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Feed the Future Mali Livestock Technology Scaling Program (FtF-MLTSP)

Participatory assessment of animal health service delivery systems in Mali: constraints and opportunities



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Participatory assessment of animal health service delivery systems in Mali: constraints and opportunities

Michel Dione, Ibrahima Traore, Barbara Wieland and Abdou Fall

International Livestock Research Institute (ILRI)

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Patron: Professor Peter C Doherty AC, FAA, FRS

Animal scientist, Nobel Prize Laureate for Physiology or Medicine—1996

Box 30709, Nairobi 00100 Kenya
Phone +254 20 422 3000
Fax +254 20 422 3001
Email ilri-kenya@cgiar.org

ilri.org
better lives through livestock
ILRI is a CGIAR research centre

Box 5689, Addis Ababa, Ethiopia
Phone +251 11 617 2000
Fax +251 11 667 6923
Email ilri-ethiopia@cgiar.org

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The Feed the Future Mali Livestock Technology Scaling (FTF-MLTS) program seeks to contribute to the inclusive growth of the ruminant livestock value chain for increased income, food and nutrition security for 266,000 cattle, sheep, and goat keepers and other value chains actors in three regions in the country (Mopti, Timbuktu and Sikasso), hence lifting them out of poverty. Supported by the United States Agency for International Development (USAID) as part of the US government's Feed the Future initiative, the program sets out to bridge ruminant livestock productivity gaps and to enhance the volume and value of ruminant livestock marketed through a wide-scale dissemination of proven livestock technologies and best practices.

The program is implemented by the International Livestock Research Institute (ILRI) working with a consortium of public institutions (Direction Nationale des Services Veterinaires, Direction Nationale des Productions et Industries Animales; Laboratoire Centrale Veterinaire, Institut d'Economie Rurale), private sector organizations (private veterinarians, feed manufacturers) and non-governmental organizations such as the Catholic Relief Services (CRS), the SNV Netherlands Development Organisation, the Association Malienne d'Eveil et de Développement Durable (AMEDD), and the Agronomes et Vétérinaires sans Frontières (AVSF). FTF MLTSP also collaborates with ongoing FTF projects such as Livestock for Growth and other rural development programs in Mali that are pursuing similar objectives in order to create synergies among them.

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Abbreviations

AMEDD	Association Malienne d'Eveil au Développement Durable
AVSF	Agronomes et Vétérinaires Sans Frontières
CBPP	Contagious Bovine Pleuropneumonia
CAHIP	Community Animal Health Innovation Platforms
CNASA	Centre Nationale d'Appui à la Santé
CRS	Catholic Relief Services
CSA	Commissariat à la Sécurité Alimentaire
DNSV	Direction Nationale des Services Vétérinaires
FMD	Foot-and-Mouth Disease
FtF	Feed the Future
FtF-MLTSP	Feed the Future Mali Livestock Technology Scaling Program
GDP	Gross Domestic Product
ICT	Information and Communications Technology
ILRI:	International Livestock Research Institute
IER:	Institut d'Economie Rurale
ICRISAT:	International Crops Research Institute for the Semi-Arid Tropics
MLTSP:	Mali Livestock Technology Scaling Program
LCV:	Laboratoire Central vétérinaire
L4G:	Livestock for Growth
LMIS	Livestock Market Information Systems
OMA:	Observatoire du Marchés Agricoles
PPR	Peste des Petits Ruminants
PROGEBE:	Projet Régional de Gestion Durable du Bétail Ruminant Endémique
SNV:	Netherlands Development Organisation
USAID:	United States Agency for International Development

Background

In Mali, livestock is the main source of income for over 30% of the population, contributing 11% and 35% of the country and the agricultural gross domestic products (GDPs) respectively (CSA 2011). Estimated at 9,438,181 cattle, 12,458,525 sheep and 17,348,577 goats in 2012, Mali has one of the highest ruminant livestock populations in the Economic Community of West African States (DNPIA reports). Overall, 85% of rural households own ruminants (VcCLIR 2012), with small ruminants being the main source of income for women. At least 80% of woman own sheep and/or goats in areas of Mopti and Sikasso regions (DNPIA reports).

The livestock development sector in Mali is characterized by low herd productivity due to recurrent seasonal feed shortages, poor forage quality and high disease burden. Productivity losses due to livestock diseases remain a key constraint. Pradere (2007) reported that in 2006, 540,000 heads of cattle and 3.4 to 5.2 million small ruminants died, causing a loss of USD135 million, corresponding to 20% of the sector's GDP. Past studies conducted by the International Livestock Research Institute (ILRI) in central Mali estimated abortions rates at 3.3% of all parturitions and total deaths at 31.6% in cattle of four years of age (Fall 2014). Furthermore, Mali faces critical challenges in the delivery of animal health services. The main reasons highlighted are limited human and financial resources of the national veterinary services and a lack of financial incentives for private veterinarians to operate in remote areas with fragmented demand. In addition, the lack of clarity of implementing legal regulations with regard to the acquisition and the distribution of drugs, the dysfunctional nature of private veterinary clinics, and conflicts of interest between private and public veterinarians have had adverse effects on livestock health and productivity, particularly in remote areas where investment programs have been historically low (Fadiga 2015). In order to reduce the burden of livestock diseases, there is need to improve animal health delivery systems to ensure the prompt and cost-effective delivery of quality drugs and vaccines to combat endemic diseases. This report documents the perceptions of livestock value chains stakeholders on the current challenges faced by the livestock sector in the delivery of animal health services in Mali and provides recommendations for further research.

Methods of assessment

Between July 2015 and December 2016, opinions, perceptions and recommendations on the delivery of animal health services in Mali were collected through several livestock value chain stakeholder meetings and key informant interviews prior the implementation of the Feed the Future Mali Livestock Technology Scaling Program (FtF-MLTSP). The stakeholders, including livestock input service providers, public and private institutions and organizations which participated in the workshops are listed in Table 1.

Table 1: List of stakeholders who participated in the workshops

Date	Activity	Participants
21–22 July 2015	FtF-MLTSP programming meeting	ILRI, Direction Nationale des Services Vétérinaires (DNSV), Laboratoire Central vétérinaire (LCV), Centre Nationale d'Appui à la Santé (CNASA), Association Malienne d'éveil au Développement Durable (AMEDD), Catholic Relief Services (CRS), Observatoire du Marchés Agricoles (OMA)/ Livestock Market Information Systems (LMIS), Institut d'Economie Rurale (IER), Agronomes et Vétérinaires Sans Frontières (AVSF), Projet Régional de Gestion Durable du Bétail Ruminant Endémique (PROGEBE)
23–25 February 2016	FTF-MLTSP inception workshop	ILRI, DNSV, LCV, Livestock for Growth (L4G) program, CRS, AMEDD, AVSF, IER, Netherlands Development Organisation (SNV), International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), OMA/ LMIS, Direction Nationale des Productions et Industries Animales (DNPIA), United States Agency for International Development (USAID)
16–20 May 2016	Training-workshop on livestock diseases control programs in Mali	DNSV, LCV, ILRI, AVSF
16–27 September 2016	Establishment of Community animal health innovation platforms (CAHIP) in FtF-MLTSP intervention communes	DNSV, SNV, AMEDD, CRS, livestock producers, livestock traders, local government, 'mandataires', women's farmer cooperatives, feed stockists, drug stockists, microfinance institutions
20–30 November 2016	Training of trainers on endemic livestock diseases and food safety	DNSV, AVSF, AMEDD, private veterinarians, para-veterinarians
5–6 December 2016	2016 program evaluation and 2017 activity planning workshop	ILRI, AVSF, AMEDD, CRS, SNV, CRS, OMA, USAID, CNASA, DNSV, IER, LCV, Association Nationale des Vétérinaires Mandataires du Mali (ANAVEM)
2015–2016	Key informant interviews	Livestock scientists from LCV and IER, community leaders and veterinary officers in Sikasso and Mopti regions.

1 'Mandataires' are private veterinary practitioners who are mandated by the DNSV to undertake the vaccination of livestock against key endemic diseases.



Photo 1: CAHIP members discussing constraints to livestock farming in Farakala, Sikasso.



Photo 2: Participants in training-of-trainer workshops on animal health and food safety in Koutiala, Sikasso.



Photo 3: Participants in the training workshop on livestock disease control programs in Bamako.



Photo 4: CAHIP member summarizing priority constraints and suggested interventions in Farakala, Sikasso.

Animal disease burden in Mali

Transboundary diseases—such as contagious bovine pleuropneumonia (CBPP), peste des petits ruminants (PPR) and foot-and-mouth disease (FMD)—were perceived by stakeholders as key health constraint on livestock productivity and international trade, hence lowering the incomes of the producers and other value chain actors. In addition, external and gastrointestinal parasite infections also constitute serious constraints. The most commonly reported parasitic infections include strongylosis, distomatosis, fashiolosis and trypanosomosis especially in humid zones, such as Sikasso. While blackleg was listed among prevailing diseases in all regions, blackquarter was considered to be more prevalent in pastoral areas. Tick-borne diseases, such as cowdriosis and piroplasmosis were less commonly cited. Bovine and ovine pasteurellosis, together with enterotoxaemia, are endemic diseases causing high mortality especially in small ruminants. High abortions rates were reported on both cattle and small ruminants, but their causes remain unknown. In small ruminants, high mortality rates were partly associated with poor housing and management; this was often pointed out and mostly by women. Foot rot was reported mostly to occur in small ruminants. Zoonotic diseases, such as anthrax, bovine tuberculosis and bovine brucellosis, were reported in different regions in the country despite the paucity of data regarding the extent of their impact. While there is a high degree of agreement that diseases are a key constraint to productivity, their true socio-economic impact is unknown because of lack of reliable data. Given the complexities, tackling of these disease constraints is only possible through coordinated efforts by the stakeholders involved in the animal health delivery services.

Institutions and their roles in the delivery of animal health services

DNSV staff are in charge of the development of national policies in the area of livestock and veterinary public health and monitoring, and the implementation and enforcement of laws and regulations related to animal health protection and veterinary public health. They lead, supervise and evaluate national programs for the control of animal diseases, including zoonosis, and support the strengthening of veterinary infrastructures and animal health services, sanitary control of animals and animal products. This includes the collection and analysis of information and statistics on animal welfare and veterinary public health, and the provision of support to local and regional authorities in the area of animal health regulation and control. They also implement and monitor livestock disease surveillance systems.

CNASA staff support the veterinary services in the assessment of animal health risks and in technical areas related to animal health, including the communication and design of livestock disease control programs. They also help implement and monitor major threats to animal and public health through the use of early warning systems.

The LCV mission includes the production of vaccines for the control of animal diseases and research on animal and veterinary public health. Staff also carry out: routine disease diagnosis, including for zoonosis; epidemiological surveillance of animal diseases; and take action to ensure the quality of livestock products and hygiene of food, and reduce pesticide residue in food. Furthermore, they give advisory services and training to the technical staff of DNSV on livestock disease control, including the design of prophylaxis schemes, and the improvement and development of vaccines.

Private veterinarians often import veterinary products and operate animal clinics. They provide health services, including sale of veterinary drugs, treatment and vaccination of farm animals and household pets, and the provision of advice. Private veterinarians who are also ‘mandataires’ play an important strategic role in the implementation of animal health interventions given their key roles in all operations related to collective health prophylaxis and surveillance of highly contagious animal diseases.

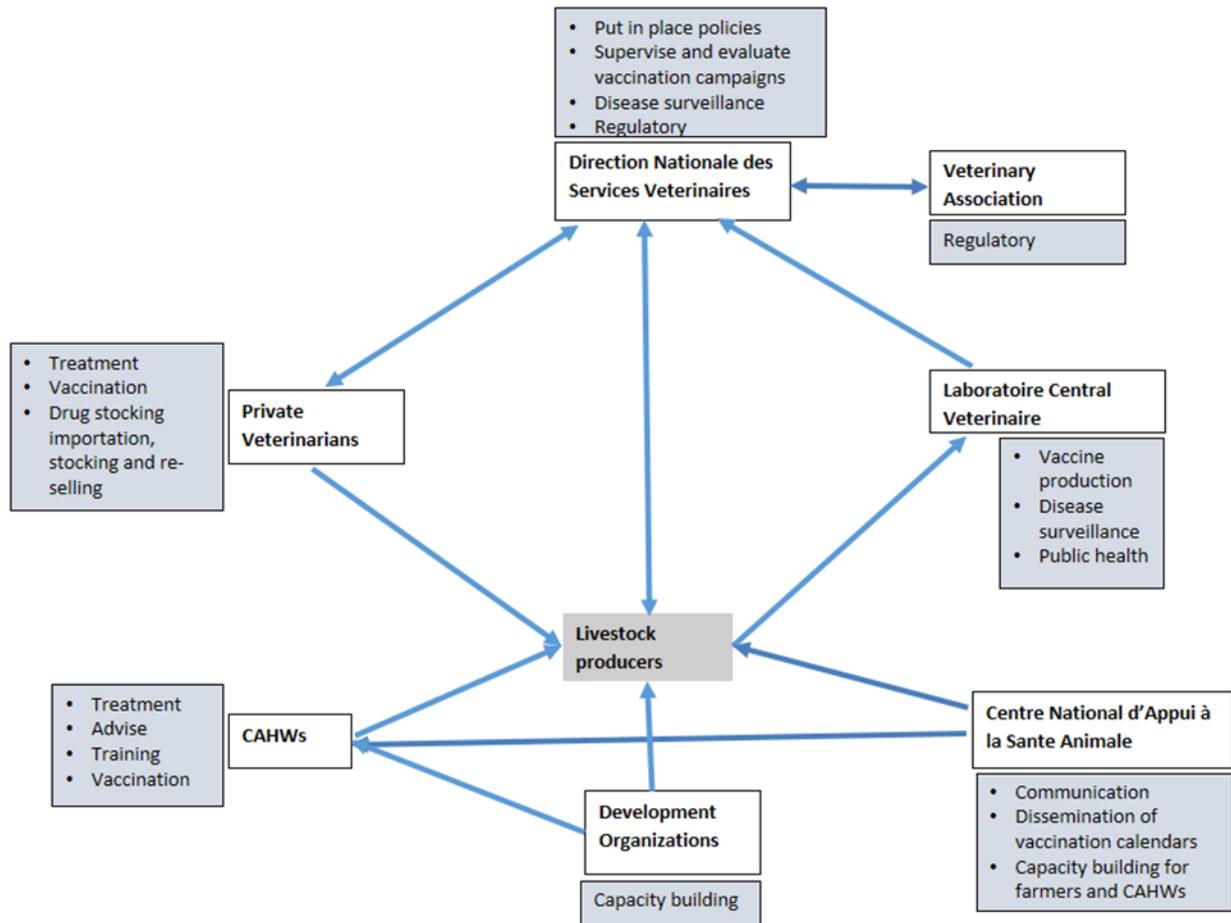
Para-veterinarians and community animal health workers provide advisory and basic health care services to livestock producers at community level. They usually reach remote areas where most veterinary practitioners do not

go. They are, therefore, responsible for disseminating some best practices on livestock management to improve animal productivity.

Development organizations contribute in building the capacity of livestock value chain actors in disease control and surveillance, and herd management through their funded programs.

Livestock producers are responsible for the vaccination of their animals, and reporting of diseases to the veterinary services. Some have established cooperatives or associations to ease their access to health services.

Figure 1: Stakeholders involved in the delivery of animal health services



Policy related challenges in the delivery of animal health services

As a result of continued fiscal challenges from mid-1980s, the government of Mali privatized and decentralized the provision of veterinary services. Many actors consequently became involved in providing veterinary services without adequate regulation, quality and supervision. Private veterinary units and pharmacies popped up across the country, initially in co-existence with the Veterinary Pharmacy of Mali until the latter ceased activities in 1995. Despite the existence of a legal framework and the establishment of an institutional structure, challenges in the area of the veterinary service provision remain unsolved. Among the major issues is the weakness of the enforcement of existing regulations, which is worsen by corruption among stakeholders and conflicts of interest between veterinarians, animal husbandry officers², para-veterinarians and community animal health workers in pastoral systems. This has led to the anarchic and often illegal practice of veterinary medicine. In addition, the lack of defined boundaries and clear roles for each actor in the animal health delivery systems has negatively influenced the situation. Stakeholders highlighted the negative consequences associated with the absence of a legal framework supporting the management of livestock vaccine production sector facing unregulated competition following high demand from the sub-region³. Until these gaps are addressed, confusion among animal health service providers will remain, negatively affecting animal health interventions.

With the resurgence of infectious diseases, and increased economic and health risks, especially to the rural poor, there is a need to understand relational patterns between the various actors to ensure good governance and to address the emerging and re-emerging animal disease risks. According to the stakeholders and given the existing fiscal challenges, the key to improving animal service delivery rests on setting the key priorities, and developing and implementing the right policies and institutions. Some key policy recommendations are documented in this report.

2 The issue here is that the training curriculum of animal husbandry officers is different from the one for veterinarians as far as drug management and animal health care are concerned. Veterinarians are specialized in animal health care as opposed to animal husbandry officers who are more trained in animal production and husbandry. However, both bodies are authorized to carry out work that requires health expertise. This causes conflict between the two groups which are both represented at the veterinary association. Veterinarians are pushing to limit membership of the association to themselves, but this is still not the case.

3 The LCV is the producer of livestock vaccines. It is a public institution whose funding comes from the services it supplies, such as the sale of the vaccines it produces. It applies a 'first come, first served' policy, mainly dealing with large clients inside and outside of Mali. This makes it very difficult for 'mandataires' to access a steady supply of vaccines as they rely on purchasing small quantities due to their limited supplies of capital available for their businesses.

Disease reporting and management of outbreaks

“Animals are seen as a prestige. To get rid of a sick animal is difficult for a farmer because the reduction in animal numbers is perceived as a loss of wealth” (A farmer says).

The perceptions of farmers about their herds as shown by the quotation above and the lack of financial resources of the government to promptly respond to disease outbreaks have been highlighted as key factors hindering the successful implementation of disease control interventions. According to stakeholders, there is a lack of systematic monitoring of disease outbreaks in Mali. Sporadic disease investigations occur, depending on the availability of government funds. In the event of a suspected outbreak, samples are collected by field veterinarians and sent to the LCV for laboratory confirmation. Often laboratory results are not generated on time to enable prompt action. Given that most outbreaks are not declared, government often have inaccurate records, leading to poor statistics, and hence an underestimation of the economic impact of an outbreak. Strategic vaccination, such as ring vaccination, is usually carried out by the DNSV after the outbreak has been reported, as an emergency strategy due shortages of funds. As opposed to routine mass vaccination carried out annually, ring vaccination during outbreaks attracts more producers. This is explained by the fact that farmers—whose herds are directly affected by disease outbreaks face a significant risk of losing their animals—witness first-hand benefits of vaccination which is efficiently carried out as the objective is to prevent the spread of the disease by any means. A large number of farmers prefer strategic vaccination than routine mass vaccination, which they often organize themselves to avoid report the presence of diseases to the authorities.

In addition, uncontrolled movements of animal and animal products was highlighted as a key constraint to the management of outbreaks, because of failure to impose quarantines, especially in pastoral areas where transhumance is common. A key constraint to animal movement control was corruption in the process of the issuance of movement permits and vaccination certificates. It was also reported that the current disease monitoring systems do not capture the movement of animals; so they do not allow for their traceability. This particularly affects the management of transboundary diseases, as it enhances the spread of high infectious diseases within and outside the country. These constraints have remained unresolved. In addition to the lack of human and financial resources to implement and monitor disease surveillance systems, there is scarcity of disease data to establish clear epidemiologic profiles for key endemic diseases.

Current vaccination programs in cattle and small ruminants

Livestock vaccination in Mali is mandatory for a number of diseases, including CBPP, PPR and bovine/ovine pasteurellosis. Vaccinations against these diseases are carried out through annually government-supported national programs overseen by the DNSV. Vaccinations against other diseases are sporadic and strategic, with anthrax, FMD and pox vaccinations only being carried out in endemic areas, such as Timbuktu for FMD, while vaccination against the blackleg disease is limited to outbreak areas. The diseases for which vaccines are available, but for which animals are vaccinated upon request by their owners, include blackquarter and lumpy skin diseases.

Livestock vaccination is carried out by the 'mandataires' who are allocated a number of communes to cover during a vaccination campaign. They carry out the vaccination exercise in addition to their normal duties as private veterinary practitioners. The process of vaccine supply is as follows: vaccines are produced by the LCV which in turns sells them to the 'mandataires' at a fee of XOF 25 per dose. Each vaccine dose is subsidized by the DNSV with a top up of XOF 75 per dose, paid directly to the LCV. In areas where there are not any 'mandataires', DNSV field staff carry out the vaccinations by themselves. Farmers pay for full cost of the vaccines, which may vary depending on the area of operation. However, most 'mandataires' apply the following charges: CBPP (50 doses for XOF 6,250); PPR (50 doses for XOF 6,250); bovine pasteurellosis (XOF 100 per dose); ovine pasteurellosis (XOF 100 per dose) and blackleg (XOF 100 per dose).

Vaccination against CBPP and PPR is undertaken once a year and while twice a year for bovine/ovine pasteurellosis. In some regions, such as Timbuktu, vaccinations are still provided to producers free of charge by development projects because of difficulties faced by animal health services providers in accessing the region due to high levels insecurity.

These projects have shown that if vaccination is free, uptake is higher which was also noted by the pastoralist stakeholders (example of a PPR project). However, for sustainability purposes, these NGOs are gradually shifting their approach to one for which farmers will have to contribute towards the cost of the vaccination. Despite of all the efforts of the government in implementing vaccination campaigns, vaccination coverage remains very low, and hence, does not result in sufficient herd immunity. Current vaccination coverage is 80% for CBPP, 7–8% for PPR, 30% in blackleg outbreak areas, and 30–40% for bovine/ovine pasteurellosis.

Factors influencing success or failure of vaccination campaigns

The key factors that hinder effective and efficient implementation of vaccination programs in Mali include difficulties faced by ‘mandataires’ in accessing vaccines due to financial resource constraints on placing orders with the LCV for sufficiently quantities of vaccines. This in turn leads to recurrent vaccine shortages in the field. In addition, poor knowledge of producers about the benefits of vaccination, a lack of awareness of producers about vaccination calendars, insufficient incentives for veterinarians to carry out vaccinations in remote areas. Bad roads and high transport costs, poor management and communication among vaccine chain supply actors complicate this situation. Inadequate infrastructure reduces the motivation of producers to participate in vaccination programs because of the time and the labour involved in restraining animals, particularly in areas where there is no infrastructure at all.

Moreover, the lack of equipment for transportation and maintenance of cold chain leads to poor quality vaccines used in the field. It is indeed difficult to protect the cold chain in the face of long distances and large coverage areas and difficulty in accessing some areas throughout the year or during specific seasons, leading to the spoilage of vaccines. The poor adherence of farmers to vaccination calendars was largely influenced by their reluctance to take their animals to vaccination centres to avoid declaring the number of animals they possess as a tax evasion strategy. This leads to underestimations of animal population to be vaccinated, which in addition exacerbates low vaccination coverage. Further, stakeholders highlighted the livestock producers’ lack of trust in vaccinators who they allege provide them with poor quality vaccines, thus resulting in poor participation to vaccination campaigns. Adulteration of the vaccine during transportation and handling was also mentioned, as was the use of inappropriate vaccine strains (e.g. the case of pasteurellosis), which can reduce the efficacy of the vaccine.

Conflicts of interest between herd keepers and animal owners was an important factor influencing the attitude of producers towards vaccination. In most cases, herders are not the owners of all their animals; they may only own a small portion. Most animal owners are settled in the urban centres where they are also occupied in other businesses. Therefore, animal keepers who are the sole managers of the herds have little interest in vaccinating the animals which do not belong to them. This particularly becomes an issue when the animal owners are not properly informed about vaccination, and consequently refuse to contribute financially to the cost of vaccination fees. This situation seems common and is seen as a big constraint to the participation of farmers in vaccination programs. According of the Disease Control Policy, animal keepers are responsible for vaccination, but they do not usually have money to pay for it. This situation calls for wider dissemination of information on vaccination among herders/managers and animal owners.

“If the animal keeper is intimidated or threaten by the vaccination controller of the area, then he may easily comply with vaccination” (a veterinarian said). The controller, who is a policy enforcer, is well respected by the community because of his power to impose these rules on producers and other actors. However, high levels of corruption have worsen the poor enforcement of regulations.

“Veterinarians have lost credibility and their service is no more respected by farmers; nowadays veterinarians have no authority compared to before privatization of the profession” (said a farmer).

According to farmers, veterinarians are perceived as offering sub-quality services. As farmers confuse vaccinators with veterinarians (all vaccinators not necessarily being veterinarians), this leads to a reluctance on the part of farmers to have their animals vaccinated, regardless of who provides the service. In addition, there is a proliferation of community animal health workers placed in communities by developments programs, but who have rarely received the necessary training to perform their duties. This further reduces the quality of services provided to producers.

In Mali, there is no embedded post-vaccination sero-monitoring to evaluate and monitor the quality of vaccination programs. Evaluation of vaccination campaigns is only based on reports sent to the government authorities by 'mandataires' and DNSV field staff. Such reports are usually sent late and do not contain accurate information on vaccinated animal population. This is a considered big gap obstacle in ensuring the rigorous monitoring of vaccination campaigns.

Box 1: Factors expected to influence post-vaccination sero-monitoring

- Difficulty in obtaining accurate estimates of the animal population to be vaccinated
- Difficulty in controlling animal movements even during outbreaks
- Reluctance of farmers to have samples collected from their animals mostly during dry season—when animals are not well fed, to avoid adverse effects following bleeding—may not necessarily coincide with the appropriate period of post-vaccination sero-surveys.
- Difficulty in collecting random test samples especially in areas with high insecurity.

Use and management of veterinary products

Chemotherapy and chemoprevention are widely used in the control of livestock diseases in Mali. Veterinary medicines commonly used in the treatment of animal diseases include antibiotics, trypanocides, de-wormers, and treatments for ectoparasites. There are a number of private companies licensed by the government to import and distribute veterinary products in the country. However, most retail networks are mainly clustered around towns. Remote areas remain unserved. The persistence of illegal networks of drug suppliers promotes unfair competition between veterinary drug suppliers. This puts downward pressure on the supply of quality services as lower quality or fake medicines are often sold in drugstores and markets at cheaper prices.

Such unregulated competition does not favour veterinary pharmacists who are licensed to legally import drugs, hence pushing them into delivering sub-quality services in order to make a profit. Despite the existence of a legal framework and the establishment of fairly consistent institutional structures, there are many challenges related to the enforcement of the regulations governing the trade and use of veterinary medicines. In addition to misinterpretations of legislative texts by the general public, these challenges include a lack of resources for: veterinary services; personnel and equipment; and the authorities to enforce the laws and regulations on the illegal exercise of the veterinary profession.

Furthermore, producers directly medicating their animals is a key factor that contributes to the inefficiency of veterinary treatment. This usually happens after producers obtain the veterinary drugs from disreputable sources so as to avoid paying for the services of qualified veterinarians or simply because of lack of access to qualified veterinarians able to provide them with quality services. Consequently, treatment failure and resistance of ticks to acaricides is frequently reported by producers. The level of direct medication practiced in Mali is alarming, leaving the livestock sector vulnerable to emerging antimicrobial resistance.

Box 2: Priority constraints to livestock production

- High risk of animal diseases and high mortality of small ruminants and poultry as a result of poor housing and management.
- High cost of livestock feeds—including agro-industrial by-products—and inadequate forage resources together with limited access to pasture and water points for livestock.
- Illegal practice of the veterinary profession and uncontrolled sale of veterinary products, particularly in the Mopti region.
- Inadequate market information and the high cross-border taxation on animal movement.
- Obstruction of transhumance routes—due to settlement and agricultural activities—reducing animal mobility.
- Low genetic potential of local breeds, leading to low milk and meat production rates.
- High rate of livestock theft and insecurity.

Conclusion

In addition to the policy gaps highlighted, logistic and human resource constraints have severely hindered the capacity of the government to implement effective disease control measures for the most dangerous animal diseases. On the other hand, the increasing proliferation of fraudulent veterinary products and illegal conduct in the veterinary profession have become a national and, possibly, a regional issues of concern. Given the significant increase in reports on the low efficiency of veterinary medicines, such as antibiotics and acaricides, misuse of these substances seems likely to be a major cause. Until these diseases are effectively under control, productivity will remain low and access to export markets for meat will be restricted. Therefore, there is urgent need for joint efforts among livestock value chain actors and other stakeholders to address the identified challenges affecting the good performance of the animal health delivery sector.

Recommendations

Some key recommendations include needs:

- For the government to increase the number of veterinarians trained every year and to intensify, extend and standardize training for para-veterinarians and community animal health workers. This could possibly be done through the establishment of a vocational education training program.
- To facilitate access for private 'mandataires' to financial loans to buy and store enough doses of vaccines so as to avoid shortages during vaccination campaigns. For this to happen, associations of 'mandataires' will need support in putting in place bankable business models (e.g. contractual arrangement between financial institutions, such as banks and the LCV). The funds could be extended to buy equipment for cold chain and transport.
- For the government to support the establishment of an accurate and regularly updated livestock database with information on the demand for vaccines to enable private sector planning.
- For increased awareness of producers on importance of vaccination. This can be achieved by the introduction of information and communications technology (ICT)-based solutions to reach larger numbers of stakeholders with relevant real-time information.
- To intensify the capacity development of producers and other value chain actors on best practices in livestock production and marketing. Both herd owners and herders should be enrolled during delivery of any other extension services.
- To implement an incentive-based system, such as the discount approach, whereby farmers who vaccinate large number of animals are asked to pay less than others.
- To improve disease reporting by addressing compensation issues. A system of insurance for farmers who have to cull 'already vaccinated' animals during outbreaks could be piloted. A herd replacement system after outbreaks should also be explored and aligned with compensation.
- To reduce corruption on movement permits through the introduction of effective livestock traceability systems and to enhance the control of transboundary diseases by raising and maintaining the quality of animal products.
- To revise and amend policies on drug management and to strengthen regulatory bodies, such as DNSV and the veterinary association, to undertake their regulatory work.
- To foster synergies among livestock value chain actors through establishment of innovation platforms for information sharing and learning in order to induce changes in practices, behaviours and attitudes. Farmers should also be shown the real impact of vaccination to motivate them to vaccinate their animals (farmer-to-farmer influence, creating suitable media material).

Recommendations for further research

Further research needed includes:

- An evaluation of the status of the privatization of the veterinary profession and its impact on livestock health delivery systems.
- A review of policies and regulations in the veterinary profession and their impact on the delivery of animal health services.

- An evaluation of the effectiveness of current vaccination strategies (herd immunity levels attained by different vaccines under field conditions).
- A determination of the socio-cultural factors influencing the participation of livestock producers in vaccination programs.
- Detailed studies of socio-economic impacts of endemic livestock diseases and new options for their management.
- An examination of the movement of animals, including transhumance, and their impact of vaccination strategies.
- An analysis of the effectiveness of real-time livestock disease reporting systems and traceability using ICTs in order to enhance outbreak detection and management.
- An assessment of capacity gaps in the livestock extensions systems in Mali, with clear recommendations on strategies that will enable efficient delivery of extensions services to livestock value chain actors.

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