



Enhancing livestock health services in India: An analytical study of para-veterinary workforce and service delivery

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ABSTRACT

This study assessed the factors influencing animal health service (AHS) delivery by para-veterinarians (para-vets) and quantified their competencies across four major livestock states in India—Rajasthan, Uttar Pradesh, Maharashtra, and Haryana. Strategic assessment using the Analytic Hierarchy Process (AHP) revealed that organizational strengths, such as empathetic behavior, cultural compatibility, and wide coverage, provide a strong operational base. However, the most critical impediment was institutional: high workforce dissatisfaction and low morale resulting from unclear job definitions and the lack of defined career pathways. The largest external opportunity lied in formal governmental recognition and the establishment of dedicated para-vet cadres. Competency evaluation using the Competency Assessment Index (CAI) highlighted proficiency in foundational skills like animal handling and basic extension assistance. Conversely, competence was critically low in areas vital for public health, specifically adherence to farm safety, hygiene, animal welfare protocols during doorstep delivery, and the use of modern communication technologies. These findings underscored an urgent need for comprehensive policy intervention focusing on professional formalization and targeted capacity building

Keywords: Analytic Hierarchy Process, Animal Health Services, Competency Assessment Index, Last-mile delivery, Para-veterinarians, SWOT analysis

The livestock sector is a foundational pillar of India's rural economy, contributing significantly to agricultural GDP, poverty alleviation, and nutritional security. Para-vets, or veterinary paraprofessionals, play a pivotal role in bridging this last-mile gap, delivering essential services such as vaccination, artificial insemination (AI), and basic health care crucial for controlling epidemic diseases and supporting productivity. Despite their operational significance, the para-veterinary workforce operates within a highly ambiguous legal and institutional framework.

The objective of this study was to use the analytic hierarchy process (AHP) and competency assessment index (CAI) to identify and prioritize the factors influencing the efficient delivery of AHS by para-vets in selected Indian states and to propose evidence-based pathways for formal workforce integration and capacity enhancement in line

with evolving national priorities, including the One Health approach.

MATERIALS AND METHODS

Sampling: The study was conducted in four states of India namely, Rajasthan, Uttar Pradesh, and Maharashtra, and Haryana. These states were selected based on the highest livestock population, the number of paravet schools, and rank in milk production. Four districts with highest number of para vet schools, namely Jaipur, Mathura, Ahmadnagar, and Hisar were selected from the above respective states. Para-vets and trainers of paravet schools were selected as respondents based on a random sampling technique. The selection criteria of para-vets were that they must have undergone at least 1-month training for minor veterinary services, and delivering minor veterinary services at farmer's door- step for at least 2 years under the guidance of veterinarians on a payment basis. They should not be working under the umbrella of any NGOs (such as J& K Trust, BAIF, etc.). Twenty para-vets were selected from two blocks of each district, constituting a total of 160 para-vets as respondents using random sampling method. Similarly, fifteen trainers (veterinarians) with at least one year of experience at paravet school were selected from each district, constituting a total of 60 trainers as respondents for the study using the random sampling method.

Analytical hierarchical process (AHP): The responses

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of stakeholders namely, trainers of para vet schools (veterinarians) and privately practicing para-vets were taken for SWOT analysis of prospects for efficient delivery of animal husbandry services at farmer's door- step. After giving a brief introduction to AHP, participants underwent brainstorming session to identify the various factors related to strength, weakness, opportunities, and threats for minor veterinary services at the grass-root level. These criteria were exclusive to each other and exhaustive. A total of 20 activities were identified which have been mentioned as sub- criteria under different parent criteria in the results and discussion section. All these activities have been tested for validity using expert judgments, where activities having relevancy weightage (RW) (>0.70) were selected for obtaining a further response. Thereafter, stakeholders (para-vets and trainers) were asked to provide input in the form of pair-wise comparison, whereby comparison was established among four parent criteria as well as among various sub- criteria. For each comparison, participants were asked to delineate the preference of one criterion over the other one, using a scale of 1-9 continuums, where 1 indicated that equal preference was given to both criteria by participants. Rating of criteria from 2 to 9 indicated increasing order of preference of first criteria over second which range from moderate to extreme (Table 1).

$$\text{Relevancy Weightage (RW)} = \frac{f_{xi} * 3 + f_{xii} * 2 + f_{xiii} * 1}{f_x * 3}$$

Where, f_{xi} = Number of more relevant response
 f_{xii} = Number of relevant responses
 f_{xiii} = Number of least relevant response
 f_x = Total number of judges
 $f_x * 3$ = Maximum possible score

Aggregating the judgment by participants regarding each set of pair-wise comparisons resulted in an aggregate hierarchy. The geometric mean of various parent criteria

Table 1. Scale values for different criteria of pairwise comparison under Analytical Hierarchical Process (AHP), as defined by Saaty (2008)

Score (Intensity of Importance)	Definition
1	Equal importance to both criteria
2	Weak or slight equal importance to both criteria
3	Moderate importance to one criterion over the other one.
4	Moderate plus importance
5	Strong importance
6	Strong plus importance
7	Very strong importance
8	Very- very strong importance
9	Extreme importance. The importance of one criterion is of the highest possible order of affirmation

and sub- criteria were used to calculate the priorities for it. To establish its validity, Saaty (1977) has proposed a Consistency Index (CI) related to the Eigen value method $\lambda(\max)$. This Eigen value $\lambda(\max)$ was obtained by summing the product of each element of the Eigen vector multiplied by the total columns of the reciprocal matrix. The Highest Eigen value was equal to the number of comparisons ($\lambda_{\max} = n$). Following formulae were used to calculate the Consistency Index.

$$CI = \frac{(\lambda_{\max} - n)}{n - 1}$$

Where, n = Dimension of the matrix
 λ_{\max} = Maximal eigen value

$$CR (\text{Consistency Ratio}) = \frac{CI}{RI}$$

Where, RI = Random Index (Supplementary Table 1)

Priority of the factors within the group as well as global or overall priority of the factor was calculated for each parent criteria and sub- criteria to delineate their cardinal importance in overall scale. Thus, final responses of respondents were obtained in form of priority weight of various sub- criteria for analyzing the prospects of efficient delivery of animal husbandry services at the farmer's door-step.

Competency assessment index: An Index was constructed to measure the prospects for active participation of service providers in the delivery of AHS. This index intended to measure the prospects for active participation of service providers in the delivery of animal husbandry services has been designed using the expert judgment method. The capacity assessment index has been designed to elicit the response of trainers (veterinarians) about the prospects for efficient delivery of animal husbandry services with the desirable level of competency of para-vets. For competency assessment index (CAI), five dimensions namely, controlling and handling of animals (CHA), Participation in preventive animal health care programmes (PPHC), assistance in veterinary extension and outreach services (AVE), Assistance in implementation of development programmes (ADP), and door-step delivery of services (DDS), have been considered. A total of 27 indicators were selected from the statements to address the prospective competency of para-vets for performance on a three-point continuum from least to highly competent. As the number of indicators varied for each dimension, so normalization was done to provide equal weightage to all the dimensions, irrespective of the number of indicators under each dimension.

$$CAI = \frac{W1*CHA + W2*PPHC + W3*AVE + W4*ADP + W5*DDS}{5}$$

A Chi-square test was run among various indicators of the dimension of the index. When there existed a trend of response (in terms of frequency) along the continuum of the

index with a large difference between the continuums, chi-square values were found to be accordingly high. The high chi-square value indicated that the indicator shows wider variation in terms of response, these need to be addressed.

RESULTS AND DISCUSSION

In India, the poor health of livestock is a technological constraint that hinders productivity and returns from the livestock sector. Para-vets under minor- veterinary services have an important role to perform in vaccination as it helps in controlling common diseases and economic losses caused by them. But the challenge in the delivery of AHS is their low proficiency and competency. So, under the present scenario conceptual pros and cons involving the in-depth analysis of strength and weakness have been done along with future and threats of these para- veterinary and veterinary services service providers.

The availability of competent para-vets should be prioritized in livestock policy, especially in developing countries, where scarcity of manpower delivering the animal health service is inevitable. Another reason behind this assertion could be that para-vets charge comparative less fees for their services and are willing to work in remote areas with on-time availability (CALPI 2008). Ahuja *et al.* (2008) also suggested that para-vets should work as paid associates to complement the government efforts as well as practice as private practitioners. The delivery of AHS by the public sector assumes greater importance, help, and assistance to resource to economically poor households (Bardhan *et al.* 2015). Para-vets have a major role in vaccination, deworming and artificial insemination under minor- veterinary services. Foot and Mouth Disease (FMD) caused an annual economic loss of ₹ 14000 crores (Knight and Rushton 2013). Diseases such as Hemorrhagic septicemia (HS) and Peste-des-Petits Ruminants (PPR) cause an estimated economic loss of 5255 crores and 8895 crores, respectively (Singh *et al.* 2014).

Various SWOT factors concerning prospects for efficient delivery of animal health services at farmers’ door- step (as perceived by para- veterinarians): Priority weight of all the four dimensions of SWOT analysis undertaken for the study i.e., strength, weakness, opportunities, and threats perceived by para-vets in the prompt and efficient delivery of animal husbandry services at farmer’s doorstep has been depicted in Table 2. As per obtained responses, it may be inferred that strength and opportunities for prospects of rendering animal health services outweighs

the weakness and threats dimension. So, adopting strength and opportunity-related practices would enable para-vets to increase their competency ultimately make them capable to reduce the weakness which hinders them to perform with greater accountability. The details of all the four dimensions along with their constituting factors have been presented in different sections. Strength, weakness, opportunity, and threats received the priority weight of 0.368, 0.247, 0.295, and 0.151 and rank as 1st, 3rd, 2nd, and 4th, respectively.

Strength: The most critical factors driving the rising demand for para-veterinary services in India, based on priority weights, were identified. Table 3 depicted that empathetic behavior and cultural compatibility of para-veterinarians with the clients, along with wider service coverage (S4), were the most dominant, with the highest local priority weight as well as global priority weight. The second most significant factor was greater financial gain and credibility among smallholder dairy farmers (S5). The third-ranked strength was on-the-toe readiness and willingness to serve in rural and remote areas (S1), which had a global priority of 0.0648. These top factors underscored the pivotal role of para-vets in providing last-mile services where government veterinarians are often absent (Agrawal *et al.* 2013).

The high ranking of empathy and cultural compatibility reflects the reality of rural India, where trust, availability at odd hours, and familiarity with local customs are crucial for service relationships, a trend also noted by Thapa (2020) in Nepal. The fourth-ranked strength was the availability of locally-based traditional knowledge systems combined with basic health care services (S2), receiving a global priority of 0.0288. This aligns with Sustainable Development Goals (2021) and recommendations by Anonymous (2018) for localized, low-cost, and sustainable service provision. The ranking of S2 and S3 suggested that while traditional knowledge and technical expertise are valued, they are secondary to the interpersonal and logistical advantages provided by para-vets. This implies that farmers may prioritize availability and trust over formal technical qualifications in routine situations. Despite these strengths, the lack of quality information and service inconsistency remained as major weaknesses in India’s extension ecosystem (Glendenning *et al.* 2010).

Weakness: The most critical weakness was poor morale and job ineffectiveness due to an inadequate job profile and lack of a defined growth path (W4). This weakness received highest local and global priority, aligning with

Table 2: Priority weight of SWOT vis-à-vis prospects for efficient delivery of animal health services by para- veterinarians (as perceived by para- veterinarians)

Factors	Priority weights	λ_{max}	Consistency Index (CI)	Consistency Ratio (CR)	Rank
Strength (S)	0.368				I
Weakness (W)	0.247				III
Opportunity (O)	0.295	4.105	0.035	0.039	II
Threat (T)	0.151				IV

Table 3. Priority weight of strength factors vis-à-vis prospects for efficient delivery of animal health services by para-vets (as perceived by para- veterinarians)

SWOT groups	Priority of the group (Scaling factor)	SWOT factors	Consistency Ratio (CR)	Priority of the factors within the SWOT group	Global or overall priority of factor	Rank
Strengths (S)	0.368	S1: On-the-toe readiness and willingness to serve in rural and remote areas at any time.	0.106	0.1758	0.0648	III
		S2: Locally available basic health care service enriched with traditional knowledge.		0.0782	0.0288	IV
		S3: High expertise and experience to provide minor health services		0.0555	0.0204	V
		S4: Empathetic behavior and cultural compatibility with clients and higher coverage area		0.4082	0.1503	I
		S5: Greater financial gain and credibility by small holder dairy farmers		0.2823	0.1039	II
$\lambda_{\max} = 5.377$					CI= 0.094	

Adisa's (2015) finding that livestock professionals often suffer low job satisfaction from undefined roles. However, this contrasted with Ali (2015), who reported high job satisfaction among para-vets in Sudan, possibly due to stronger institutional support.

The second-highest ranked weakness was the perception of para-vets as the "second choice" (W5) by wealthier and more informed farmers, who prefer veterinarians due to a perception of superior competence (Table 4). Closely following was below-the-mark performance in technical and professional competencies (W1). This self-acknowledged skill gap mirrors findings by Kumar et al. (2022) and Glendenning et al. (2010), which highlighted the need for better training and technical exposure for para-vets in India.

Self-acknowledged skill gaps in technical and professional competencies (W1) also feature prominently, mirroring broader systemic findings that para-vets often lack the training for emerging roles in biosecurity and disease surveillance. The low prioritization of infrastructure-related weaknesses (W2) and extension packages (W3) indicates that human resource issues—specifically role clarity and job satisfaction—are more pressing concerns than the lack of physical tools. The low ranking of the extension-related weakness (W3) is likely because most para-vets work privately and receive no direct incentive for providing extension services, a role typically attributed to the public sector (Muthiah et al. 2013).

Opportunities: The most significant opportunity factor for para-veterinarians was job security and promotion

Table 4. Priority weight of weakness factors vis-à-vis prospects for efficient delivery of animal health services by para-vets (as perceived by para- veterinarians)

SWOT groups	Priority of the group (Scaling factor)	SWOT factors	Consistency Ratio (CR)	Priority of the factors within the SWOT group	Global priority of the factor	Rank
Weakness	0.295	W1: Below the mark performance in technical and professional competencies.	0.0045	0.292	0.086	III
		W2: Lack of suitable kits and equipment, and poor utilization of disease testing facilities		0.112	0.033	IV
		W3: Unavailability of extension packages for livestock health and production		0.125	0.037	V
		W4: Poor morale and job ineffectiveness due to inadequate job profile and growth path		0.350	0.103	I
		W5: Para-vets as second choice after vets by good socio-economic and aware farmers.		0.336	0.099	II
$\lambda_{\max} = 5.020$					CI= 0.005	

prospects through the formation of a separate para-vet cadre. This underscores a strong desire for formal recognition and clear career advancement within the animal health sector (Ahuja *et al.* 2008). Such institutional mechanisms are crucial for enhancing job satisfaction and retaining para-vets in rural areas. Furthermore, the integration of para-veterinary training into national frameworks such as the National Skill Qualification Framework (NSQF) under the Pradhan Mantri Kaushal Vikas Yojana (PMKVY) (O4) provided a structured pathway for improving technical skills and ensuring quality standards. The optimism regarding the privatization of animal health services (O5) suggests that many para-vets see themselves as future entrepreneurs in a more liberalized veterinary market (Table 5).

Policies promoting the privatization of animal health services ranked third, reflecting optimism for increased private sector involvement. However, past experiences in states like Kerala and Andhra Pradesh show mixed results, often requiring continued public sector involvement to protect smallholder farmers (Sikhakolani, 2007). The lowest ranked opportunity was delivering quality services under the guidance and supervision of veterinarians, suggesting para-vets prefer greater autonomy while still recognizing the need for professional oversight in complex cases. The priorities echo findings in Nepal (Thapa, 2020), where para-vets sought business expansion but acknowledged limitations without veterinarian intervention. Models like the para-vet cadre in Himachal Pradesh provide a practical example of salaried government positions and regulated work scope, improving service outreach (Veterinary Council Act, 2010).

Given the shortage of veterinarians, training unemployed rural youth in services like artificial insemination (AI) and vaccination (Kiara *et al.* 2017) and formal district-

level registration (Barbaruah, 2019) represent practical opportunities. Ultimately, robust monitoring, regulation, and continuous capacity building are vital to ensure quality service delivery (Banda and Kazembe, 2008; Shubeena *et al.* 2019).

Threats: The most significant threat perceived by para-veterinarians was the lack of job security and poor recognition in government policies after completing their diplomas and courses. This factor received highest global priority (Table 6), directly restricts new para-vets from entering the market.

Ranking second in priority was insufficient recognition under the Veterinary Act, which was viewed as hindering capacity development and limiting job opportunities. This was followed by inefficient para-veterinary training schools. These schools were seen as contributing to increased irrelevant competition and posing a significant threat due to the limited capacity conferred by short-duration programs (ranging from a few months to less than half a year).

Of particular importance within the "One Health" context is the threat posed by the over-use of broad-spectrum antibiotics and practices insensitive to animal welfare (T4). The misuse of antibiotics by para-vets, often driven by farmer pressure or lack of knowledge, contributes directly to the global crisis of antimicrobial resistance (AMR). The proliferation of inefficient training schools with varying standards (T2) further threatens to dilute the quality of the workforce. Para-vets often misuse broad-spectrum antibiotics, exacerbating antimicrobial resistance (Kumar and Gupta, 2017). Concerns about increased drug misuse and compromised service quality have led several countries to restrict para-vets from delivering privatized veterinary services (Ilukor *et al.* 2013). Illegal practices

Table 5. Priority weight of opportunity factors vis-à-vis prospects for efficient delivery of animal health services by para-vets (as perceived by para- veterinarians)

SWOT groups	Priority of the group (Scaling factor)	SWOT factors	Consistency Ratio (CR)	Priority of factors within SWOT group	Global or overall priority of the factor	Rank
Opportunity	0.295	O1: Deliver quality services under guidance and supervision of veterinarians	0.079	0.086	0.025	V
		O2: Prospective to get proper recognition towards skill and expertise at district level database through Identity Card in future		0.186	0.055	II
		O3: Prospective in job security and promotion due to formation of separate para- vet cadre		0.415	0.122	I
		O4: Prospective to increase competency and skill of para-vets through NSQF under PMKVY.		0.153	0.045	IV
		O5: New Policies encourages privatization of Animal Health Services		0.160	0.047	III
$\lambda_{max} = 5.353$		RI=1.12	CI= 0.088			

Table 6. Priority weight of threat factors vis-à-vis prospects for efficient delivery of animal health services by para-vets (as perceived by para- veterinarians)

SWOT groups	Priority of the group (Scaling factor)	SWOT factors	Consistency Ratio (CR)	Priority of the factors within the SWOT group	Global or overall priority of the factor	Rank
Threats	0.151	T1: Insufficient recognition under the veterinary Act hindering the capacity development opportunities.	0.087	0.040	0.006	II
		T2: Increasing irrelevant competition due to mushrooming of inefficient Para veterinary training schools, varying training eligibility and duration		0.027	0.004	IV
		T3: Providing sub- standard vaccines to small farmers		0.015	0.002	V
		T4: Over-use of broad- spectrum antibiotics and various practices insensitive to animal welfare and one-Health- Approach		0.029	0.004	III
		T5: Lack of income sustainability and poor recognition into policies by government		0.089	0.067	I
$\lambda_{\max} = 5.389$		RI= 1.12	CI= 0.097			

also allowed para-vets to access drugs and vaccines directly from company sales representatives (Barbaruah and Samad, 2014). The least prioritized threat was the provision of sub-standard vaccines to smallholder farmers.

Comparative representation of priority weights of SWOT as perceived by para-vets: Based on the comprehensive analysis of Supplementary Figure 1, para-veterinarians perceived strengths as the primary drivers and threats as the least influential factors in animal health service (AHS) delivery. The highest ranked strength was the empathetic behavior and cultural compatibility of para-veterinarians with their clients, combined with wider service area coverage (S4), which dominated the drivers of demand. The most critical weakness identified was poor morale and job ineffectiveness stemming from an inadequate job profile and lack of a defined growth path (W4), which signaled major human resource challenges. Conversely, the most significant opportunity was the potential for job security and promotion prospects through the formation of a separate para-vet cadre (O1), indicating a strong aspiration for formal institutional recognition. Finally, the greatest threat perceived was the lack of job security and poor recognition in government policies (T1), which was seen as restricting new entrants and hindering overall sector growth.

Competency assessment Index to ensure active participation of para-vets with veterinarians for effective delivery of animal health services: A perusal of Supplementary Table 2 reveal that the most severe competency gaps were concentrated in regulatory awareness, biosecurity practices, and modern communication skills rather than basic veterinary service delivery. The highest deficiency (93.75%) was observed in the ability to apply judgment

regarding livestock trade practices, animal movement frequency, and the management of animal holding areas. The highest chi square value (263.150) was recorded for "Applying judgment regarding nature of trade/frequency of movement," where a staggering 93.75% of respondents reported low competency. These competencies could be particularly important in the context of disease surveillance and biosecurity frameworks, especially under emerging national initiatives such as the One Health Mission. Similarly, extremely low competency levels were recorded in implementing government guidelines related to livestock markets, sanitation, and disease control protocols. This inferred that para-veterinary workers remain insufficiently integrated into formal disease management systems despite being the primary service providers in rural areas.

Another critical finding was the widespread lack of adherence to farm safety, hygiene, and animal welfare protocols, with more than 86 percent of respondents reporting low competency. In the context of zoonotic disease prevention and antimicrobial resistance (AMR), this gap represents a significant risk to both livestock productivity and public health. The responses also revealed deficiencies in the use of personal protective equipment (PPE) and safe animal handling techniques. These shortcomings highlight the urgent need for training programs emphasizing biosecurity, occupational safety, and humane animal handling practices. Indicators related to public health and safety showed extremely high chi square values, such as "Guiding implementation of government guidelines" chi square value of 209.113 and "Following farm safety and hygiene protocols" chi square value of 202.550 (Supplementary Table 2). This indicates a statistically significant trend where nearly the entire workforce feels

unqualified in essential biosafety measures.

The CAI results indicate that while para-veterinarians possess adequate practical exposure to basic service delivery, their competencies in regulatory compliance, biosecurity practices, and development programme facilitation remain insufficient. These areas therefore represent priority domains for future capacity-building interventions.

Index value for various dimensions of the competency assessment index: Among the five dimensions of the Competency Assessment Index, the highest index value was observed for “controlling and handling of animals” (0.410), followed closely by “assisting in veterinary extension services” (0.401). The dimensions “development program implementation and marketing in the livestock sector” (0.307) and “services at farmer’s doorstep” (0.187) received the second-last and last ranks, respectively, indicating relatively lower perceived competency in these areas (Supplementary Table 3). The mean index value of 0.337 reflects an overall moderate-to-low level of proficiency, with significant variance between traditional tasks and emerging professional requirements.

Para-veterinarians serve as vital contributors to the delivery of minor veterinary services and last-mile animal health services in India. This study highlights that while para-vets possess significant strengths, as empathetic behavior, cultural compatibility, and wider service coverage, they face notable weaknesses including unclear job profiles, low morale, and gaps in technical competency. Opportunities for formal recognition, career advancement, and skill enhancement exist, but threats such as limited policy support, misuse of veterinary drugs, and insufficient institutional recognition hinder their effective integration into the broader veterinary system. Competency assessment revealed high proficiency in animal handling and assistance in veterinary extension services, whereas doorstep service delivery and development program implementation were comparatively weak. Nearly half of para-vets were categorized as having medium competency, indicating a pressing need for targeted capacity-building initiatives. To improve the efficiency, accessibility, and accountability of animal health services, it is imperative to implement standardized training curricula, structured career pathways, and continuous professional development programs. Strengthening collaboration between veterinarians and para-vets, along with policy interventions and institutional support, can enhance service delivery, ultimately improving livestock health, productivity, and farmer livelihoods across India

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