

Review of animal health service delivery in the mixed crop-livestock system in Ethiopia



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International Livestock Research Institute (ILRI)

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Executive summary

This paper reviews the animal health services in rural areas in the highlands of Ethiopia, particularly those areas of intervention by ILRI's LIVES Project in Oromia, Tigray, Amhara, and Southern Nations Nationalities and Peoples' (SNNP) regional states. Ethiopia has established animal health services by both the national and regional governments, and private service providers, some of which are supported by non-government organizations. The numbers of veterinarians seem large, there is evidence of professional capacity, and the country was a leader in the national and international program of eradication of bovine rinderpest. However, many authors quote the inadequacy of animal health services. The aim of this review was then to assess and document the animal health service status in the rural areas and forward recommendations. The study covered 117 rural clinics, 31 woredas, and 10 zones in the four LIVES regions.

The animal health service in the rural areas is structured with regional laboratories for diagnostic and surveillance services, woreda clinics at woreda towns, rural health posts each serving three to five peasant associations (PA), though this ratio varied between the four regions. There are also private clinics/drug shops and community animal health workers (CAHWs) supporting the services. Rural clinics are manned by one clinician, sometimes two. The woreda offices and clinics are manned usually by veterinary graduates supported by diploma holders. The clinicians work basically comprises individual treatments, vaccinations, spraying and assisting births. The treatments are usually basic injections, drenching and castrations.

The clinics usually have two or rarely three rooms, one for the clinic, one for a store and one for a living room with bed. The clinics vary in construction and age. Rural clinics rarely have electric power and water. Some clinicians do not even have a separate clinic building and depend on living quarters in villages. Each clinic has a crush, for both clinical examinations and artificial inseminations. The drugs lists are comprised mostly of antibiotics, anthelmintics and trypanocides. Broad spectrum drugs are favoured. It was clear from the review that clinicians were covering large areas without transport. Clinicians must walk to woreda offices to pick up vaccines and then walk to distant PAs to provide the services. Further, it was evident that the allocation of transport, particularly motorbikes, favoured other departments than the health service.

Clinicians rely for diagnosis almost entirely on clinical signs only. There was little evidence of equipment for post-mortems, not even knives and steels. Some woreda offices and clinics had microscopes mainly for faecal examination (but no flotation chambers), and hand centrifuges. Further, when questioned, most admitted they rarely make use of regional veterinary laboratories. The zonal reports show vaccines are regularly administered for the following diseases: anthrax, blackleg, bovine pasteurellosis, ovine pasteurellosis, lumpy skin disease, Newcastle disease, sheep and goat pox, *peste des petits ruminants*, African horse sickness, foot and mouth disease, contagious bovine pleuropneumonia, and contagious caprine pleuropneumonia. There was never any mention of vaccinations for clostridial diseases other than blackleg, like enterotoxaemia and black disease. It is likely there could be concern for these, if there wasn't the need for preoccupation with those severe infectious diseases mentioned above. Regarding effectiveness of vaccines, Newcastle disease, lumpy skin disease and ovine pasteurellosis were the diseases with the most apparent failures, especially lumpy skin disease, mentioned by nearly half the clinicians questioned.

There are 17 regional veterinary laboratories throughout Ethiopia. The two visited laboratories during the review did not appear to be active. In the review of rural clinics, the clinicians were questioned about use of regional laboratories. In most, the replies were 'rarely'. The roles of private clinics were limited as they were not allowed to vaccinate. CAHWs are largely organized and supported by non-governmental development organizations and largely in pastoral areas. However, the review showed that CAHWs also serve in the highland mixed crop-livestock system as well. Blackleg, bovine and ovine pasteurellosis are the most commonly reported diseases.

The recommendations to improve service delivery would include more budget (re)allocation across departments, reasonable treatment of clinicians, increased liaison and activity between regional veterinary laboratories and field livestock agency/departmental staff, review into the effectiveness of regional veterinary laboratories, effort to increase the accuracy of diagnoses by clinicians and effectiveness of some vaccines, and the liberalization of the provision of animal health services.

I. Introduction

This review was conducted on behalf of LIVES project of ILRI. This project is funded by the Canadian International Development Agency. One of the writers who did the field work (Peter Hooper) was also funded by the Australian Volunteers for International Development's Scope Global Project.

Ethiopia is endowed with a staggering number of livestock resources. Recent estimates indicate that 54 million cattle, 25.5 million sheep, and 24.06 million goats are found in the rural sedentary areas of the country (CSA 2012/2013). The large numbers were not consistent with high productivity. For example, Tegegne et al. (2013) indicated that the country has a large potential for milk production, but it still lags behind, even relative to other African countries.

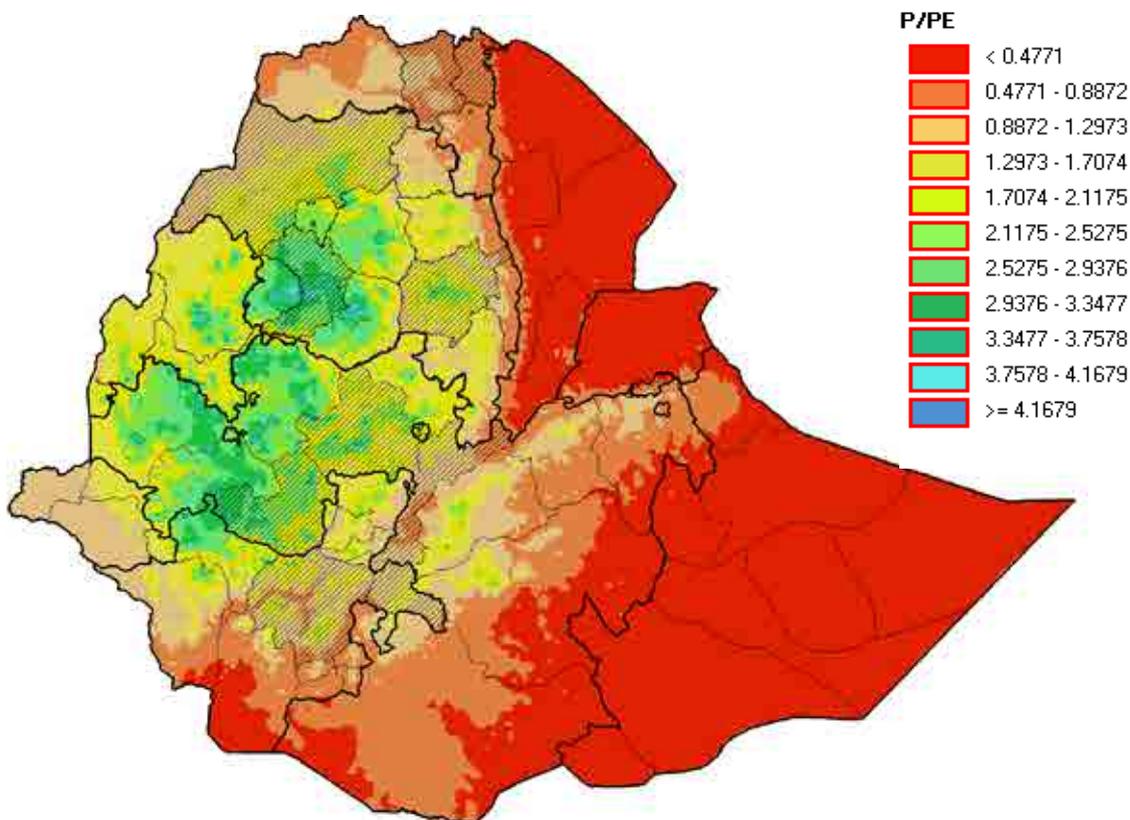
Animal diseases are big factors limiting productivity (Muktar and Robert 1994), although modern veterinary services in Ethiopia started early in the 19th century (Berhanu Admassu) which began with a French veterinary mission providing veterinary services in 1908. The country has established animal health services by both the national and regional governments, and by private individuals, and supported by non-government organisations. The numbers of veterinarians seem large (MoA 2012) and there is evidence of professional capacity. Ethiopia was a leader in the national and international program of eradication of bovine rinderpest.

However, many authors quote the inadequacy of animal health services, notably Ethiopia's own animal health ministry (personal communication). This is a review of some of the services in the rural areas, particularly those areas of intervention by ILRI's LIVES project.

2. Method of the review

This review covers LIVES livestock value chain intervention areas in the mixed crop-livestock system in the highlands of Ethiopia. The area extends in 10 zones and 31 woredas within four regional states, namely Amhara, Oromia, SNNP and Tigray, (Figure 1). The review approach consisted of visits to a large number of regional government woreda agricultural offices, woreda veterinary clinics, rural health posts and regional veterinary laboratories. A total of 117 were visited. Private clinics, animal drug shops, and community animal health worker supports were also visited. Clinicians were interviewed, and their clinics, equipment and circumstances of their work were inspected. A woreda office would be visited first to discuss the woreda as a whole, visit its clinic, and then plan the review of its rural clinics. Most often, a woreda officer, usually the senior veterinary head, would accompany the visits to the rural clinics. Standard questionnaires were developed, one for woreda offices and woreda clinics and one for rural clinics, to obtain as much information on animal diseases and on the condition of the clinics. Every effort was made to see clinicians in action. Emphasis was made on infectious diseases.

Figure 1. The study locations (light gray striped area) of the 10 administrative zones with climatic zones (P=precipitation, E=evapotranspiration)



3. Animal health services

3.1 Rural health posts/clinics

The regional governments have a wide distribution of small veterinary clinics (posts) in rural, even quite remote, areas. They are supported by senior staff at woreda agricultural offices. The staff in the woreda offices are also responsible for distribution of vaccines, drugs and instruments. These offices also have clinics, which are of a higher standard than the rural clinics.

Distribution of clinics/health posts

The review team was advised early on that there should be three to five PAs per rural health post. This seemed to be confirmed in Ada Berga, Ejere and Metarobi woredas in Oromia region, but lower numbers of PAs per health post were cited in North Gondar, West Gojjam and South Wollo Zones in Amhara region, with as high as 52 clinics for 98 PAs in the three LIVES zones. The situation in SNNPR was similar but more irregular. Bonke woreda in SNNPR was quoted at one health post for two PAs for its 17 clinics and Mirab Abaya one for six PAs in its four health posts. Arba Minch Zuria woreda had only two for 28 (more services were being provided by the centralized woreda clinic in Arba Minch Zuria). In Tigray, there were consistently fewer health posts per woreda. The ratio was closer to one:eight; for example, Laila Maichew two for 15, Tahray Maichew two for 16, and Ganta Afeshum two for 16.

Clinic facilities, equipment and supplies

The clinics usually have two or rarely three rooms, one for the clinic, one for a store and one for a living room with bed. There are often two desks, one as an office and another for clinical work. The clinics vary in construction and age, and are usually in a village. Rural clinics rarely have electric power and water. Some clinics do not even have a separate clinic building and depend on living quarters in villages (Figure 2).

The clinics in Tigray were consistently better than elsewhere. We were told of support by the Catholic Church. In addition, we noticed a superior degree of tidiness and cleanliness in Tigray clinics (Figure 3). Whereas other rural clinics, like Hara clinic in Amhara region (Figure 4) are housed in unsatisfactory buildings.

Figure 2. A clinician with drugs in a room at Bekegudo PA, Seka Chekhorsa woreda, Jimma zone, Oromia region. He has no clinical building and electric power supply.



Figure 3. A very good clinic building in Tigray.



Figure 4. A building that is not satisfactory, at Hara PA, Tehuledere woreda in South Wollo, Amhara region. The interior was not much better.



Each clinic has a crush, for both clinical examinations and artificial inseminations. They are usually open-ended as the animals are so quiet and can be controlled manually. Some have forcing pens, attached yards to manoeuvre animals into the crushes. The crushes vary in quality. Many if not most are made of steel. Some are good (Figure 5) while others are not (Figure 6).

Figure 5. New crush with clinic yard behind at Kirkiressa PA, Oromia.



Figure 6. Not so good yards at Howelkelte PA.



The clinics have a basic set of instruments so they can provide vaccinations and make basic treatments. Most have a burdizzo, both or either large and small. Most have a thermometer, a stethoscope, syringes and needles, and a balling gun. Some have a hoof trimmer, and trocar and cannula. Rarely, there was a microscope, and/or hand centrifuge, and/or catheter. Some but not all have spray equipment and sprays for external parasites.

The drug lists comprised mostly antibiotics, anthelmintics, and trypanocides. Broad spectrum drugs are favoured. The most common antibiotics are 10% and 20% oxytetracycline, penstrep and some sulpha drugs. Albendazole and ivermectin were the most common antiparasiticides. A drug shop (Girma Ajeme of Girma and Assefa, Ketreto PA, Metarobi woreda) quoted the following prices of drugs *Alben* 150g ETB 2/bolus; *Tetrachlozosh* ETB 4/bolus; Anti tryp *Dimnshish* ETB 8/sachet; oxytetracycline 20% ETB 30/vial; *penstrep* ETB 120/vial; *Avirmictine* 50 ml ETB 35/vial.

In tsetse fly areas, a range of proprietary prophylactic drugs were quoted, especially isometamidium and diminazene.

Figure 7. A typical set of instruments at Ilu Aga rural health post.



It was clear from the start of this review in Oromia that clinicians were covering large areas without transport. Clinicians must walk to woreda offices to pick up vaccines and then walk to distant PAs to provide the services. The situation was similar in the remaining regions: Amhara, SNNPR and Tigray. Further, it was evident there were many motorcycles at woreda offices visited in SNNPR, but none were provided for the Livestock Agency in the same set of buildings (Table 1). In SNNPR, 22 woreda offices of other SNNPR agricultural agencies had motorcycles, while all six Livestock Agencies had none. The situation in Amhara was similar. The situation was better in Tigray.

It is not only in transport that there is a lack of support for livestock agencies or departments and their clinics. Nearly all rural clinics lack power and water. Clinicians are not provided much in the way of *per diem* and they often face shortages of drugs and equipment. One clinician said she needed to purchase materials out of her own pocket to continue to provide a service.

Table 1. Provision of motorcycles for the agencies at district Livestock Agency/Department offices

SNNPR	Livestock	Crops	Rural youth	Irrigation	Natural resources	Food security	Coffee and tea
Gamu Gofa	0			NA		NA	NA
Mirab Abaya	0		NA				NA
Arbamich Zuria	0		NA	NA		NA	NA
ArbegoNA	0			NA			NA
Bensa	0		NA				
BoNA Zuria	0		NA	NA			
Amhara							
Gondar Zuria	0	Other agencies not rated at time of review					
Lay Armacho	0						
Dessie zuria	0						
Bahir dar zuria	0	"All other agencies provided"					
Mecha	0	Other agencies not rated at time of review					
YilmaNA Densa	0						
Tigray							
Medelbay zana	broken	Other agencies not rated as livestock was provided					
Howzen							
Gulumekeda							
Ganta Afeshum							
Tahtay maichew							
Laelay Maichew							
Kilte Awlaelo							

NA = not applicable (not known or not represented at the district office)

The clinicians, their services and accuracy of diagnosis

Rural clinics are manned by one clinician, sometimes two. Their qualifications are usually that of animal health assistants with three-year diploma qualifications. The woreda offices and clinics are usually manned by veterinary graduates supported by diploma holders. Their ages vary and they are more frequently male.

The clinicians work basically comprises individual treatments, vaccinations, spraying and assisting births. They often work alongside of artificial inseminators. Farmers mostly bring animals to clinics as clinicians have no transport. The treatments are usually basic injections, drenching or inserting pessaries or boluses with balling guns, castrations, mostly with burdizzos, and sprayings. They assist with placental removals. Remarkably, a surgical repair of a prolapsed rectum has been observed.

Clinicians rely for diagnosis almost entirely on clinical signs only. There was little evidence of equipment for post-mortems, not even knives and steels. Some woreda offices and clinics had microscopes mainly for faecal examination (but no flotation chambers), and hand centrifuges. Further, when questioned, most admitted they rarely make use of regional veterinary laboratories. The most likely use of the laboratories is for simple faecal examinations for internal parasites. There was little evidence of sample bottles.

Figure 8. Rarely, clinics were provided by scientific instruments, such as this microscope and hand centrifuge at a clinic in Lay Armachho woreda, Amhara.



Vaccination, vaccine delivery and efficacy

Ethiopia is affected by a broad range of animal diseases. It has a long dry season so there is nutritional stress, resulting in poor growth and infertility. Typical of a third world country in a tropical zone it has an unenviable range of infectious diseases. The zonal reports show vaccines are regularly administered for the following diseases: anthrax, blackleg, bovine pasteurellosis, ovine pasteurellosis, lumpy skin disease, Newcastle disease, sheep and goat pox, *peste des petits ruminants*, African horse sickness, foot and mouth disease, contagious bovine pleuropneumonia, and contagious caprine pleuropneumonia.

There was never mention of vaccinations for clostridial diseases other than blackleg, like enterotoxaemia and black disease. It is likely there could be concern for these if there wasn't the need for preoccupation with those severe infectious diseases mentioned in the previous paragraph. The actual vaccine strain for Newcastle disease varies. There is no evident preference for the thermostable virus, although available.

Figure 9. Donkeys being vaccinated at Addis Alem clinic in West Shoa, Oromia.



Clinicians at the remote rural animal health clinics need to obtain vaccines from their woreda livestock agency or department offices. Of 32 clinicians recorded in relation to method of delivery, only two were financially or physically supported for travel to obtain vaccines. Ten required public transport at their own expense, costing them between ETB 20 and 140. At least 19 walked. Thirteen walked long distances to the woreda offices and back, six both walked and used public transport, two hired a mule or horse, and one needed to hire a motorbike at his own expense. At one extreme, a clinician walked three hours from his clinic to the main road, then took a bus to a main town, then another bus to the woreda office, then a bus back to the main town, then a bus to nearest spot to his clinic on the main road, and then three hours walk to his clinic. Then, if the vaccinations are not at the clinic crush, clinicians may have to walk long distances to other sites at perhaps distant PAs. All of the above could have effects on the viability of vaccines, as well as the general inefficiency. Yet, studies have found that a major reason for failure of vaccines is a mismatch between the virus strain in the vaccine and the virus strain circulating in the field.

A number of woreda livestock agencies/departments were asked if they knew of any apparent ineffectiveness of vaccines, evident by the presence of disease months after vaccination. They were asked to assess by 'common' (C), 'occasional' (O) or 'never, don't know or vaccine not used' (N). Table 2 lists the C and O results and N for the remainder. Newcastle disease and lumpy skin disease were the diseases with the most apparent failures, especially lumpy skin disease, mentioned by nearly half the clinicians questioned. These were followed by ovine pasteurellosis.

Table 2. Incidences of infections after vaccinations assessed as C for common, O for occasional and N for none or unaware

Diseases	Percent responding (N=20)		
	C	O	N
Anthrax	0.0	14.3	85.7
Blackleg	0.0	23.8	76.2
Bovine pasteurellosis	9.5	23.8	66.7
Ovine pasteurellosis	28.6	19.0	52.4
Lumpy skin disease	33.3	14.3	52.4
Newcastle disease	23.8	19.0	57.1
Sheep and goat pox	14.3	4.8	81.0
Peste de petits ruminants	0.0	4.8	95.2
African horse sickness	4.8	14.3	81.0
Foot and mouth disease	0.0	19.0	81.0
Contagious bovine pleuropneumonia	0.0	19.0	81.0
Contagious caprine pleuropneumonia	0.0	9.5	90.5

3.2 Meat inspection at abattoirs

There was a variation in the control of abattoirs and the provision of meat inspection. In Tigray, for example, there was a variation in responsibilities. Of four woredas with abattoirs, only one was under livestock department control. At two woredas, the abattoir and meat inspection was under the woreda town administration with no relation to the Livestock Department which did not receive reports from inspections at the abattoirs. In another woreda, the town abattoir was run by a private group with a qualified veterinarian who was expected to provide reports to the Livestock Department.

3.3 Regional veterinary laboratories

There are five regional veterinary laboratories throughout Ethiopia, each under regional government control. Two were visited during the review. The Tigray Regional Veterinary Laboratory was in a state of flux as it was about to move to a new building. It did not appear to have been very active, particularly as it had a very small staff. The impression of the Sodo Regional Veterinary Laboratory in SNNPR state was of inactivity. It has capability with the right disciplines, basic equipment and staff, but suffered from inactivity. Perhaps it might be improved with greater field activity and increased liaison with field staff. In the review of rural clinics, the clinicians were questioned about use of regional laboratories. In most, the replies were mainly 'rarely'.

3.4 Private veterinary clinics

There are private veterinary clinics in rural areas. In those visited, the clinicians were veterinary diploma holders, three year animal health assistants without the full veterinary degrees. The regional governments would only allow them to practice if they had three years' experience. Their roles were limited as they were not allowed to vaccinate. Private clinics by diploma holders must have two years' experience to qualify for a license.

3.5 Community animal health workers (CAHWs)

CAHWs have historically played a role as animal health service providers in many parts of Africa, including Ethiopia. Their training was limited but then again their role was limited but useful. The Food and Agriculture Organization (FAO) of the United Nations has a definite opinion about the use of CAHWs in Ethiopia, which includes the sustainability of Ethiopia's community-based animal health delivery system and that CAHWs have become an integral part of animal health service delivery in remote pastoral areas of Ethiopia over the past 20 years.

CAHWs are largely organized and supported by non-governmental development organizations and largely in pastoral areas. The Dryland Husbandry Project (DHP) operates in the pastoral areas of Ethiopia, Kenya, Sudan and Uganda. DHP took animal health care as one of its key objectives in its action-oriented activities. This was implemented by training pastoralists and agro-pastoralists as CAHWs or as para-veterinary (paravet) service providers. Paravets learn the basic elements of what are the causes, symptoms and treatments of some common animal diseases in a scientific way. Veterinarians keep contact and provide technical advice to paravets. As paravets carry new ideas to look after animals, they can serve as development agents in the pastoral areas. They can also teach community members about animal health care and serve as early detectors of animal diseases in pastoral areas.

Evangelical Mission (Arba Minch) and 'Send a Cow' in SNNPR state confirmed that they had initiated the training and placement of a number of CAHWs. Training was by regional livestock agency veterinarian over a period of one month. The Mission continues with financial support, particularly for drugs, from an international donor (Brooke Institute). CAHWs are now placed in four different woredas. They indicated that they would welcome the integration of the CAHWs program with government services.

In the review of the clinics, it was clear CAHWs were present and working alongside departmental clinicians. In the woredas visited in Tigray, 69 CAHWs were in Ganta Afeshem, 12 in Gulemekeda and 12 in Kilte-Awlaleo woredas. The CAHWs are supported by the Catholic Church and the Belgian Government.

4. Animal diseases

The review regularly inquired about the prevalence of diseases, especially infectious diseases. Little effort was made to discuss nutritional diseases and general ailments such as accidents and birthing difficulties as it could be assumed that these would be common and similar to other countries, coincident for example with long sequences of dry periods. Milk fever is commonly recognized. A number of infectious diseases such as mastitis, actinomycosis and actinobacillosis are not included as they tend to be internationally universal, even environmental, rather than significant as Ethiopian. Clinicians indicated that they were common problems.

Table 3 provides a summary of the opinions of the prevalence of the major diseases provided by clinicians and heads of woreda offices of livestock agencies. The figures are merely indicative. The numbers for the regions should not indicate comparisons between the regions. More clinics were surveyed in Oromia at the start of the review, fewer in Amhara, and fewer again in SNNPR and Tigray where there were fewer clinics. Equally, the figures only show opinions of which are the common diseases and should not be taken as levels or prevalences in the regions. For example, zero or low rating does not indicate absence or low prevalence, merely not rated as common by the clinicians. Moreover, some diseases were probably under-rated. Many clinicians did not include parasites, and Newcastle disease was not included early in the survey.

The table confirms that blackleg is the most commonly reported disease. Bovine and ovine pasteurellosis follow. There are a number of conditions that were distinctly higher or lower in some regions and zones than the remainder. Contagious caprine and contagious bovine pleuropneumonia were very strongly reported in Gamo Gofa, and *peste des petits ruminants* in East Shoa, while sheep and goat pox did not rate in SNNPR, nor did anthrax in Sidama and South Wollo. Anthrax is a common problem in Ethiopia but seemingly less so in plateau areas such as South Wollo and Sidama.

On the other side, there are many diseases that are common in other countries but not mentioned by clinicians. Examples include some clostridial diseases. Even though blackleg is one of the most commonly diagnosed diseases, other clostridial diseases common in other countries, enterotoxaemia, black disease, botulism and tetanus, were never mentioned. There are references to bovine brucellosis but not ovine and caprine brucellosis. Abortion rates are high in some areas, especially Tigray. Venereal trichomoniasis and campylobacteriosis were never mentioned.

Table 3. Summary of diseases assessed as common in woredas

Disease	Regions				Total
	Oromia	Amhara	SNNPR	Tigray	
Anthrax	19	16	9	11	55
Blackleg	39	25	19	9	91
Bovine pasteurellosis	37	23	16	13	89
Ovine pasteurellosis	38	21	8	12	79
Internal parasites	13	11	8	12	44
External parasites	15	12	11	12	50
Lumpy skin disease	27	20	0	4	49
Newcastle disease	NA	9	9	9	27
Sheep and goat pox	25	20	0	4	49
<i>Peste de petits ruminants</i>	13	NA	6	10	29
African horse sickness	26	8	4	8	50
Foot and mouth disease	2	16	3	4	27
Contagious bovine pleuropneumonia	0	0	8	0	8
Contagious caprine pleuropneumonia	0	0	9	0	9
Trypanosomiasis	12	8	7	6	33

Numbers indicate number of respondents. NA = not available

5. Discussion

5.1 Animal health services

Public service delivery

Use of veterinary services is generally low. For instance, assessment of animal disease management practices in north Gondar zone (Kebede et al. 2014), one of the zones in the current review, showed that only 46.3% of the respondents used veterinary clinics and that only after initially trying local medicaments, whereas 19.5% of the respondents administered modern medicines obtained from private or illegal sources themselves when their animals became sick.

The performance of the animal health clinicians at various woreda and rural clinics was found to be impressive. They are working under great strain and in poor conditions. They work in clinics that do not have electricity and water. It is evident that they lack transport, such as motorbikes, that would increase effectiveness, efficiency and likely reduce numbers of clinicians. They spend a lot of time walking to pick up vaccines and drugs and to vaccination sites. This may result in degradation of vaccines. This review showed that there is evidence that post-vaccination infections occur and insufficient care of the vaccines may be a factor. Many spend much of their little income paying for buses to pick up vaccines. Lack of transport means that clinicians are rarely able to attend emergency cases, e.g. milk fever, calving difficulties, etc. The above factors must have a huge effect on morale. It might be argued that most of the farmers they serve suffer in the same way. However, farmers probably do not need to be so mobile.

Both woreda and rural animal health clinics/health posts provide basic clinical services. These comprise vaccinations and treatments, and there is little advanced veterinary surgery and medicine. Disease diagnoses is mainly based on clinical signs. Post-mortems appear to be very rare. Few places had equipment to conduct them, and collect specimens, either from autopsies or from live animals. There seems very little relation with or use of regional veterinary laboratories. Similar observations were made in a survey of veterinary services in North Gondar (Kebede et al. 2014) where of the 20 public veterinary clinics visited, only 10% were known to use laboratory diagnostic aids for faecal egg screening. In none of the government clinics were either local or general anaesthetic agents evident, which indicates surgical procedures were not performed, or if they were, they were unethical, without pain management.

The two regional laboratories visited did not seem to be busy. However, disease diagnosis may not be a problem since, fortunately, most of the major infectious diseases have distinct clinical appearances, especially those like sheep and goat pox, lumpy skin disease, and foot and mouth disease. It was noticeable that diseases mentioned by clinicians tended to follow one another within woredas. Obviously, this is because they are more common in those areas. However, in detail, the pattern might also follow their peers and their training by woreda staff. On the other hand, some clinicians mentioned unique diagnoses, not merely following the pattern, for example, malignant catarrhal fever, bovine farcy and streptothricosis in two clinics. Such contributions were rare.

Absence of confirmations by post-mortems and only minimal use of regional veterinary laboratories could mean errors in diagnosis. It does not allow for more sophisticated diagnoses and therefore greater understanding. We have the impression that many of the diagnoses were made on clinical grounds only, missing out alternatives. Even those diseases with distinct clinical appearances have counterpart diseases that resemble them. Lumpy skin disease even has a reasonably common look-alike 'pseudolumpy skin disease' caused by a totally different virus. There are erosive diseases that resemble foot and mouth disease, for example, mucosal disease caused by a pestivirus. A new viral disease closely resembling African horse sickness has emerged in Australia, Hendra virus disease. This one, if it arose here, would be of concern because it also causes fatal disease in humans when in contact with sick horses.

Some of the more common diseases may not always be diagnosed accurately. Is blackleg that common? Or other muscular conditions such as white muscle disease? The pneumonia of bovine pasteurellosis is very similar to that of contagious bovine pleuropneumonia. Coenurosis in sheep resembles listeriosis. Both are 'circling diseases'. There may be an assumption that a late bovine abortion could be due to brucellosis but the protozoan *Neospora* has been shown to be important in Ethiopia. Post-mortems followed by laboratory examinations should be conducted to properly differentially diagnose them.

The authors' comments on regional veterinary laboratories included they 'might be improved with greater field activity and increased liaison with field staff'. The activity and liaison would also benefit field staff. An attempt could be made to develop this. We are not suggesting that confirmations should be made of all diagnoses. Rather, we think it appropriate to check some in case other diseases were missed. This could result in more accurate strategies, such as control of the unrecognized diseases, and even lead to fewer apparent post-vaccination failures.

Private health service delivery

The private clinics visited resembled the government clinics in the services provided with one notable exception, those visited were not able to vaccinate. The reason was not clear and we suggest that this be changed, not only to directly provide more hands on this aspect of services but indirectly to encourage the private services. However, the current practices of the private sector are not up to expectations. For example, in North Gondar 95% of private service facilities surveyed by Kebede et al. (2014) were private drug retail shops and only 41.2% fulfilled the criteria set by the regional bureau of agriculture and in 30 % of the facilities clinical services were provided for which they were not licensed.

Community animal health workers (CAHWs)

CAHWs are widely used in Africa where there is insufficient animal health support. There is even a published CAHW—Training Manual prepared by the Dryland Husbandry Project of the Organisation for Social Science Research in Eastern and Southern Africa (OSSRESA). They receive one month training by veterinarians in basic diagnosis and treatments. They are selected members of farming communities and receive little pay, perhaps part of the price of drugs they sell. Like private clinics, they do not have a license to vaccinate.

In Australia, some of the most valued members of the community that provide animal health services are stock inspectors (or equivalent local names). Stock inspectors are usually government officers who provide regulatory and veterinary services in rural and remote areas. They usually have no academic qualifications but are experienced in animal management. They receive training by veterinarians once they join the government service.

CAHWs could be the equivalent of stock inspectors. If so, they would be allowed to vaccinate and so perform much of the work of the clinicians. Moreover, they could be integrated with the government services and be guided or directed by the clinicians. This would then lead to a three tier system for rural animal health services—woreda offices with graduate veterinarians guiding and directing rural clinicians, and rural clinicians guiding and directing CAHWs. There are practical and economic advantages; greater spread of services and so less walking or other travelling by clinicians to various PAs, fewer clinics and clinicians, cheaper per unit services and so more services and more money

to provide for transport and other needs. This expansion should mean more drugs and equipment are needed so there would be a stimulus for more and widespread drug shops.

Prospects of improvement of services

The previous section could indicate the greatest method of improving services. Clearly, most improvements will require more money. There are some areas where this extra expenditure is highly justified. Two regions reviewed provide motorbikes to their woreda livestock agency. Two others do not, even though nearly all other adjacent agricultural agencies do so.

Electricity and water should be provided when it is available. For example, the clinic (below) has electricity running right past it. Every effort should be made to correct the injustice whereby clinicians must walk vast distances or pay for transport and other items out of their own pocket. Adequate per diems should be available to negate these injustices and make the whole services more efficient.

Figure 10. Clinic at Shabamo, Arbegona woreda, SNNP—there is power line extended right past the building but it does not supply the clinic.



5.2 Animal diseases

Blackleg, bovine and ovine pasteurellosis are the three infectious diseases most frequently rated as most common in the review. Blackleg is a remarkably common disease in Africa. Anthrax is a common problem in Ethiopia but seemingly less so in plateau areas such as South Wollo and Sidama. A number of clinicians confirmed they took the precautions of burying infected carcasses. Rabies was more frequently mentioned in Tigray. Milk fever and mastitis were commonly recognized as common and important. Woreda clinics in Tigray retain calcium borogluconate.

External and internal parasites were always regarded as important. Clinicians use backpack sprays and regularly provide anthelmintics. The efforts on ticks must be reasonably effective. Tick burdens with *Boophilus (Rhipicephalus) microplus* never seem as high as in range conditions.

Ethiopia is unfortunate to have such a long list of infectious diseases that cause severe ill health and are factors in trade. These include foot and mouth disease, lumpy skin disease, sheep and goat pox, *peste des petits ruminants*, Newcastle disease, African horse sickness, trypanosomiasis, contagious bovine pleuropneumonia, and contagious caprine pleuropneumonia. These require expensive control by vaccination programs that take up much of the time of the rural animal clinicians.

The continual presence of the major diseases would help mask other diseases that would have been considered important in their own right. A number of diseases were never mentioned that are common in other countries. Many of these are worldwide and environmental, even as soil organisms, so very likely to be in Ethiopia. A particular group could be those caused by clostridia other than blackleg. Enterotoxaemia particularly, tetanus, and botulism, have been recognized in Ethiopia but are never mentioned by the clinicians. Another is black disease caused by *Clostridium novyi* type B. The organism multiplies in areas of liver necrosis caused by migration of liver flukes and produces a powerful toxin resulting in a severe, often lethal toxic hepatitis. The clinicians often quoted the high frequency of liver fluke, so it would be reasonable to think black disease should be common, but was never mentioned. Post-mortems and laboratory examinations might reveal a greater frequency.

There were other diseases never mentioned that would most likely only be detected by laboratory examinations. These include the viral diseases, three-day sickness (ephemeral fever), infectious bovine rhinotracheitis, and pestivirus. Variants of the latter could infect a number of animal species. The never-mentioned list also includes the bovine venereal diseases, trichomoniasis and campylobacteriosis. It is important for the artificial insemination program that these diseases be controlled at the artificial breeding station as their presence could cause problems in attaining high rates of pregnancy percentages.

There was a variable understanding about the prevalence of the zoonotic diseases, bovine tuberculosis (TB) and brucellosis (both *Br. abortus* in cattle and *Br. melitensis* in sheep and goats). This may reflect insufficient information from woreda abattoirs. They and major networks should be good sources of information about TB and other zoonotic conditions such as hydatids.

6. Conclusions and recommendations

Conclusions

1. Most of the animal health services are provided by the government animal health service. The private sector involvement is insignificant, mainly serving as drug shops.
2. The network of government animal health service is well structured with rural animal health clinics serving a group of two to five PAs, woreda level clinics coordinating the rural health posts and diagnostics and surveillance laboratories at region level.
3. The woreda clinics are relatively well staffed and equipped.
4. However, a number of the rural health posts are ill equipped and staffed, and the situation is challenging for the rural staff to meet their responsibilities. However, the reviewer observed that the staff performance is impressive.
5. The regional laboratories are not functioning at their full capacity or not meeting their goals. Their working relations with the woreda clinics is minimal.

Recommendations

Rationalizing budgetary support

1. There should be more budget to increase funding or at least redeploy budgets for animal health services.
2. Regional governments should be balanced in relation to provision of support for their agencies/departments. An example is that they should provide motorbikes to livestock agencies/departments just as they do to other livestock agencies/departments. In two regions, there were upwards of four motorbikes at woreda offices, one each for each other agency, but none for the Livestock Agency.
3. Clinicians should be reasonably treated in relation to provision of transport, electricity, water and per diem and other expenses. Examples—
 - a. At the least, they should not pay for collection of vaccines out of their own pockets.
 - b. Electricity should be provided when it runs right past the clinics.

Regional laboratories

4. Attempts should be made to increase liaison and activity between regional veterinary laboratories and field livestock agency/departmental staff.

5. A review should be made into the effectiveness of regional veterinary laboratories, and if funds are insufficient, they should be redeployed to field services.

Rationalization of veterinary service

6. The provision of animal health services should be liberalized.
 - a. The value of CAHWs should be recognized and encouraged, and be part of the rural animal clinic system.
 - i. Rural clinicians will support and direct CAHWs.
 - ii. Senior veterinarians at woreda offices will in turn direct rural clinicians
 - b. There should be encouragement for private veterinary clinics, starting with licenses to vaccinate.
 - c. There will then be a three tier integrated system: woreda offices and woreda clinics, rural clinics, and CAHWs.
7. Animal health services have benefited from the support of a number of NGOs, for example the higher quality of clinics in Tigray and for the deployment of CAHWs. Such support should be encouraged.

Effectiveness of services

8. Every effort should be made to increase the accuracy of diagnoses by clinicians, for example more post-mortems and provision of specimens to laboratories.
 - a. The work will be that of monitoring to make sure regular diagnoses are as they suspect and not be other diseases with similar clinical appearances.
 - b. It will also provide opportunity for the recognition of other diseases.
9. There should be further studies made of the effectiveness of vaccines, particularly those indicated in this review that may have excess numbers of post-vaccination infections, those for bovine and ovine pasteurellosis, lumpy skin disease and Newcastle disease. The review should include care in transport and application.
10. Efforts should be made to obtain as much information as possible on the prevalence of diseases from the woreda, local and major networks.
11. The artificial inseminations programs should be guaranteed free of the venereal diseases trichomoniasis and campylobacteriosis.
12. Clinics in all areas should be encouraged to attain the degree of neatness and apparent efficiency evident in Tigray clinics.

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