
Low	65.8	10.7	89.1	8.3	-	-	67.5	9.0
Average	**58.0**	**6.6**	**85.8**	**5.8**	**34.2**	**2.5**	**75.0**	**6.0**
Madhya Pradesh								
High	67.5	2.3	-	-	15.0	3.4	2.1	10.6
Med	76.3	7.0	-	-	0.0	0.0	0.0	0.0
Low	82.5	11.5	-	-	0.0	0.0	0.0	0.0
Average	**75.4**	**6.9**	**-**	**-**	**15.0**	**3.4**	**2.1**	**10.6**

Table 4.10 ***Commonly Used Mode of Transport for Accessing Livestock Services***

Access to Livestock Services	Bicycle		Bike		On Foot		Bus		Local Transport	
	Minutes	% of HH	Minutes	% of HH	Minutes	% of HH	Minutes	% of HH	Minutes	% of HH
Haryana										
High	26.0	45.0	15.0	20.0	16.0	31.3	25.0	8.8	22.0	3.8
Medium	24.0	58.8	21.0	17.5	28.0	5.0	19.0	12.5	24.0	8.8
Low	30.0	21.3	23.0	36.3	25.0	23.8		0.0	29.0	23.8
Average	**26.7**	**41.7**	**19.7**	**24.6**	**23.0**	**20.0**	**22.0**	**7.1**	**25.0**	**12.13**
Orissa										
High	21.0	83.8	17.0	8.8	28.0	71.3		0.0	-	-
Medium	49.0	90.5	24.0	13.8	64.0	12.5	34.0	6.3	38.0	6.3
Low	81.0	83.9	19.0	11.3	71.0	10.0	48.0	7.5	70.0	3.8
Average	**50.3**	**86.0**	**20.0**	**11.3**	**54.3**	**31.3**	**41.0**	**4.6**	**54.0**	**3.3**
Madhya Pradesh										
High	30.0	12.5	15.0	2.5	38.0	87.5	60.0	2.5		
Medium	29.0	16.3	31.0	10.0	51.0	70.0	135.0	5.0		
Low	55.0	32.5	28.0	7.5	70.0	31.3	55.0	25.0		
Average	**38.0**	**20.4**	**24.7**	**6.7**	**53.0**	**62.9**	**83.3**	**10.8**		

Use of Veterinary Services

Table 4.11 presents the ground situation of the use of veterinary services for vaccination and treatment. Among all livestock, coverage of cattle for vaccination and treatment is the highest in all three states. Vaccination is on the initiative of the government service providers because farmer awareness about vaccination is low hence they do not demand vaccination (Table 4.11). The coverage of vaccination is high in Haryana and Orissa and lowest in Madhya Pradesh. On the contrary, farmers reporting treatment is the highest in Madhya Pradesh, possibly because of low vaccination. Coverage of small ruminants under vaccination is relatively lower than cattle.

Poultry vaccination and treatment is on the initiative of the farmers themselves. While none of the farmers in Haryana and Madhya Pradesh reported vaccinating the birds, about a quarter of the farmers surveyed in Orissa were vaccinating the birds. The situation is different in Orissa because the study area had significant activity of industrial broiler and layer birds because of

which awareness is high. Orissa also has high population of fighting cocks that are of high value. Also, because of outbreak of bird flu in the bordering state of West Bengal, awareness about vaccination is high in Orissa. Finally, these districts have also been identified as areas of intense poultry activity by the Orissa government. Combination of these factors has probably led to higher awareness of poultry vaccination.

Since vaccination was already occuring to some extent in Orissa, we tried to get the details about vaccinations. The farmers had used F1, LaSota and R2B vaccines, through oral as well as subcutaneous methods of vaccine administration. The source of vaccinations was the medicine store located about 5-6 km away and they could administer the vaccine within two hours of purchase. They were using thermos flasks with ice to maintain the cold chain between the village and medicine store. The most preferred vial size is 100 doses which is the smallest package available in the market.

Table 4.11 ***Ground Situation of Veterinary Services for Vaccination and Treatment***

(Percentage of Households)

	Haryana	Orissa	Madhya Pradesh
Vaccination			
Cattle	55	65	36
Small ruminants	0	26	17
Poultry	0	23	0
Treatment			
Cattle	33	66	77
Small ruminants	4	37	45
Poultry*	15	15	1.5

***Note**: Poultry vaccination and treatment is largely through purchase of medicines from medicine store, not through veterinary services*

Table 4.12 ***Reasons for not Vaccinating Cattle and Small Ruminants***

(Percentage of Households)

	Reasons for not vaccinating Cattle			Reasons for not vaccinating Small ruminants		
Reasons	**Haryana**	**Orissa**	**Madhya Pradesh**	**Haryana**	**Orissa**	**Madhya Pradesh**
Vaccines not available	1.3	0.7	0.4	13.3	4.7	0.8
Not aware of advantages and use	27.1	11.5	34.1	50.2	36.6	36.7
High cost of vaccines	0.0	0.8	9.6	0.4	0.8	10.3
Govt. Vets and paravets not available	15.1	14.3	21.2	19.4	35.0	24.1

Following the limited use of veterinary services, we take a closer look at the reasons for lack of vaccination in small and large ruminants (Table 4.12). Lack of awareness and unavailability of service providers were the two most important reasons. In case of Haryana and Orissa, livestock owners reported that vaccines were not available for goats.

In case of poultry, we capture the reasons for not vaccinating and treating birds (Table 4.13). In Haryana and Madhya Pradesh 80%-90% of the farmers reported lack of awareness as the most common reason for not vaccinating the birds. In contrast, only about a quarter of the respondents in Orissa said they were not aware of poultry vaccinations. High cost of vaccination was mentioned as a limiting factor by about 20% of the respondents in Orissa. The dominant response in Haryana and Madhya Pradesh was lack of awarness regarding treatment of poultry along with unavailability of service providers. **Significantly, these findings reflect that since the poultry birds have largely been reared in a traditional environment, the farmers do not have the concept of vaccination and treatment of backyard poultry birds.**

Table 4.13 ***Reasons for not vaccinating and treating birds***

(Percentage of Households)

	Haryana	Orissa	Madhya Pradesh
Reasons for not vaccinating birds			
Not aware of vaccinations	91	24	86
It is not common to treat poultry birds in this area	58	24	4
Govt. vets/paravets not available for vaccinating poultry birds	74	38	18
Vaccine are not available	8	4	1
Vaccines are costly	2	20	0
Vaccine are difficult to administer	1	0	0
Reasons for not treating birds			
Not Aware that poultry birds can be treated	63	29	74
It is costly to treat birds	6	35	0
Diseases do not harm productivity	4	6	0
Govt. vets/paravets not available for treating poultry birds	49	15	9

Availability of Vaccines and Medicines for Livestock

Vaccines for large and small ruminants are produced and administered by the government veterinary service providers; these vaccines are not widely available at the medical stores except in some dairy developed areas in the country. Medicines for small and large ruminants are often available from the veterinarians and/or paravets at the time of treatment. In case of short supply, these are purchased from the medicine stores.

On the contrary, medicine stores were the dominant source of poultry medicines and vaccines because of the well established network of service providers catering to the industrial poultry sector. In Haryana, farmers purchase medicines for poultry from medicine stores, while there is hardly any purchase of poultry vaccine (Table 4.14). In Orissa, the medicines for poultry are sourced from government veterinary units as well as medicine stores, while vaccines are mostly procured from medicine stores. In Madhya Pradesh, there is almost no use of vaccines or medicines for poultry. The average distance to medicine stores is about 6 km in Haryana and Orissa, while it is about 12 km in Madhya Pradesh.

Table 4.14 ***Extent of Use and Procurement of Vaccines and Medicines for Poultry***

(Percentage of Households)

	Haryana		Orissa		MP	
	Vaccine	**Medicine**	**Vaccine**	**Medicine**	**Vaccine**	**Medicine**
Use of vaccines/medicines	0	18	25	19	0	1.5
Procurement from government	0	1	4	19	0	0
Procurement from Medicine shop	0	18	25	16	0	0
Distance to medicine shop (KM)	5.8		5.9		11.9	

The findings from the ground reveal that there is hardly any involvement of government veterinary services for poultry birds. In Haryana and Madhya Pradesh, the farmers do not have the concept of vaccinating the birds. In Orissa, awareness about poultry vaccination is high, hence vaccination is performed to some extent, but mostly on farmers own initiative. The next

section focuses on the supply of vaccination by the government and private sector chains to explore options for enhancing coverage to this sector.

5. SUPPLY AND DISTRIBUTION OF NEWCASTLE DISEASE VACCINES

In India, private and public sector organizations are involved in manufacture of ND vaccines (see annex 4 for a list of poultry vaccine manufacturers in India). The ND vaccine is manufactured in two forms as Live and Killed/Inactivated vaccines available as a single vaccine or in combinations with other vaccines. Use of live vaccines is more common as compared with the Killed/Inactivated variants. The live vaccines are available in packages of 100 to 10,000 doses, whereas the killed/inactivated vaccines are not available in packages of less than 400 doses (see Annex 5 for details of the ND vaccines available in the country).

The major vaccines for ND are B1 strain, F strain, LaSota strain and R2B strain. F, B_1 and LaSota are all mild vaccine strains (Lentogenic); Komarov and Mukteswar (R_2B) are more pathogenic (Mesogenic) strains. An ND vaccination program begins with F or B1 in the first few days followed by LaSota in the 2nd week of age. The first week vaccination provides only local cell mediated immunity. LaSota is more pathogenic than F and B1; it provides more lasting immunity. Industrial broilers receive only 2 live vaccines against ND if marketed at 35 days of age. A third vaccine (usually LaSota) is given if the marketing age is postponed or in summers when the ND challenge is high.

The Lentogenic vaccines are administered either intra nasal/intra ocular or in drinking water. The first vaccine is usually given in the eye or the nose. Administration in drinking water is convenient particularly when populations are large. The vaccination program for laying flocks is different. The LaSota strain vaccination is repeated every four to six weeks of age. Some farmers use the Mesogenic strains at 10 to 12 weeks of age or use an inactivated vaccine. The mesogenic strain or inactivated vaccine is repeated just before commencement of lay. LaSota vaccination is repeated during lay every 6 weeks depending upon the weather and challenge. Because of the use pattern, LaSota is the most widely used ND vaccine in the country.

In the private sector, three companies with main business focus on production of poultry account for about 90% of the market share in the country – Ventri Biologicals, Indovax and Hester

Biosciences. Other companies like Intervet, Zydus AHL and Fort Dodge are also involved in manufacture of poultry vaccine along with biologicals for other livestock. In the government sector, poultry vaccines are manufactured by the Biological Product Units, which are a part of the state institutional infrastructure of livestock development. Currently, there are 19 BPUs in the country, of which16 are involved in production of ND vaccine. A number of these do not have a valid GMP certificate. See Annex 4 for a list of poultry vaccine manufacturers in India.

The private sector vaccine manufacturers cater to the industrial poultry industry, situated largely in the peri-urban areas. The main vaccine-manufacturing companies have a somewhat different market focus. Ventri Biologicals caters to the demand of large commercial farms; while Hester's focus is large broiler integrators. Indovax focuses on all segments, hence they have more emphasis on production of small vial sizes.

The backyard poultry sector is largely uncovered by the private vaccine manufacturers. The government's use of poultry vaccines caters to the need of the state poultry farms used for rearing birds for distribution under the government scheme and to some extent for vaccination of backyard poultry birds through the government system of veterinary services. In this section, we undertake a detailed analysis of both these distributional channels to understand the functioning of these chains, extent of coverage of backyard poultry birds, limitations in catering to the backyard poultry sector and to explore options of extending coverage to this sector.

Key aspects of supply chain addressed for both the chains include – manufacture of vaccines, volumes produced, chain participants, cold chain management, costs and margins, coverage of backyard poultry sector and constraints and suggestions for enhancing reach to this sector. There is no secondary data or studies of poultry vaccine supply chains in the country. Hence, this section is based largely on interviews conducted with the supply chain participants. This is also one of the first studies documenting the supply chain for livestock vaccines, which will also serve as a useful model for other such efforts with increasing emphasis on animal health and disease management.

Initially, key informant interviews were conducted to map the chain participants, and the functions they perform. This primary information about the two chains helped to develop

guidelines to conduct interviews with all participants in the public and private chain for conducting a detailed supply chain analysis. For the private sector supply chain, we collected information from manufacturers in the country, distributors and dealers in study states and medicine stores in rural areas. For the government supply chain, we collected information from the State Department of Animal Husbandry in the study states and Biological product Units of the government to understand the production aspects. Veterinary officials at district and block levels along with local dispensaries in rural areas were interviewed to understand the situation of administering vaccines in rural areas.

5.1 Private Sector Supply chain for ND Vaccine:

Of the three main vaccine manufacturers, Ventri Biologicals has somewhat higher market share, while Hester Biosciences and Indovax are close competition. Other companies like Intervet, Zydus AHL and Fort Dodge account for a very miniscule share of poultry vaccines. The size of poultry vaccine market increased from Rs.1500 million (~USD 33 million) in 2006 to Rs.2200 million (~USD 48 million) in 2010 – a growth rate of about 47% (www.indiainbusines.nic.in). This increase is the joint impact of growth rate of broiler and layer industry along with the increase in the use of inactivated vaccines in the recent years.

Started in 1971, the Venkateshwara Hatcheries (VH) Group is the pioneer of the industrial poultry sector in India. The company is one of the largest suppliers of broiler and layer chicks in the country. Ventri Biologicals started in 1980 is the vaccine division of the VH Group. It has diverse stakes in breeding of poultry, poultry equipment, hatcheries, egg and chicken processing, animal health products, production of specific pathogen free (SPF) eggs and poultry feed. The company was a pioneer of contract farming for industrial broiler. The vaccine-manufacturing unit was set up as a backward linkage to support the company's broiler and layer farming activity.

Incorporated in 1986, Indovax Private Limited is a leading manufacturer of biologics in India and a part of the Kegg Farms Group. As discussed in the introductory section, Kegg Farms group is a pioneer in research and production of poultry breeds for the backyard sector. Indovax has several innovations to its credit, notable amongst which is live attenuated vaccines against very virulent IBD using attenuated indigenous isolates. Indovax was the first Indian company to

offer Technical Services in terms of problem solving, MDA profiling of DOC and suggesting vaccination schedule for layer and broiler chicks; serological monitoring of post-vaccination titres for major diseases; monitor product efficacy and engineer tailor made solutions for specific clients. Indovax has jointly promoted a biotechnology company Immunetic Lifesciences Pvt. Ltd. to produce SPF eggs and diagnostic reagents. Avitech Nutrition, the third constituent of Kegg Farms Group is engaged in animal nutrition.

Hester Biosciences, located in Ahmedabad, was incorporated in 1997, and has grown at a fast pace to be the second largest vaccine manufacturing company in the country. Now, it is also venturing in the overseas market. They are also involved in marketing poultry disease diagnostic kits and offer sero-monitoring services.

Mapping the Chain: Key players in the private sector vaccine supply chain are manufacturers, distributors, dealers and medicine stores who sell to end users (Figure 5.1).

Figure 5.1 Private Supply chain for ND Vaccine

Manufacturers ➡Distributors ➡Dealers ➡Medicine Stores➡Farmers

All the vaccine manufacturers are operating across country, though the shares vary across states. There are two distribution channels for poultry vaccine: direct sales to companies involved in production of Day Old Chicks and contract farming and sale through distribution network. The share of each of these varies by company. We emphasize the sale through distribution network because this channel is of significance to the backyard poultry sector.

The manufacturers have a network of zonal distribution centres covering the east, west, north and south zones in the country. Some companies have their own zonal distribution centres or depots in all zones for storage of vaccines and distribution to the states in that zone. The companies carry out vaccine distribution through exclusive Super Distributors / Distributors, who mostly work exclusive with a company, but in some cases also serve as agents for multiple companies.

The distributors are located in the state capital or in significant poultry concentrations and the company's poultry vaccine is their primary business. They procure vaccines from their respective companies, maintain stocks and sell to dealers and farmers across the state. They are responsible for the maintenance of cold chain till the vaccines reach their customers. It is not uncommon for a big distributor to deal with 60-100 customers in the state, who are mostly involved in selling feed, vaccines, and medicines or have large poultry operations. About 20-25% of the dealer's business comes from vaccines. Normally, there are multiple dealers in all the towns, cities, poultry pockets in a state. The dealers' count depends on the number of the state's small towns, cities or poultry pockets. They cater to the demand of the medicine stores covering 20-50 km around the cities, and at times also directly sell to farmers. The medicine stores in rural areas are the final link with farmers. Medicines for livestock account for around 10-20% of sales. Medicines for large ruminants comprise a dominant share of the sales from livestock drugs. Poultry vaccine comprises 2-5% of the total sales of the medicine stores. The rural medicine stores cater to about 15-25 villages and farmers from 10-25 km come to purchase the medicines, though the average distance is 10-12 km.

In the study states, distributors were located in the capital cities of Bhubaneswar and Cuttack in Orissa, Bhopal and Indore in Madhya Pradesh and Gurgaon in Haryana. The dealers are based in all small cities and towns. For example in Madhya Pradesh, dealers are based in towns like Gwalior, Jabalpur, etc. The distributors and dealers are also doing institutional sale procuring vaccines for small hatcheries and NGOs involved in poultry projects. None of the rural stores in Haryana or Madhya Pradesh were keeping poultry vaccines. These storekeepers mentioned that there was no demand for poultry vaccines. If the demand arises they were willing to stock. They mentioned that ensuring supply would not be a problem if there were demand in the local market. On the contrary, in Orissa, poultry medicines and vaccines were available in the store at the district as well as block level and also in some medicine stores in big villages. Two main reasons for the availability of poultry vaccines and medicines in rural areas in Orissa are the presence industrial poultry farms in survey area and ownership of high value fighting cocks. The storeowners mentioned that sales of poultry vaccines had increased as compared to five years ago because of a larger number of backyard poultry owners are buying from them, because of higher awareness.

Volumes Handled: Since the distributors account for a major share of vaccines used in the state, the volumes are significantly large. They deal in about 10 to 18 million doses annually, depending on the size of industrial poultry in the state. The dealers in small towns deal in 25,000 to 30,000 doses annually. The annual sale of poultry vaccines at the district level stores was about 2,000- 4,000 vials, while the block level stores reported sales of about 200-300 vials.

The big distributors purchased vaccines two-four times a month, while dealers bought them on need basis. Usually, they order vaccines once or twice a month, based on the demand. Similarly, retailers also procure vaccines on local demand. None of the agents reported issues with availability of supply or quality at any level. Most of the distributors reported that the sales have increased over time along with the growth of the poultry industry. However, some distributors also mentioned that higher integration has led to the decline in demand for poultry vaccines. Now, integrators themselves are supplying the vaccines.

Managing the Cold Chain: From the company, the vaccines are delivered to distributors or regional distribution centres by air-cargo. Gelpacks are used for packing the vaccine that is then placed in ice-filled thermocol boxes to ensure maintenance of cold chain. Diluents are transported through normal transport, using trucks or buses. Distributors reported using buses or trucks for sending vaccines to other areas in the state. Maximum time taken to transport to other parts of the state is about 10 hours. Like the companies, they also pack in Gelpacks and use thermocol boxes to maintain cold chain. Manufacturers also reported using a fleet of company owned refrigerated vans for transporting to different zones, from where they use non-refrigerated vans to transport to further to local areas. This is done to ensure control over the product at all times, hence ensuring quality.

Almost all the distributors we spoke with were very conscious of managing the cold chain. They mentioned that it is very important to manage the cold chain to sustain the sale of vaccines. Some distributors also noted that they would not sell to retailers and dealers who are not maintaining cold chain since the farmers will lose faith in vaccination.

From the dealers, the vaccine is transported to medicine stores in thermocol boxes. Usually, the distance is not very large. Finally, the farmer picks up vaccines from the retail outlets in thermos

flasks. They put a few pieces of ice in the thermos flask along with the vaccine to maintain the cold chain. Some farmers we interviewed at the medicine stores in Orissa mentioned that they administer the vaccine within one or two hours of purchase.

Costs and Margins: Between the distributor and the medicine store level, there is a total 35%-40% margin across the chain. The share of the distributors is 10%-12%, while the dealers and retailers have a margin of 10%-20% each.

Extension Information: Vaccine usage in the industrial poultry sector is influenced by breeding companies, consultants/veterinarians and vaccine companies. In general terms, the vaccine companies direct technical marketing efforts to these agents. Periodically technical seminars are held in major poultry areas where important health issues / diseases are discussed. The involvement in extension activities varied depending on the market segments these companies were catering to. However, none of the companies were involved in extension activities for the backyard poultry sector.

The distributors and dealers interviewed on the field reported limited involvement by the companies in extension activities. A leaflet is supplied with each vial, providing information about the use of vaccines. The distributors further reported that they have gathered information about good practices through their own resources while talking to other distributors and veterinarians and reading relevant materials. Likewise, they are also not involved in providing information to other levels in the chain. In some exceptional cases, storeowners in rural areas have themselves been involved in conducting extension and information sharing with the backyard poultry farmers to enhance sales.

Linkages with the Backyard Poultry Sector: Currently, there is very limited involvement of private sector firms in backyard poultry sector. Some NGO's are sourcing products from companies or their distributors for distribution in the backyard poultry. They emphasized three major constraints in reaching out to backyard poultry sector. The foremost reason was limited farmer awareness regarding the use of vaccines/medicines and general healthcare. Marketing strategies to create awareness among the villagers include distribution of leaflets in local language to increase awareness. Second important reason cited was the lack of cold chain

infrastructure in rural areas because of power cuts. They had suggestions for managing the cold chain. Instead of a refrigerator, a small freezer may be used to maintain temperature in the rural areas. This was more effective in maintaining temperature when there is a power cut and was also less expensive. The third critical reason was the small size of poultry flocks maintained by rural households. Poultry flocks are limited to 5-10 birds, while the minimum vial size contains 100 doses. As in the case of all packaged products, unit price of vaccine increases as the dose pack decreases. Further, small dose packs also substantially reduce manufacturer's production capacities.

Regarding increasing involvement in the backyard poultry sector, a very positive signal was that the representatives of all companies were keenly interested to engage in backyard poultry sector. As they have been traditionally catered to the industrial poultry sector, this is a new area for them, but they are ready to explore the opportunity. They mentioned that if there were a project or campaign to involve in catering to the backyard poultry sector, they would willingly participate. The companies offered direct sale to NGOs to minimize the cost as compared with purchasing from the regular channel. They also offered to be actively involved in extension activities for the backyard poultry sector.

5.2 Government supply chain for ND Vaccine

The public sector investment in control of livestock sector diseases has increased in the recent years. The increasing globalization of the Indian economy had led to emphasis on quality — an essential attribute to compete in the international market. Consequently, several schemes with significant amount of government spending have been funded to minimize outbreaks in the livestock sector. The Central government is implementing a sponsored macro-management scheme called "Livestock Health and Disease Control". It is being implemented with an outlay of Rs 5,250 million. The scheme has several components — Assistance to States for Control of Animal Diseases (ASCAD), National Project on Rinderpest Eradication (NPRE), Foot and Mouth Disease Control Program (FMD-CP) and Professional Efficiency Development (PED). There is no impact of this program on backyard poultry sector as none of the poultry diseases is covered under ASCAD. Detailed analysis of the government supply chain for ND vaccines will

provide insights regarding the views of the state department officials regarding the importance of ND vaccines.

Mapping the Chain: The key players in the government vaccine supply chain are the State Department of Animal Husbandry (DAHD), Biological Products Unit, along with a network of veterinary services at the district, block levels and local units that are manned by vets and paravets (Figure 6.2). The set up of supply chain is on the lines of state's administrative units that comprise of districts, blocks and villages.

Figure 5.2 Government Supply chain for ND Vaccine

State DAHD➡BPU ➡District DAHD ➡Block DAHD unit ➡Local DAHD unit ➡Vaccinator (Vet/paravet) ➡farmer

The State Department of Animal Husbandry is the nodal agency responsible for all livestock related activities in the state. It gives guidance for all livestock as well as poultry-related activities in the state. They determine the size of poultry vaccines and also fund their production. The vaccines are manufactured by the state-owned Biological Product Units. All the three states have a BPU based in Hissar, Bhubaneswar and Mhow (near Indore) in Haryana, Orissa and Madhya Pradesh, respectively. While poultry vaccines are produced by BPUs in Orissa and Madhya Pradesh, the Haryana unit is not involved in production of poultry vaccine. Hence in this section we focus on Orissa and Madhya Pradesh.

The actual administering of vaccines at grass-root level is done through network of government veterinary services. The livestock sector activities at the district level are managed by Chief District Veterinary Officer (CDVO). CDVO is in charge of monitoring the activities of all blocks in the district. The block level veterinary unit is managed by Veterinary Assistant Surgeon (VAS) responsible for activities of all dispensaries and LACs in the block. CDVO ensures the availability of vaccines in the district. S/he is also responsible for the number of vaccinations carried out in various blocks in the district. The block-level VAS collects the vaccines from the district HQ during the monthly meetings or as required. The VAS and paravets managing the

dispensaries and LACs are responsible for vaccination of livestock in the area, including poultry. As discussed in section 4, the focus is on large ruminants while there is hardly any vaccine coverage for backyard poultry sector. The reasons for limited coverage of backyard poultry birds are discussed later in this section.

Volumes Handled: The state DAHD determines the volume of vaccines to be manufactured and funding the production of vaccines, which is based on several considerations. Discussions with officials of DAHD gave insights into the decision making process for vaccine production. The DAHD collects the demand for all types of vaccines from all the districts, which in turn collect the demand from the block level. The demand at the block level is determined by the livestock population of the block and the number of vaccines they can administer depending on the available manpower. Some user fees is collected for administering vaccines and repaid to the department. This amount is linked to the volume of vaccines received regardless of whether the vaccines are administered or not. In case they have not been able to administer the vaccines, the veterinary personnel have to shell out the user fees from their own pocket. Hence, they are cautious about placing the requirements. Often, the farmers are not aware of the benefits of vaccination because of lack of education regarding livestock diseases. The other important factor in determining the number of vaccines is the "target coverage" decided by the state government, which is mandatory for district officials to achieve. The target can be focused on enhancing coverage or the eradication of a particular disease. The third consideration in deciding the volume of vaccines is the budgetary constraints, vaccinations undertaken in the past year is also an important consideration in placing a demand for vaccine production. There is usually some increment over the past years production, in accordance with the increasing livestock population.

The BPU in Orissa reported total vaccine production for all species at about 20 million doses in 2009-10. About 80% of the vaccines were for large ruminants, including HS, BQ and Anthrax. Anthrax was used both for large and small ruminants. About 17% (3.7 million doses) of the total vaccines produced were for poultry; most of which was R2B vaccine. Other poultry vaccines produced are F1 and Fowl Pox. The BPU in Madhya Pradesh reported producing 20 million vaccines of which about 72% was for large ruminants while about 13% were poultry vaccines. Four types of poultry vaccines are produced — F1 and R2B (1.5 million each), Fowl Pox (0.5

million) and Marek's (60 thousand). These include vaccine production for the state poultry farms as well. It is intriguing that despite a sizable volume of manufacture of poultry vaccine, the administration of vaccines by the government sector is almost negligible in Madhya Pradesh and very minimal in Orissa.

The viral vaccines produced for the poultry are the live vaccines as they are more effective, easy to produce and cheaper. The common size of the vials produced is 100 and 200 doses; the smallest size of the vial that is a balance between cost and use is 100 doses. An important point mentioned is that to reduce costs, the BPU does not manufacture the diluents required for the vaccines. It has to be purchased separately. The most common size of the vials demanded by the veterinarians is 100 doses. The state governments are in the process of upgrading the BPUs to produce vaccines with latest technology. There are also efforts to enhance production capacity to enable covering a larger share of livestock population under vaccination.

Management of Cold Chain: The DAHD has deputed vehicles to dispatch the vaccines from the BPU to the designated districts with proper maintenance of cold chain. In Orissa, the block-level VAS reported collecting the vaccine from the district HQ as required because there was a problem of managing the cold chain at block level. The cold chain is maintained at block level with the help of thermocol box or the thermo flask. There was concern about managing the cold chain of vaccines beyond the district level. The veterinary officials mentioned that often they had to keep the vaccines in the refrigerators of their friends or relatives or nearby medicine stores to maintain the cold chain. Out of the block level DAHD offices visited, the refrigerators were either too old to function or did not have the electricity to function severely affecting the quality of vaccine and cold chain.

Cost for Vaccination: In Orissa, the officials reported charging Re. 1 per vaccination for large ruminants and small ruminants and Re. 0.15/bird for poultry birds. In Madhya Pradesh there was no charge for vaccination, especially as the two districts were in the tribal belt. The government initiative is to provide vaccinations for free in the tribal belt for the development of this sector.

Extending Coverage to the Backyard Poultry Sector: In Orissa, the poultry population in Mayurbhanj is about 2.6 million and in Keonjhar (1.3 million). The district officials reported less

than 0.2 million poultry vaccinations were used in each district. There was hardly any poultry vaccination being undertaken through the government veterinary system in Haryana and Madhya Pradesh.

Detailed discussions regarding the state government initiatives on backyard poultry were held with the senior officials of the State DAHD in both the states. The officials mentioned that activities related to backyard poultry have become important in the recent years because of increasing recognition of backyard poultry in poverty alleviation. As a consequence of the emerging importance of this sector in poverty alleviation, the states have ongoing schemes on backyard poultry. Most of these schemes focus on giving birds to beneficiary farmers to the economically and socially backward sections of the state as measures towards poverty alleviation. The vaccination of backyard poultry birds takes place to the extent of the initiative of the local veterinarians and livestock inspectors or paravets, but the officials in both the states recognized that not more than 5-10% of the birds are covered by vaccination.

The state government officials in both the states recognized the high mortality due to Newcastle Disease and that it was important to vaccinate the birds, but they also mentioned that vaccination of backyard poultry birds has not been taken up as a priority area by the government department.

The major constraints for bringing BYP under vaccination are the lack of farmer awareness about the benefits and use of vaccines, lack of infrastructure for maintaining cold chain, limited manpower to administer vaccines, and hilly terrain. Lack of farmer awareness is a major issue, because the vaccination program is supply driven and the farmers are not motivated to vaccinate the birds. This makes the planning and implementation process very difficult.

Management of cold chain is also very difficult in rural areas. Up to the district level the cold chain was managed, but beyond that it was difficult to maintain temperature because of the lack of refrigerators and/or sporadic electricity supply. Timely availability of vaccines was also a problem.

The veterinary manpower to conduct vaccinations is very limited. Each official in the veterinary dispensary—whether veterinarian or paravet—was managing 25-30 villages. Since it was

difficult to cover even the large ruminants, coverage of backyard poultry birds would be possible only with increased manpower.

Another major constraint to high coverage of poultry birds is the scattered houses in far-flung hilly areas which are difficult to reach. The poultry vaccinations are undertaken in the evening when the birds come home from scavenging. If the paravet vaccinates 100 birds in the evening, it is dark by the time this is done and it is a problem for him to come back home. However, if there is prior information about vaccination and if there is co-operation from the farmers then this hurdle can be overcome. The farmers can keep the birds within the premises of the house on the specified day, so that vaccination can be done any time during the day. To improve the reach of livestock services "gaumitras" or paravets were trained in Orissa. Local youth were trained by the government to provide primary veterinary services by charging a user fee. These trained paravets earn an income of Rs.1000-1500 by providing AI, vaccinations, de-worming first aid services and charging a nominal amount for the same. A major issue with the paravet system is that the drop-out rate is very high, because they move out of this profession and often out of the rural area when they find a better paying job. Based on the learning from these field experiences, and experiences of other countries, paravet programme focuses on training local women who are less likely to migrate to other areas.

Other recommendations on extending coverage included using the help of SHGs for enhancing farmer awareness and involving women in vaccination programs. Another suggestion was to put in place a position of a vaccinator for one Gram Panchayat, which forms a group of four to five villages. This person would be responsible for vaccinating all the animals in the Gram Panchayat. This would give them enough number of livestock to earn a substantial income, and this person would also be responsible to the Panchayat (the judiciary body at the village level) for this work. This would help to address the issue of failure of paravet system by ensuring sufficient livestock population to earn a minimum level of income to continue staying in the profession.

6. MARKET-SIZE OF NEWCASTLE DISEASE VACCINE FOR BACKYARD POULTRY

The two main objectives of the report are to estimate the market size of demand for ND vaccine by the backyard poultry sector and to identify options to enhance this coverage. Based on the primary and secondary information and discussion with key actors in the chain we can arrive at some estimates of the market size. We have information about poultry ownership and vaccination at various levels: the household level through the household survey, the village level information is estimated from the village census conducted for the study, the district level and state level information is available from livestock census and discussion with officials of the DAHD. Finally, national level information is available from livestock census. Put together, these pieces of information give a reasonable estimate of the potential market size for ND vaccine determined by birds not covered by vaccine.

i) From the household survey we know that the average flock size of backyard poultry birds was 8, 5 and 3 in Orissa, Haryana and Madhya Pradesh respectively.

ii) As discussed in the sampling issues, village census of about 100 households was conducted in each village (~ 3600 in three states) with information about poultry ownership and vaccination of birds. Village questionnaire was also used for estimating number of households in a village and livestock ownership in the village. Based on the information from the village level, there are on average 1390, 2376 and 875 backyard poultry per village in Haryana, Orissa and Madhya Pradesh respectively. Out of these, only 10% poultry owners reported vaccinating the birds in Orissa, while in Haryana and Madhya Pradesh, there was no vaccination.

Table 6.1 ***Estimated Poultry Population and Extent of Vaccination***

	Poultry Population Per Village	Percentage of Poultry Population Vaccinated
Haryana	1,390	0%
Orissa	2,376	10%
Madhya Pradesh	875	1%

Source: Village and Census Questionnaire

iii) From the supply chain analysis of the public sector, the district level officials also reported that not more than 5-10% of the birds were vaccinated in Orissa, while in the other two states the level of vaccination was almost negligible. Hence, only 10% of the total birds in the state of Orissa are vaccinated. In the case of Madhya Pradesh and Haryana, the ground situation suggests that there was hardly any vaccination of backyard poultry birds in the villages. In Haryana, the government was not at all involved in manufacture of ND vaccine. Thus in these two states, almost the entire population of 3.2 million and 0.2 million birds is uncovered by vaccination. The situation in the rest of the country is not very different. As discussed in the introductory section, some projects have been initiated in some states for vaccination of backyard poultry birds, but these cases are few and far between, while the vast majority of birds are not covered by vaccination.

Based on these estimates it is quite reasonable to assume that at least about 90% f the country's 153 million backyard birds are yet to be covered by vaccination. Assuming 2 doses of vaccines per bird, the requirement of vaccines for this sector will be about 260 million doses or 2.6 million vials of 100 doses. This amounts to an additional revenue generation of Rs. 117 million (assuming current retail price of Rs. 45/100 dose vial), which is about 5% of the current market size.

7. OPTIONS FOR ENHANCING COVERAGE

Following the detailed demand and supply analysis the Focus Group Discussions (FGDs) were conducted with farmer groups to explore options for strengthening/evolving supply chains for ND vaccines for backyard poultry birds. **Thus, the specific objective of the Focus Group Discussion was to explore the options for setting up an effective, well functioning and sustainable supply chain for ND for the backyard poultry sector.**

To lay grounds for exploring the options and to validate the findings from the household survey, the discussion covered four areas: i) current situation of livestock services; ii) importance of livestock in rural livelihoods; iii) vaccination of backyard poultry birds; iv) options for setting up a system to start the vaccination of birds; and v) addressing practical issues in administration of vaccines.

The technique of Focus Group Discussion (FGD) is particularly suited in exploratory research, in generating and formulating hypotheses, and in exploring beliefs, experiences, opinions, values, and concerns of research participants within their own perception system (Kitzinger and Balbour, 1999; Krueger and Casey, 2000; Millward, 2000).

As compared with the survey method, the advantage of the FGDs is that it is a very useful tool to understand the intricacies of the ground situation from various perspectives through a rich discussion on the specific topics which do not emerge from the survey. FGDs help to incorporate the perspective of the stakeholders in analyzing the issues. Project designed based on stakeholders inputs (in this case the livestock owners), are likely to be more successful because they are likely to be more tailored to the needs of the users. On the other hand, the key drawback of FGDs is that the findings only reflect the views and opinions of the participants. These findings cannot be generalized to the population at large as in case of sample surveys.

In the current study we conducted 24 FGDs, eight in each of the three study states. The objective was to cover the high, medium and low availability villages in the FGDs to understand the extent of difference in service provision in each of this category of villages. Each FGD had 10 to 12 members. In Madhya Pradesh and Orissa, the FGDs had male as well as female participants because both are involved in care of livestock in the house. In Haryana, the FGDs were mostly conducted with women because men have very little management of backyard poultry. Each FGD lasted for about 45 minutes to 60 minutes.

7.1 Key Findings from FGD

Three points emerged regarding the use of veterinary services: i) access to veterinary services becomes very difficult as we moved from high to low access villages. One village in Madhya Pradesh was about 20 km away from the veterinary dispensary; participants reported that veterinarians hardly ever came to that area. ii) Veterinary services were largely catering to large ruminants. Some times farmers approached the service providers for goats, but largely they believed that poultry was out of the purview of government services. Finally, even in the case of large ruminants, most of the help was sought for treatment. The farmers hardly ever approached the government veterinarian for vaccinations because they are not aware of the timing or benefits of vaccination.

Large ruminants were the most important source of livelihood because of the importance in income from sale of milk and because of use for animal traction. The second most important animal was the goat because of the availability of ready cash of Rs.1000-2000 from the sale of a goat. The poultry birds were third in the order of importance in all the three states and poultry was important for immediate cash requirement of the household.

When asked about the most important constraint in the poultry livelihood, the farmers in all the three states unanimously agreed that they are unable to increase the stock of poultry birds because of high mortality in birds. One of the participants in Madhya Pradesh reported that why should we raise the birds when they die. **"All the birds die at one stroke and then there is nothing unless we buy new birds and start from scratch".** The symptoms reported by the farmers and the names for the disease which result in high mortality are indicators of ND as a major disease affecting poultry enterprise. In all the three states, many poultry owners reported that they approached the local medicine stores when the birds fell ill. **They had spent up to Rs. 5 per bird in an attempt to save the birds.** "But nothing works, they all die", was a common response in all three states. It is a very important finding that farmers are already spending money on saving the birds, hence if they understand the concept of vaccination and perceive the benefit from it, they would not hesitate to pay for the same.

In all the three states under study, there was largely no concept of the vaccination of backyard poultry birds. The facilitators explained the concept of vaccination of birds in relation to the vaccination for children and the importance of vaccination in reducing the impact of diseases such as polio etc. All participants across all states reported vaccinating their children and quickly understood the connection between diseases and vaccination. In many cases, many livestock owners reacted very quickly saying if heavy mortality which is the most important constraint in poultry farming can be addressed by vaccination then they could have a much bigger stock of birds. In Orissa, the participants responded that if they had a large number of birds, then they would house them in a separate room. In case of Madhya Pradesh also, one group reported that each household can own up to 100 birds at a time if the mortality is controlled. The farmers were also aware that if they had a large number then they would not be able to survive on scavenging. However, they were willing to spend on feeding the birds. The general consensus amongst the

FGD participants was that if they can earn money from the birds then what is the harm in feeding them? **This clearly signifies that ND is one of the major constraints in enhancing the poultry based livelihoods. Addressing this constraint has the potential to change poultry from a minor activity to a full-fledged livelihood option and become one of the major sources of income for small and marginal farmers and landless labourers.**

Because of the lack of awareness about vaccination, it is obvious that to encourage the farmers to vaccinate, or in other words to create demand for vaccination, it is important to provide information about the diseases the timing of vaccination and the potential benefits for the same. In discussion with farmers, the following elements should be considered in developing an effective extension programme: First, the extension information should cover all aspects of poultry management including information on disease management, schedule and type of vaccinations, and details about administering vaccines. The farmers also agreed that information about housing and nutrition would be very useful. Second, the farmers reported that extension activities should include all species, large and small ruminants as well as poultry as they are all part of the rural household. Third, extension activities should include men as well as women as women primarily take care of animals at home. Finally, the farmers further specified that extension activities should be organized at a common meeting place in the village. These activities should be conducted at least once in two months, for them to remember the concept.

Several key aspects were covered in exploring options for setting up a system for vaccination – options for service providers, management of cold chain, administering of vaccines and willingness to pay for vaccines. We also discussed the practical problems in administering of vaccines such as maintaining the cold chain, use of vial of 100 doses for small flocks, administering the vaccines, etc.

For the service provider, the first option discussed was the government veterinarian. In all the three states, the livestock owners responded that the government veterinarians would not be able to do this. Because of the focus on large ruminants, the image in the minds of the people is that the government department only caters to large ruminants. They also felt that he does not have time to reach out to the large animals, then how will he have the time for so many birds which are there in every household?

The second option was of training village women or educated youth in the village as poultry vaccinators. The participants in Orissa thought that educated youth in the village would be the most capable to do this work. There were also some women Self Help Groups organized in Orissa who could be involved in this work. The participants in Madhya Pradesh were in favour of educated village youth to do this work. Because of the low level of education and awareness, the women were not confident to take up this work. They reasoned that if they see how the vaccine was administered, then overtime they would become competent enough to do it on their own. The household survey showed that in Orissa, the poultry owners were vaccinating the birds on their own. In Haryana, it seemed that if the women were aware of the type of vaccine, and the timing, they would administer the vaccines on their own. This is also probably because dairy farming is an important activity in Haryana and women have become confident in the use of injections. Though they agreed that because the birds were small and delicate, they would have to develop the skills through training for doing this on their own.

Regarding cold chain management, the farmers in Orissa mentioned that the men will purchase the vaccines from the market and retailer shop. In Madhya Pradesh, the men or women were open to purchasing the vaccines from the market. In Haryana, the women were very active. They said they will take their children who were educated or in school to the medicine shop as they would know if they are getting the prescribed vaccination. In all the three states, the average distance for the medicine stores was about 10-15 km. In very rare cases, the low access villages were about 25 km away from a medicine store. The farmers said that they would purchase the vaccines in a thermos flask as it would take them about one-two hours to reach the village after purchase of vaccines, if they had a bicycle.

The facilitators explained to the farmers the practical problems in administering the vaccines and asked for suggestions to overcome these issues. Two issues were discussed: first, minimum vial size of about 100 doses whereas each house had about 5-10 birds and second, that the vaccine had to be administered within one-two hours of opening the vials while still cold. In Orissa, the farmers were very straightforward in responding that the farmer who purchased the vaccine would use it and then s/he would give the remaining to the other farmers in the vicinity to use. They said that “it is useless to me after I have used it, so instead of wasting it, it is better if it is

used by my neighbours". This willingness to share and work jointly with neighbours and community for using vaccines did not come immediately in Madhya Pradesh. This is because the houses are more scattered in the villages in Madhya Pradesh. Being a tribal belt the people usually do not stay in clusters or communities. They live individually on their farms. Because of this housing pattern, the community feeling is not very natural. However, when the facilitators probed a little further and posed the question of sharing, they said "we are open to learning and will appreciate your ideas on the best approach". In Haryana, as in case of Orissa, the farmers' immediate response was that "we will share the vaccine with the rest in the vicinity".

Besides, to administer the vaccines in the stipulated time of 1-2 hours, the livestock owners in all the three states were of the opinion that the vaccines should be administered by going from house to house. Farmers were generally not in favour of collecting birds at one location. They said there would be a huge ruckus and confusion if all the birds would collect in one place. Also, it would be difficult to tell which birds were vaccinated and which were not. A few participants, however, were willing to transport birds to a common location if required.

After the group consensus on the importance of vaccinations, the facilitators steered the discussion towards willingness to pay for the vaccines. They emphasized that there would be some cost for vaccination – Rs.40 for a vial of 100 doses for vaccine to be administered two-three times in a year. To make the calculations a bit easier, we asked if all the farmers would be willing to pay the village youth about Rs.1-2 per bird per vaccination.

All the participants unanimously agreed that that they would gladly pay for the vaccines if they found it effective. "But if our birds will die even after vaccination then why to pay?" They said that the value of one bird is much higher than the cost of a vaccine. They said that they pay quite high amounts of Rs.200-300 for the large ruminants, whereas they never do anything for the birds. In Orissa, some women compared the cost of a vaccine to the cost of money spent on alcohol. The women said that when our husbands can spend so much money on liquor which is wasteful expenditure, they would willingly spend on vaccination to save the birds. In Madhya Pradesh, the farmers said that Rs.2-5 per bird was a small amount and none of the farmers would have any problems shelling out that money if it meant protecting their animals from diseases.

Same was the case in Haryana. They also pointed out that they are already paying up to Rs.5/bird to buy medicines from the retailer in an effort to save the bird when it was ill.

To clarify things a little further, we asked the farmers specific questions regarding F1 vaccines in newborn chicks. We said that there was the option of sharing the cost of vaccines in case of older birds. However, F1 had to be given to birds within the first week. It was difficult to find another flock of birds of the same age group – would they still go out and buy a vial of vaccines of 100 doses for the 5-10 new born chicks. In this case, there was a mixed reaction. Some farmers seemed a little reluctant. They said that maybe they vaccinate the older birds but not the younger birds. In a Haryana village, there were two women in the group one with a small baby of less than six months old and another with a child of about 4-5 years. The facilitators immediately asked: which of these children will you vaccinate? At that time, the women immediately agreed that it was important to vaccinate the new born chicks. This reaction also brings to bear the lack of understanding of the economics of poultry farming. When asked about the value of a bird, many participants said that the value of the bird was about Rs. 200-300 which is the selling price of the bird. Many of them did not take into account the eggs laid, the new chicks given and that the entire earnings from a bird was much higher than the sale value. This also highlights the fact that the economics of poultry farming should be a part of the extension programme.

8. SUMMARY OF KEY FINDINGS AND WAY FORWARD

With the overarching objective of extending coverage of vaccines to the backyard poultry sector, the study had three key questions: What is the demand situation of ND vaccine for the backyard poultry sector? What is the supply situation of ND vaccine by the private and public sector? What are the options to extend coverage of vaccines to this sector? We present here a summary of the key findings along with some recommendations based on the insights from the ground.

8.1 Key Findings of the Study

The study reinforced the pro-poor aspect of backyard poultry. About 80%-90% of the poultry owners were landless labourers or small and marginal farmers, using income from poultry was largely used as emergency spending by the family. The net annual income from poultry accounting for the cost of feed (broken grains) and medicines was about Rs. 900-2,000 in

Madhya Pradesh and Orissa, respectively. The farmers reported that the main constraint in the growth of this enterprise is heavy mortality due to diseases limiting the farmers from increasing the poultry flock. The local name for ND was heavily cited leading to heavy mortality in birds. In Haryana and Madhya Pradesh, each household had lost about 7-8 birds on average, whereas in Orissa this number was as high as 20 birds per household. This heavy mortality is a sure indicator of the need for vaccines to increase the flock size and hence increase incomes from the sale of birds.

Vaccination of birds was taking place in Orissa only, where a quarter of the households reported vaccination, while none was reported in Haryana and Madhya Pradesh. The major reason for not treating the birds was lack of awareness about availability of poultry vaccines. An important observation is that when the birds were sick, the farmers were giving medicines purchased from the local medicine store to save the birds, incurring an annual expenditure of Rs 100-200.This reflects the willingness of the farmers to pay for saving the birds.

The importance of poultry in rural livelihoods, heavy mortality of birds make farmers desperate to save their primary source of income. However, the effort to save is futile when they have not vaccinated the birds. These findings are a clear indicator of the farmers' willingness to vaccinate birds and emphasize lack of information as a major constraint.

From the private and public sector supply chain analysis of ND vaccine, the main factors constraining vaccination of backyard poultry birds were lack of information among farmers and cold chain infrastructure in rural areas. The government sector also emphasized limited manpower for administering vaccines.

Based on the demand and supply situation, at the most 15% of the birds are covered by vaccination. Thus, the market size of birds to be brought under vaccine coverage is an overwhelming 85% of the total backyard poultry birds in these two states. The situation is not very different at the national level.

Following the understanding of the ground reality based on the demand and supply analysis, Focus Group Discussions (FGDs) were conducted with farmer groups to explore options for

setting up supply chains, which are likely to be sustainable in rural areas. The critical findings from the FGDs were that the farmers were very keen on saving the birds and reducing mortality. Payment for vaccination did not emerge as an issue in any of the FGDs. The major constraint in vaccination of birds was lack of awareness about the benefits and use of vaccines. If farmer awareness were raised through extension programs, they would take the initiative to vaccinate the birds. The farmers were immediately excited at the idea of reducing mortality, which will help them to increase flock size. They also mentioned that they could keep up to 50 birds and also invest in purchasing grains for feeding, if they could get higher incomes from this enterprise.

Detailed discussion of mechanisms for administering vaccines revealed that farmers were sceptical about the ability of the government veterinary services to cover the backyard poultry birds. The most common response was to involve local people in poultry vaccination. They also mentioned that once they were aware, they would be able to do the vaccination on their own. The farmers were willing to co-ordinate the vaccination with their neighbours to make effective use of the 100 dose vial and to share the cost. It is also important to mention that on knowing about poultry vaccines all the farmers eagerly expressed interest in knowing about vaccination of goats to reduce mortality.

8.2 Way Forward

A very important finding from the study is that all the major players are keenly interested in enhancing coverage for the backyard poultry sector and will be interested in involving in the related activities within the constraints of their organizational structure. The farmers are eager to save the birds and ready to pay for the same. The government sector also recognizes the importance of this activity. However, the issue of limited vaccine production, limited manpower, for administering the vaccines and inadequate cold chain facilities cannot be overcome in the short run. The donor agencies have been collaborating with NGOs to support the backyard poultry sector for their poverty alleviation projects. Finally, the private sector players recognize this area as a potential business opportunity and are also interested in vaccination and disease control in the backyard poultry sector to limit the adverse impact of outbreaks on the industrial

poultry sector. The interest of all stakeholders in this activity is a very positive sign for the success of this endeavour or bringing major share of backyard poultry birds under vaccination.

The major challenges in enhancing coverage of vaccines in backyard poultry are: lack of information about diseases, lack of service providers, availability of vaccines in the rural areas, and maintenance of cold chain. Based on the insights provided by the study, we offer some suggestions to address these issues:

To address the issue of information about poultry diseases and demonstration of poultry vaccination, the government sector can be involved in mass campaign through spots on radio and television along with distributing pamphlets thorough government veterinary services.

The NGOs and donor agencies can be involved in implementing pilot projects for vaccination of backyard poultry birds by developing a system of paravets. It is very difficult for any new initiative to gain momentum, especially in poor households, where the risk taking capacity is very low. Involvement of NGOs at the grassroots level will help to raise awareness and help the farmers to see the potential impact of vaccination. This will also motivate other farmers in the vicinity to undertake vaccination. The positive side is that involvement of local youth in the project ensures the availability of the service provider in the vicinity, and hence increases the changes of vaccination. However, as seen in some cases, because of low earnings, and finding alternate jobs, these trained local youth tend to migrate. In developing the system of paravets it is important to minimize this migration rate by higher involvement of women and ensuring minimum earnings.

Involvement of private vaccine manufacturing companies in enhancing farmer information about poultry vaccination will significantly enhance vaccine coverage. They can be involved in conducting extension programmes for distributors, dealers and very importantly, the network of rural medicine storeowners. They can also organize mass campaigns in the rural areas for extension activities as well as conducting some vaccinations as a demonstration for poultry owners. A parallel of private sector involvement in rural activities is similar to that of pesticide companies investing in informing farmers about pesticides. Again, the downside is large-scale misuse of pesticides because of lack of adequate knowledge, which has severe adverse

consequences for all stakeholders. To avoid such mishaps, care should be taken to put in place a system where adequately trained personnel are available for monitoring and guidance.

Finally, the private sector can put more effort in ensuring availability of vaccines in rural areas. With the existing network of medicine stores in rural areas, supply of vaccines to these areas will not be a challenge if there is a demand. Poultry vaccine is already being sold in the rural medicine stores in villages of Orissa.

This study brings many insights to bring the backyard poultry sector under vaccine coverage. It is evident that a combined effort of all organizations is required to overcome the challenges. The next step will be to bring together all the stakeholders to help evolve a strategy for enhancing coverage of vaccine to this sector, identifying specific roles for the key players. A well-planned and implemented strategy will surely go a long way in meeting the objective of bringing a large share of backyard poultry birds under vaccination.

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ANNEXURES

Annex 1: Map of Study Locations

Annex 2: Socio-Economic Characteristics of Study Locations

Parameters	Unit	Dhar	Jhabua	Keonjhar	Mayurbhanj	Mewat
Geographic Area	**Sq km**	**8,153**	**6,778**	**8,303**	**10,418**	
No. of Household	No	3,02,701	2,24,588	3,26,784	4,72,123	1,42,822
Household size	No	6	6	5	5	7
Population	No	17,40,329	13,94,561	15,61,990	22,23,456	9,93,617
Male	%	51.1	50.3	50.5	50.5	52.8
Female	%	48.8	49.6	49.4	49.4	47.1
Growth (1991-2001)	%	27.3	23.6	16.8	17.9	
Rural	%	83.4	91.3	86.3	92.9	95.3
Urban	%	16.5	8.6	13.6	7	4.64
SC Population	%	6.4	2.8	11.6	7.6	7.9
S Tribe Population	%	54.4	86.8	44.5	56.5	
Literacy and Education Level						
Literacy Rate	%	52.5	36.9	59.2	51.9	44
Male	%	64	65.3	61.3	63.8	61.5
Female	%	36	34.6	38.6	56.6	24.2
Type of Houses	%					
Permanent	%	40.3	35.8	20.3	12.8	
Semi-permanent	%	57.9	63.4	32.3	26.7	
Temporary	%	1.8	0.8	47.5	60.5	
Workers						
Total Workers	%	46.6	52.5	39.7	46.2	39.8
Main	%	73.4	66.5	63.6	60.1	
Marginal	%	26.5	33.4	36.3	39.8	
Non Workers	%	53.3	47.4	60.2	53.7	60
Religion						
Hindus	%	93.7	95.4	97.6	83.6	
Muslims	%	5.3	1.8	1.3	1.1	Majority
Others	%	0.7	12	0.4	14.6	
Tot Inhabited Villages	No	1 ,473	1,317	2 ,069	3,748	512
Drinking water facilities:	%	99.5	99	99.6	99.9	
Safe Drinking water:	%	98.7	98.3	98.6	97.5	
Electricity (Power Supply):	%	97.3	93.1	68.3	59.6	100
Electricity (domestic):	%	31.2	47.9	59.7	51.7	
Electricity (Agriculture):	%	30.3	42.1	4.2	6.51	
Primary school:	%	89	92.3	81	71.5	100
Middle schools:	%	27.9	25.5	36.5	23.7	53.1
Secondary/Sr Secondary schools:	%	10.5	7.9	23.9	12.9	13.2
College:	%	0.27	-	1.6	0.85	1.1
Medical facility:	%	51	39.4	18	14.9	
Primary Health Centre:	%	3.2	3.0	2.8	2.3	3.3
Primary Health Sub-Centre:	%	24.9	9.8	14.3	13.2	21.4
Post, telegraph and telephone facility:	%	35.8	27.9	33	20.4	
Bus services:	%	29.7	23.8	25.8	23.2	
Paved approach road:	%	41.7	39.7	46.2	41.4	100
Mud approach road:	%	54.3	73.1	86.4	86	

**Source: www.censusindia.gov.in. As the data for Mewat was not available in the census, the following source was used to obtain the data (http://mda.nic.in/Mewat-Profile.htm)*

Annex 3: Poultry Diseases – Findings from Participatory Epidemiology

Symptoms of Diseases	No Mortality	Partial Mortality	100% Mortality
HARYANA			
Watery discharge from mouth		√	
Watery white diarrhoea			√
Watery green diarrhoea			√
Parasites		√ (After some time due to weakness)	
Paralysis in limbs		√ (Not able to walk and eat)	
Pox		√	
Watery discharge from mouth + Watery green diarrhoea			√
Snoring sound / rales + Watery green diarrhoea			√
Depression + Watery green diarrhoea			√
Jump and suddenly die			√
ORISSA			
Diarrhoea (Green)			√
Diarrhoea (White)			√
Swollen neck	√		
Fowl pox (Local name basant)		√ (Not able to see and eat)	
Jump and sudden death			√
Worms		√ (After some time due to weakness)	√
Diarrhoea (White) + Twisted neck (Local name Ghumarog)			√
Diarrhoea (Green) + Fowl pox			√
Diarrhoea (White) + Diarrhoea (Green) + Twisted neck (Local name Ghumarog)			√
MADHYA PRADESH			
Snoring sound with closed eyes	Initial symptom		
Diarrhoea (White) + Snoring sound with closed eyes			√
Twisted neck (Local name Ghumarog) + Diarrhoea (White)			√
Watery discharge from mouth + Diarrhoea (White)			√
Discoloration of crown + Watery discharge from mouth + Diarrhoea (Green)			√
Parasites		√ (After some time due to weakness)	
Paralysis in Limbs		√ (Not able to walk and eat)	

Annex 4: Poultry Vaccine Manufacturers in India

Poultry Vaccine Manufacturers in the Private Sector:

- Venkateshwara Hatcheries Limited
- Hester Biosciences Limited
- Indovax
- Biomed Limited
- Intervet
- Fort Dodge
- Zydus AHL

Poultry Disease Vaccine manufacturers in the Public Sector

- Institute of Animal Health & Veterinary Biologicals, Biological Products Div, Calcutta
- Institute of Veterinary Biologicals, Lucknow
- Indian Veterinary Research Institute (IVRI), Biologicals Products Div, Izatnagar
- Institute of Veterinary Preventive Medicine, Ranipet
- Regional Veterinary Biological Unit, Jaipur
- Orissa Biological Products Institute, Bhubaneswar
- Institute of Veterinary Biological Products, Pune
- Institute of Animal Health & Veterinary Biologicals, Mhow
- Institute of Animal Health & Veterinary Biologicals, Thiruvananthapuram
- Institute of Animal Health & Veterinary Biologicals, Bangalore
- Institute of Animal Health & Biological Products, Srinagar
- Animal Vaccine Institute, Gandhinagar
- Institute of Animal Health & Production, Patna
- Institute of Veterinary Biologicals, Guwahati
- Veterinary Biologicals & Research Institute, Hyderabad
- Poultry Viral Vaccine Production Unit, Samalkot

Annex 5: Types of ND Vaccines Manufactured in India

Type	Ventri Biologicals	Indovax	Hester Biosciences
New Castle Disease			
Living	LaSota Strain [ND] R2B Strain [ND] B1 Strain [ND] ND and IBD ND and IB	LaSota Strain [ND] R2B Strain [ND] F Strain [ND]	LaSota Strain [ND] R2B Strain [ND] B1 Strain [ND] **B1-M48** [ND and IB] **LAS-MAS** [ND and IB]
Killed	ND ND and IBD ND and IB ND, IB and IBD ND and IBH	**Polyvax (NB)** [ND and IB] **Polyvax (NG)** [ND and IBD] **Polyvax (NBG)** [ND,IB and IBD] **Polyvax (NBGR)** [ND, IB, IBD and REO] **Polyvax (NBGE)** [ND, IB,IBD and EDS] Encivax [ND]	ND Chick-ND Pullet-ND IBD, ND IBD+, ND ND, IB ND, IB+ IBD, ND, EDS IBD, ND, IB IBD, ND, REO IBD+, ND, IB+ IBD, ND, IB, EDS IBD, ND, IB, REO IBD+, ND, IB+, REOa

**ND-New Castle Disease, IBD- Infectious Bursal Disease, IB- Infectious Bronchitis, IBH- Inclusion Body Hepatitis, REO- Viral arthritis, EDS- Eggs Drop Syndrome*