ONE HEALTH CASES

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How Crop–livestock Clinics Are Advancing One Health: A Pilot Case from Uganda

This case narrates the early experiences with crop–livestock clinics – a novel, integrated advisory service for smallholder farmers, which is based on existing government extension structures and capacities. The pilot work is carried out by a transdisciplinary team exploring clinic operations and possible synergies and efficiency gains in four districts in central Uganda.

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Cover image: **Clients waiting with goat and plant samples at a crop–livestock clinic in Uganda. (Photo: C. Alokit)**

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Contents

Summary

Crop and livestock health are crucial to agricultural productivity and farmers' livelihoods. However, in low-income countries, farmer advisory services tend to be permanently short of funding and staff, leaving the majority of smallholders underserved. CABI's work with plant clinics has revealed potential 'One Health' benefits of broadening the scope of the plant clinics to better meet farmers' demands for advice. This case shows how a team from different disciplines and sectors co-created a new type of farmer advisory service in Uganda: a 'plant and livestock clinic' (consultation centre). These joint clinics represent an innovation in farmer service delivery using existing organizational structures and capacities. The case explores the results and lessons learned from the first pilot year. The joint clinics add value to the One Health offer in several ways: (i) crop and livestock staff are able to share operational costs, knowledge and insights in a way that they would not normally be able to do; (ii) plant and livestock consultations in the same place save time for farmers and provide opportunities for cross-learning – farmers 'hang around' to hear the advice other farmers receive and exchange information with one another; (iii) joint clinics are an entry point to improving referral systems and targeting delivery of technology such as animal vaccines and clean cassava cuttings; and (iv) crop–livestock clinics provide an avenue for finding out what farmers know and don't know about One Health issues – crucial information to design solutions. The case also examines the opportunities for furthering crop–livestock clinics as an entry point to advance One Health.

What is the incremental value that makes this a One Health case?

The case shows the transdisciplinary process of co-developing a new type of integrated, cross-sectoral health service for smallholder farmers. The pilot intervention explores opportunities for adding value to existing crop and livestock service delivery in terms of coverage, cost savings, cross-learning among farmers and service providers, and targeted delivery of knowledge and technology.

Learning Outcomes

- Implementing crop–livestock clinics is feasible within the organizational structure of the agricultural extension system in Uganda.
- A cross-sector, multi-stakeholder partnership made it possible to leverage existing resources and skills to develop a new type of integrated health service for farmers.
- Leadership, creativity and adaptive learning are crucial to achieve organizational innovation, especially where resources and capacities are scarce.

Background and Context

The majority of Ugandan smallholder farmers have mixed farming systems, relying on a variety of crops and animals for food, feed and income. The Platform for Agricultural Risk Management identified pests and diseases in crops and livestock as being among the most important constraints to agricultural productivity in Uganda (PARM, 2017). Farmers need advice to address issues that affect the health and productivity of their crops and animals. Yet farmer advisory services in Uganda are permanently short of funding, staff and skills, leaving the majority of smallholder farmers underserved (Ilukor, 2017; UBOS, 2020).

CABI's work with plant clinics over the last 18 years (David *et al*., 2019) inspired new ideas on how to meet farmers' broader demands for advice. A survey among 180 plant doctors (local extension workers

trained in plant health) in Uganda, Kenya, Zambia, Peru and Costa Rica showed that most of them also received queries (and in some cases gave advice) on livestock from farmers during plant clinic sessions, although these clinics were set up exclusively to address plant health problems (Danielsen *et al*., 2020). This fuelled interest in expanding the scope of plant clinics and in improving co-ordination between crop, animal husbandry and veterinary officers whose work is normally not connected.

Hoima district in western Uganda was among the first to express its intent to align crop and livestock services, as stated by the District Production and Marketing Officer: 'We are thinking about conducting parallel sessions...our livestock officers could be around the same place [as the plant clinic] and conduct a livestock clinic. Farmers have had challenges of getting these [livestock] services. That would also address the One Health approach' (Mur *et al*., 2015).

While the search for efficiency gains was the initial driver behind the crop–livestock clinic idea, the prospect of reaping One Health benefits through such integrated services became an additional impetus, as indicated in the quote above.

Why One Health? Animal and plant health are intrinsically linked, to each other and to the health of humans and the environment, in a number of ways: mycotoxins make people and animals sick; misuse of pesticides and veterinary drugs harms the environment, people and animals and contributes to antimicrobial resistance; animal and human nutrition depends on healthy crops of the right quality; poor animal health and hygiene add to the disease burden of people (e.g. zoonoses, parasites); the same is the case with food-, water- and manure-borne diseases. Integrated approaches are required to address these health interfaces, notably in low-income countries where resources are scarce (Fig. 1). Yet, to this day, integrated health services remain under-explored within One Health (Danielsen *et al*., 2020).

This case study shows how a team of people from different disciplines and sectors co-created a new type of farmer advisory service in four districts of Uganda: a combined plant and livestock consultation centre, or clinic, that advises smallholder farmers on plant and animal health and husbandry (the term 'clinic' will be used throughout the case). The case explores the results and lessons learned from the first pilot year,

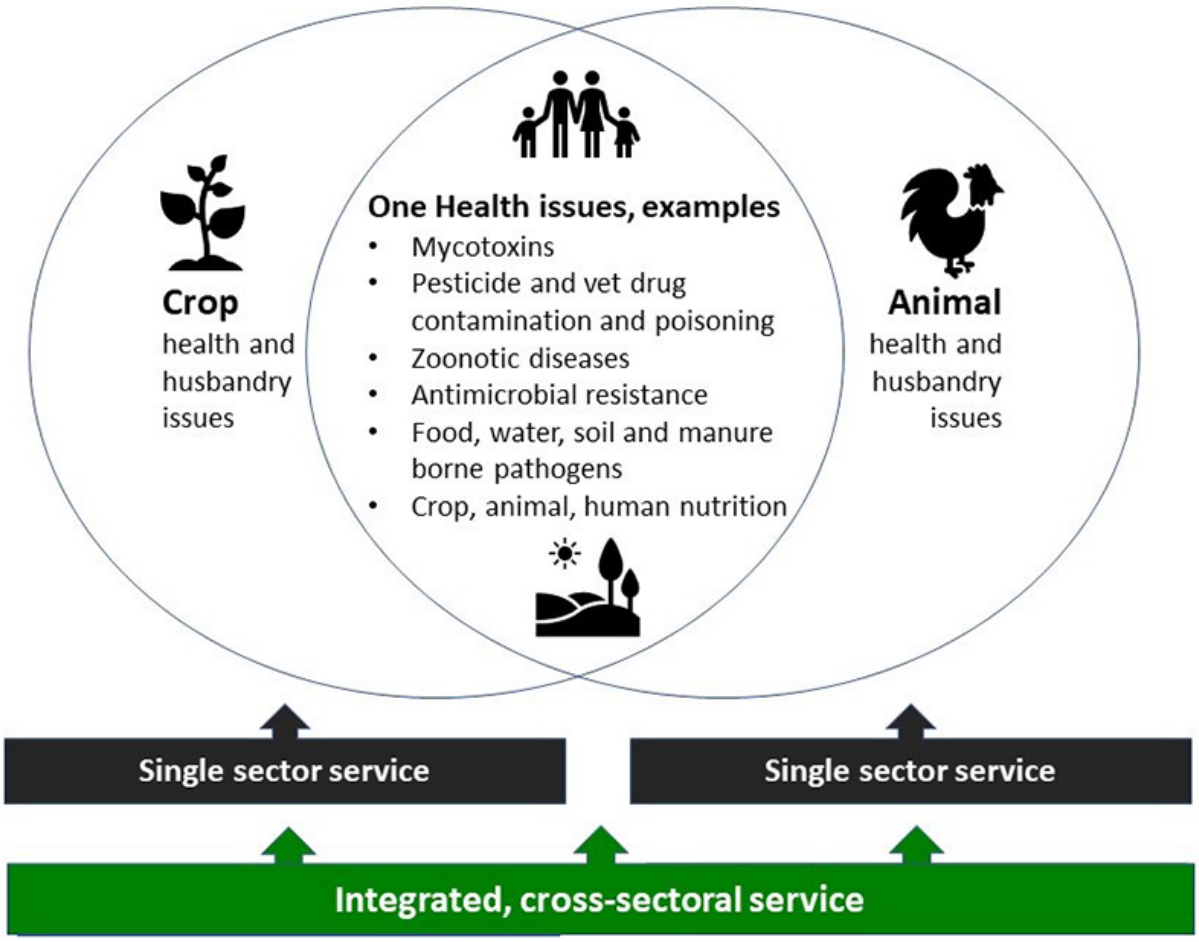

Fig. 1. Cross-sector vs. single-sector approach *vis-à-vis* the One Health crop–livestock interface. (Photo: S. Danielsen)

focusing on: (i) the establishment and operations of joint clinics (see 'Organizing Crop–livestock Clinics'); and (ii) farmer demand for advice and possible One Health added values (see 'Crop–livestock Clinics in Action'). Finally, under 'Project Outlook', we discuss the potential role of crop–livestock clinics as a platform to advance broader One Health action.

Organizing Crop–livestock Clinics

Transdisciplinary team and approach

With a grant from Biovision Foundation, a transdisciplinary partnership – between: local government in four districts; the Ministry of Agriculture, Animal Industries and Fisheries (MAAIF); Makerere University; and CABI – started pilot crop–livestock clinics in 2021 in four districts of central Uganda: Buikwe, Kayunga, Luwero and Mukono. Two additional districts, Hoima and Kagadi, joined in 2022. The partnership includes representatives of the crop and livestock sectors: extension service provision, government regulation and oversight, academia, and development practitioners.

All participating districts had experience with running plant clinics from previous years. They expressed their unanimous interest in experimenting with more integrated clinics with the hope to serve farmers better with targeted, quality healthcare for crops and animals. This gave the initiative a head start which helped to motivate the livestock partners to become involved.

The fact that crop–livestock clinics are well aligned with the structure of the public agricultural extension system in Uganda was another important driver for this cross-sector collaboration. Within a district, each sub-county has assigned one or two crop and livestock/veterinary officers to serve farmers. Agriculture officers (hereafter 'crop officers') are overseen by the District Agricultural Officer (DAO); and the animal production and veterinary officers (hereafter 'livestock officers') by the District Veterinary Officer (DVO). The DAO and DVO report to the District Production and Marketing Officer (DPMO) who is responsible overall for the district's production activities. Thus, once these management levels have endorsed the joint clinic collaboration and deployment of staff, the clinics can take place.

Prior to inception of the joint clinics, a consultation process with farmers and local leaders in the four districts was carried out using focus group discussions (70 participants, of which 54% were female) and a simple survey (39 farmers, of which 46% were female). The purpose was to gauge the main challenges farmers face in handling their crops and animals and to gather inputs for the operation of the new crop–livestock clinics; for example about preferred day, hour and location of clinic sessions. Several farmers emphasized that publicizing clinic sessions via local leaders would help to motivate farmers to attend and create trust in the service.

At the first planning meeting, project partners agreed on principles of co-creation and joint learning as the basis for collaboration. Specifically, this means community involvement, learning while doing, and stepwise improvement, as well as joint assessments and decision making on the direction ahead. Partners' roles were agreed upon, as outlined in Table 1.

While the idea of providing simultaneous crop and livestock advice to farmers was instantly accepted by all partners, the One Health aspects of the joint clinics were less obvious – in the beginning, even confusing, given that in Uganda, One Health initiatives largely focus on zoonoses and antimicrobial resistance. Through multiple discussions and exchanges of ideas during physical and online meetings, field visits and training sessions, partners jointly developed a broader understanding of the One Health roles of crops and animals and their interface (Fig. 1), and how crop–livestock clinics might contribute to improving farmers' knowledge and practice of the same.

Integrated crop–livestock clinic operations

The crop–livestock clinics are modelled after plant clinics, a farmer advisory method adopted by dozens of districts in Uganda since their introduction in 2006 (Mur *et al*., 2015). Over the years, around 1000 crop officers and university students have been trained as 'plant doctors' across the country, receiving specialized training in field diagnostics, plant health advisory and the practicalities of running a clinic. Details of Ugandan plant clinic operations, evolution and benefits are meticulously described in the working paper 'Listening to the silent patient' (Mur *et al*., 2015).

A crop–livestock clinic is a simple set-up consisting of tables and chairs placed under folding tents or at a community facility where farmers can come and go on the agreed dates and within the planned time

(Fig. 2). The clinics, marked with a banner, are usually run by two crop officers and two livestock officers (sometimes more) who offer their services to farmers at least twice a month, typically for half a day. Farmers are invited to present any plant or animal problem, with or without a sample (see next section on biosecurity). The staff are supported by simple examination tools such as knives, thermometers, disposable gloves, weight estimation tapes and magnifiers; and reference materials with pictures of symptoms and information on management practices. Here, the farmer's problem is diagnosed and they receive written advice (an 'advisory note') on how to deal with it – sometimes written in the local language (Fig. 3). The clinic staff keep a record of queries presented (prescription book), which is later entered in Excel. Simultaneously, a digital clinic record system is being developed and tested with a team from the National Food and Agricultural Statistics System (NFASS) under MAAIF's Department of Agricultural Planning and Development. Some districts involve community-based facilitators in clinic sessions where they act as clinic nurses, helping with registration of farmers and handling of samples. They also help to mobilize farmers in their communities.

Table 1. Roles of cross-sectoral partners in crop–livestock clinic pilot project.

Item	District local governments	MAAIF statistics unit	MAAIF crop and animal departments	Makerere University	CABI
Clinic implementation	X				
Training of clinic staff[1]		X	X	X	X
Lab referral[2]	(X)		(X)		
Extension materials[3]	X		X	X	X
Peer and expert support[4]	X		X	X	X
Data management[5]	X	X	X		X
Performance monitoring[6]	X		X		X

[1] Training in animal health, One Health, clinic operations, data collection
[2] Lab referral procedures are being developed; there are cases of samples sent to National Animal Disease Diagnostics and Epidemiology Centre (NADDEC) laboratories.
[3] Sourcing or development of factsheets, photosheets, pamphlets and posters for use at the clinics
[4] Through WhatsApp group chat, and monitoring visits by supervisors and subject matter specialists
[5] System to collect and process records on farmer queries from the clinics
[6] Through monitoring visits, feedback from farmers and community leaders, review of clinic records and review meetings

Fig. 2. A crop–livestock clinic session set up at a public premises that already hosts several health services for people (see sign on the left). Farmers waiting in line are seated under the adjacent tree. (Photo: S, Danielsen)

Fig. 3. A female farmer reads the advisory note she has just received at the crop–livestock clinic. (Photo: A. Ziryamunno)

District staff are not allowed to give or sell inputs to farmers. However, providing guidance on proper sourcing and use of pesticides, veterinary drugs, breeds and seed is an important role of the crop–livestock clinics. There are huge problems with counterfeit products and mismanagement of chemicals and medicines, both in crops and animals. Some staff bring samples of products for display to help explain their use, risks and precautions.

Livestock officers were unfamiliar with the clinic approach. Normally, they visit farmers individually or organize group activities such as training and vaccination campaigns. Operating mobile clinics *together* was new, for the crop and livestock staff equally. Additionally, the vets acknowledged that their training usually focuses on treating the problem at hand but not so much on giving holistic advice on livestock management to farmers. The extension aspect of their work is weak. Through the joint clinic approach, they have gained skills to understand farmers' queries better and give practical and targeted advice (source: district progress reports).

Adaptive learning, examples

Running crop–livestock clinics will inevitably involve challenges and trade-offs. When the clinics began operating, there were many unknowns regarding the practicalities, with many operational aspects needing to be tried out. This section illustrates how the project partnership is dealing with the issues as they emerge, using two topics as examples: biosecurity and sitting arrangements.

Biosecurity

Should farmers be allowed to bring live animals to the crop–livestock clinics, thus risking spreading disease? This question emerged soon after the joint clinic idea began to take shape (Danielsen *et al*., 2019).

The debate about biosecurity is well known from CABI's work with plant clinics, which was initiated in 2004 (Bentley *et al*., 2009). Initially, not much thought was given to the possible risks of moving sick plants from farmers' fields to the plant clinics; but with time, more rigour was applied to how plant doctors should guide farmers and handle diseased samples after clinic sessions, with the establishment of due sanitary procedures. In general, though, the crop cases that would cause alarm, such as quarantine diseases, were rare, and the risk of disease spread from plant clinics was considered low.

This was different with animals. During the early discussions about how to set up joint clinics, strong opinions were expressed, especially by government regulatory bodies and researchers, that farmers should not be allowed to take animals to these clinics. The risk of spreading notifiable diseases was simply considered too high, particularly for clinics held in busy marketplaces. After all, plant samples can be destroyed after a clinic session; live animals cannot.

Early on in the project, all districts decided to adopt a 'mobile clinic' scheme rather than operating always in a fixed location such as a marketplace. A mobile clinic would reach more farmers across the districts. There turned out to be other advantages of the mobile model: (i) farmers have to travel less to attend a clinic session (basically within the same village) and can more easily bring a sample; (ii) holding clinic sessions closer to farmers' homesteads enables clinic staff to make occasional follow-up visits in the field immediately after the clinic session, for example to assess the extent of a certain problem, verify a diagnosis or collect a sample for further analysis; and (iii) female farmers and other vulnerable groups are better able to attend clinic sessions held close to their home.

The mobile mode of operation led to a new decision regarding biosecurity. Due to the short distances between farmers and clinics ('village containment'), project partners now consider it acceptable to allow farmers to bring sick animals to the clinics, though with certain precautions, such as keeping the animals at a safe distance from other people and animals during waiting time and examination (Fig. 4.). Also, not all animal problems are contagious. The first live animal that was taken to a joint clinic was a goat with a small tumour in the head, a non-communicable disease (see cover photo). A small surgery was done on the spot to remove the tumour (Fig. 5).

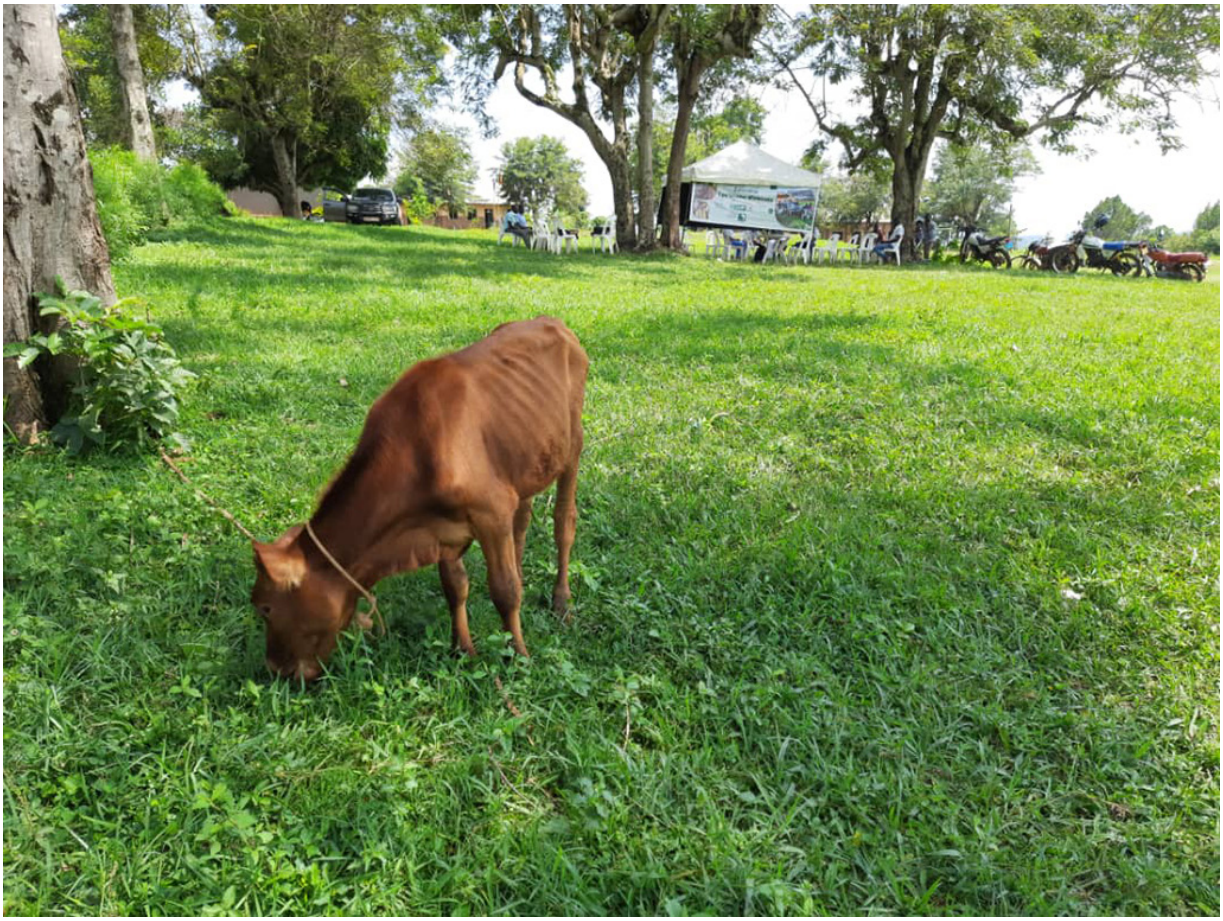

Fig. 4. Animal waiting to be attended to at a crop–livestock clinic (in the background). Image shared in the project WhatsApp group with the caption 'Sick animal kept at a distance as a clinic biosafety measure'. (Photo: A. Ziryamunno)

Fig. 5. A vet officer carries out a minor surgery during a crop–livestock clinic session to remove a small tumour from the head of a goat. (Photo: C. Alokit)

Discussions are still ongoing on where to draw the line between what type of sample or 'patient' the farmers should be allowed to bring. Project partners have started to develop joint clinic guidelines that clearly describe safety procedures for handling of crop and animal samples.

Sitting arrangements, together or apart?

Having crop and livestock officers working side-by-side offers opportunities for exchange and 'cross-learning' among extension workers and farmers on crop and livestock topics. One of the initial questions was: How can sitting arrangements help to stimulate cross-learning? The answer is not simple. There are inevitable trade-offs, which the piloting districts have tried to deal with in different ways.

Early experiences with receiving crop and livestock queries in the same tent, at the same table, were mixed. On the one hand, it created a lot of dynamic interactions. On the other, it sometimes became too noisy and 'messy', making it difficult for the clinic staff to hold proper consultations with each farmer. In some of the districts, this led to the decision to split the crop and livestock tents/tables (Fig. 6). This makes it easier to manage the clients. However, such a set-up limits cross-learning between the crop and livestock groups. Where farmers are allowed to listen in to the consultations, either before or after their own, it is more likely that those farmers acquire a lot of extra information in addition to their own query. For example, at a clinic session in one of the districts, we observed a group of eight farmers (plus others coming and going) patiently staying in the livestock tent for more than an hour, listening and taking notes (they brought their own notebooks) until all farmers had presented their queries. In such cases, the waiting time is used productively for learning and exchange.

Another district is trying a different adaptation, where the crop and livestock officers share a table and attend to their clients simultaneously, one by one, within earshot of each other, while the other clients wait for their turn from a distance (Fig. 2). This set-up enables thorough, focused cross-learning between the two farmers and the two clinic officers sitting at the table, simultaneously. Yet, the farmers who are waiting do not benefit from these exchanges.

Managing waiting time, ensuring that every farmer is well attended to, and optimizing learning for all – including cross-learning – is a challenge that inevitably involves some compromises. To illustrate these, we rated four

different sitting arrangements (I-IV: separate vs. joint tents; farmers 'listening in' vs. waiting at a distance) with regard to opportunity for 'added learning' (within crop and livestock topics), opportunity for cross-learning (across crop and livestock topics) and undisturbed consultations. We used a scale from 1 to 3, where 1 = minimal, 2 = fair and 3 = good. Fig. 7 shows that every sitting arrangement has its pros and cons.

New ideas to be tested involve making displays of relevant information – for example using posters, photosheets and factsheets – so that farmers can use the waiting time to study and discuss with each other. Another idea is to actively encourage farmer-to-farmer exchange before or after clinic sessions. This could be moderated, for example, by one of the clinic staff not serving the farmers at that specific time or by a community-based facilitator.

Fig. 6. Crop and livestock officers attending clients in separate tents. (Photo: C. Alokit)

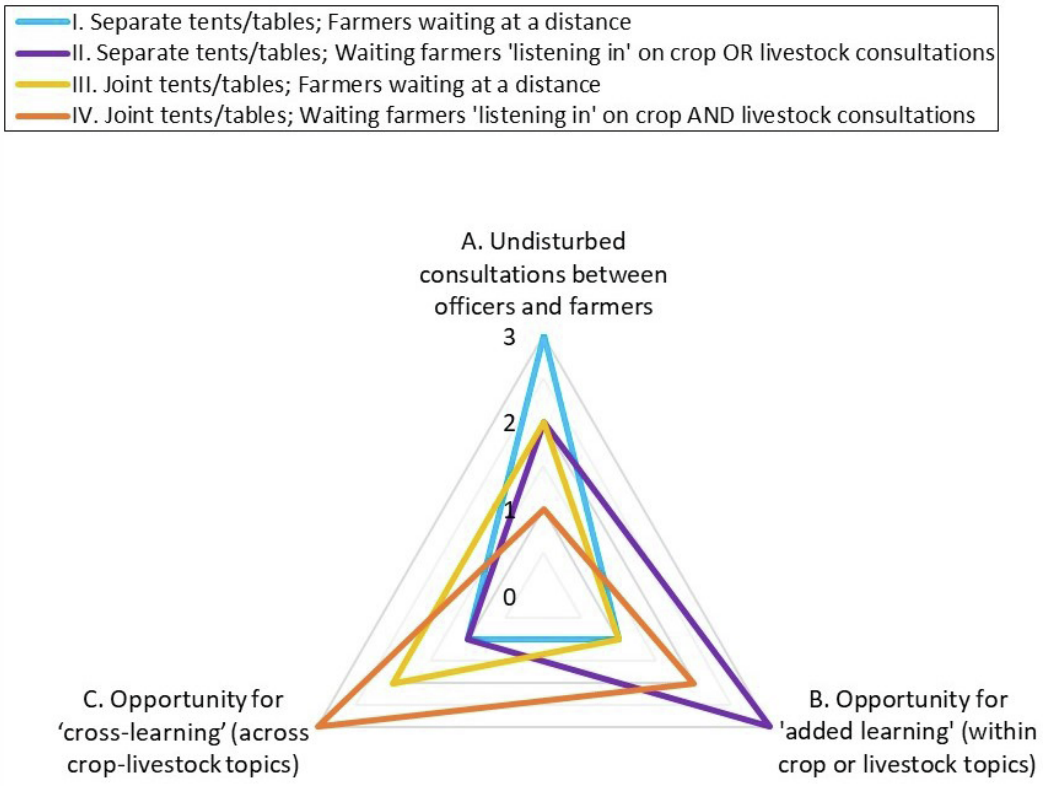

Fig. 7. Rating of four different sitting and waiting arrangements (coloured lines) according to the features (A–C) indicated at the corners of the triangle. Scale: 1 = minimal; 2 = fair; 3 = good.

Crop–livestock Clinics in Action: Results and Lessons from Pilot Year

What clinic records tell about farmers' demands for advice

The crop–livestock clinics capture farmers' explicit demands for information and advice. As such, clinic records are a valuable tool to identify knowledge needs (for farmers and clinic staff) and to plan follow-up actions and resource allocations.

During the first nine months, more than 1000 queries were presented at the four crop–livestock clinics by over 700 farmers of whom 43% were women (Table 2). There were more crop than animal queries, probably because farmers were already familiar with plant clinics. On the other hand, 15% of the clinic users presented both crop and animal queries, indicating that farmers are beginning to take up the idea of a double-purpose service.

A total of 32 different crops and nine animal species were presented at the clinics. The dominant species were coffee, banana, maize, tomato and cassava (67% of all crop queries); and cattle, poultry (chicken), pigs and goats (97% of all animal queries). Less frequent crops include oranges, beans, egg plants, cocoa, mango, cabbage, groundnut, avocado and other minor roots, fruits and vegetables. A few queries were presented on dogs, rabbits, sheep, turkeys and cats.

Some gender-related trends appeared from the clinic records. For example, coffee and cattle queries were dominated by men, while banana and poultry queries were dominated by women (data not shown).

Several dozen problems were presented, mostly on pests and diseases but also on crop and animal husbandry issues (Table 2). The five most frequently identified problems are listed in Table 3, all well-known, widespread problems in Uganda with banana bacterial wilt and Newcastle disease at the top, both problems of female-dominated commodities. These findings suggest that extension messages and farmer mobilization need to target the specific needs of female and male farmers.

Table 2. Overview of farmer attendance and types of queries presented at crop–livestock clinics.

Clinic visitors	
Farmers visiting the joint clinics	741
Females	43%
Farmers with both crop and livestock queries	15%
Return clients	10%
Queries, overall	
Total queries presented	1080
Crop queries	59%
Animal queries	41%
Types of queries	
Crop queries	
Queries on pests and diseases	90%
Queries on crop husbandry issues	10%
Animal queries	
Queries on pests and diseases	72%
Queries on animal husbandry issues	28%

Source: Clinic records 2021, all four pilot districts

Table 3. Five most frequent crop and animal problems identified at the crop–livestock clinics.

Crop problem	No. of queries	Animal problem	No. of queries
Banana bacterial wilt	86	Newcastle disease in poultry	22
Black twig borer in coffee	74	Salmonellosis in chicken	18
Red blister disease in coffee	35	Mange in pigs	18
Fall armyworm in maize	27	Helminthiasis/worms in cattle	17
Banana weevils	24	Ticks in cattle	16

Source: Crop–livestock clinic records 2021, all four districts; diagnoses not verified

What clinic records tell- and don't tell- about One Health issues

Looking at the clinic records through a One Health lens, some issues are obvious while others remain concealed or simply absent. Around 13% of all queries were categorized as One Health issues. Of these, zoonoses and their vectors were by far the most frequent and directly identifiable (Table 4).

For other types of One Health issues, clinic consultations may give indications, but not a clear-cut diagnosis. For example, misuse of pesticides and veterinary drugs can be difficult to identify. The signs are not necessarily clear, consistent or even present. The misuse of pesticides can take many forms, including using counterfeit or banned products, overdosing, and cleaning/disposing of containers in an unsafe manner. Extracting as much information as possible from the farmers about their knowledge and practices is an important function of the clinic staff to discern the underlying problems.

Mycotoxins did not appear in the records although they are known to be a severe problem in Uganda, notably aflatoxins in maize and groundnut (Omara *et al*., 2020). Three clinic records mentioned twisted neck in chicken (Table 4), which may be caused by a toxin, but not necessarily. The absence of queries on mycotoxins, or 'moulded grain', raises questions about farmers' awareness of this issue. This may mirror the situation in Malawi where smallholder farmers do not consider aflatoxin contamination a problem that can be controlled (Gichohi-Wainaina *et al*., 2021).

Before starting the crop–livestock clinics, we gauged farmers' One Health knowledge in the four pilot districts, asking questions such as: 'Do you know of problems in crops/grain/fodder that can affect animals or people?' and 'Do you know of problems in animals that can affect people?'.

Some farmers were aware of some One Health-related issues, such as pesticide poisoning, mycotoxins, poisonous plants, specific zoonoses, as well as the consequences of consuming unsafe food or feed (Table 5). However, in general, awareness was scattered, incomplete or missing, except in the case of brucellosis, which most of the interviewed farmers knew about (Danielsen *et al*., 2021).

Antimicrobial resistance is a hugely complex issue which cannot be solved, let alone identified, at the individual level. It is therefore not surprising that the clinic records do not capture this phenomenon explicitly. The same applies to food-, soil- and water-borne diseases, which are likely not easily recognized by farmers or service providers. A case from rural villages in the Eastern Cape, South Africa, demonstrates this: although the prevalence of human food-borne diseases was reported as high, the records in clinic registers were scant, indicating that some problems fall under the radar of the healthcare system (Bisholo *et al*., 2018). This is likely to be the case with crop–livestock clinics as well. The value of clinic records lies both in what they tell and what they don't tell. Most farmer queries can be identified and addressed through

Table 4. One Health issues identified from the crop–livestock clinic records.

Type of One Health issue	Total cases	Detail
Zoonoses	88	Helminthiasis, salmonellosis, mange, trypanosomiasis, anaplasmosis, mastitis, 5 others
Minor zoonosis	21	Newcastle disease
Vector of zoonoses	18	Ticks, tsetse fly
Pesticide/medicine misuse	15	Acaricide, herbicide
Maybe toxin?	3	Twisted neck in chicken

Source: Crop–livestock clinic records 2021, all four districts; diagnoses not verified

Table 5. Farmers' awareness of One Health issues (% affirmative responses).

One Health issue	Responses
Problems in crops/feed that can affect animals and/or people	
Harmful feed (uncooked cassava, high moisture content in feed causing bloating)	18%
Mouldy grain (proxy for mycotoxins)	15%
Harmful effects of pesticides (poisoning, skin irritation)	10%
Problems in animals/animal products that can affect people	
Brucellosis	62%
Other zoonoses	36%
Consumption of contaminated milk/meat	15%

Source: Farmer survey, Uganda, 2021 (n=39) (Danielsen *et al*., 2021)

individual consultations and action. Other issues, like the ones mentioned above, are not easily identified and understood through individual cases, requiring different interventions that include the involvement of stakeholders across sectors and disciplines. As such, crop–livestock clinics can be an entry point for broader action including awareness raising.

One Health benefits: added values of integrated clinics

Saving time for farmers

Even before the crop–livestock clinics had started, surveyed farmers from the four pilot districts were clear that the advantage of such an integrated service, a sort of one-stop centre, would be that they could save time (Danielsen *et al*., 2021) and the pilot confirmed this benefit. In addition, distances to the mobile clinics are short, typically within walking distance, meaning no direct costs related to attending clinic session for farmers, apart from the time they invest.

A similar positive attitude to integrated health services was seen in Tanzania, where child deworming was carried out simultaneously with vaccination of dogs against rabies. Participants appreciated the integrated intervention, due to time and cost savings and increased access to essential healthcare (Davis *et al*., 2022).

Cost benefits – how to value the joint clinics

Although estimates of cost-efficiency and -effectiveness of the crop–livestock clinics remain to be made, there are signs that joint clinics have improved service delivery in different ways. Feedback from clinic staff and district managers indicates that the mobile clinics, while costly due to transportation of staff and equipment, enhance farmer reach as well as geographic coverage within the sub-counties compared to other extension methods. This type of cross-sector collaboration is new and highly appreciated. Operational costs for transport and publicity are shared between the crop and livestock departments.

The mobile clinic model has an important advantage compared with other extension methods, such as field demonstrations and farmer field schools: as the clinics rotate between different parishes in a sub-county, they gather data about the common pests and diseases in these localities. These data are valuable to inform district planning and budgeting processes and to generate quarterly disease reports for MAAIF. This is an important added value since resources for crop and animal pest surveillance are always scarce. In this way, the joint clinics become a mechanism for pest vigilance. No other extension method has that function.

But there are other ways in which the joint clinics are becoming enablers of complementary actions. Clinic staff regularly carry out follow-up visits to farmers' fields/farms after the clinic session, thus saving costs for additional transportation. Where possible, they refer farmers to agrovet shops or other reliable input sources. In one case, clinic staff responded to farmers' queries on cassava brown streak disease by subsequently organizing the distribution of clean cuttings of the resistant variety, NAROCASS1.

In another case, a district veterinary laboratory technician began to join clinic sessions to take samples for diagnosis or confirmation to the newly revamped district laboratory (see some of the analyses that are offered freely to clinic users in Box 1). There are several advantages to this: (i) costs of transport are lowered as the technician sometimes gets a lift with the other clinic staff and samples are collected in one

Box 1. Some of the analyses carried out at a district veterinary laboratory.

- Brucella screening
- Faecal examination for worms (helminthiasis)
- Testing for tick-borne diseases (east coast fever, anaplasmosis, babesiosis)
- Trypanosomiasis testing
- Tuberculosis
- Mastitis (bacterial culture)
- Avian influenza screening
- Mange
- Semen analysis

place instead of from scattered farmer locations; (ii) both farmers and clinic staff benefit from the expertise of the technician who demonstrates how to take a sample correctly, how to pack it and how to transport it; (iii) these samples are taken directly from 'clinical cases' to the district laboratory, making the referral chain the shortest possible and reducing loss of samples during transportation, a common challenge of referral systems. Results from the tests are subsequently communicated to the farmers via the clinic livestock officer.

The joint clinics have also become a helpful instrument to identity needs for vaccination and other treatments. In some cases, animals are vaccinated on the spot (Fig. 8). One vet officer organized village vaccination and deworming when he realized that there was a big gap in routine treatment:

> *Without the clinic, I would never have found out that this gap existed….Because of the way we normally operate, we don't get in contact with many farmers. We don't have the resources. The joint clinic has given me an entry point to connect better with farming communities. It has made me more visible and relevant.*

These examples show that joint clinics are becoming a valuable entry point for broader action (pest reporting, referral, technology delivery, follow-up) that contributes to strengthening healthcare for crops and animals.

Besides, being highly demand-led, the clinic approach allows targeting of farmers with greatest need. More farmers have established a rapport with extension due to the one-on-one interactions and shared contacts for follow-up visits. Clinic staff have noticed that these interactions are helping to build farmers' confidence to engage with public and private extension.

Therefore, cost–benefit estimates need to look broadly at the clinic benefits, not only at the number of farmers reached against direct costs.

Fig. 8. A livestock officer vaccinates a dog against rabies during a crop–livestock clinic session. (Photo: A. Ziryamunno)

Cross-learning

Cross-learning is benefitting farmers as well as clinic staff. This excerpt from a district progress report broadly represents the shared experiences across all pilot districts:

> *In most cases, farmers come with different issues, but they return home with more information than they came for, learning about other crop and animal problems from fellow farmers and clinic staff. Also, the agriculture and vet officers learn from each other on how they handle the different issues.*

The previous section on sitting arrangements narrates the ways in which such cross-learning between farmers and between farmers and clinic staff can take place: through 'listening in' to other consultations as well as through one-on-one or group exchanges, either during waiting time or after consultations.

Dealing with the multiple queries that farmers bring to the clinics is a huge challenge for the clinic staff, since they do not know beforehand what problems farmers will bring. Yet they need to act on the spot to give the farmers a sense that they are well served. Cross-learning, peer and expert support are central to clinic staff feeling confident in their work.

Cross-learning can take place in different ways. Apart from the face-to-face collaboration happening at the joint clinics, a joint clinic WhatsApp group has become an important mechanism for exchange, consultations and encouragement among peers and experts from the crop and animal sectors: clinic staff and crop and animal specialists from the districts, MAAIF and Makerere University.

One of the first messages posted in the WhatsApp group was indeed about a One Health issue: a warning against what several group members recognized as a dangerous practice that some farmers use, namely mixing or replacing acaricides with a pesticide ('dudu', synonym for Dudu Acelamectin, an insecticide for use in crops) for control of ticks in cattle (Fig. 9). This practice can cause blindness in cows and make the milk and meat unsafe for human consumption. It seems to be a growing problem in Uganda, caused by increasing levels of tick resistance to conventional acaricides (Ssengendo, 2022).

Group members (37 in total) actively share news, extension materials and resources for continuing learning, for example a YouTube film on miscarriage in goats, a video clip about aflatoxins and a link to tools on preparedness and response from the Africa Centre for Disease Control. Members also share images of clinic sessions and give feedback on practical aspects of clinic operations such as: filling out of the prescription form, placement of the clinic banners, and design of the advisory note. Photos of crops and animals with symptoms are posted with requests for help with identification.

Fig. 9. WhatsApp message about the dangerous practice of using crop insecticide (dudu) to control ticks in cows. (Joint clinic WhatsApp group)

The various crop and livestock staff, who belong to the same department (agriculture) within their districts, said they have previously not had close working relationships and that the joint clinic approach has enlightened them on each other's work and enabled aspects of cross-learning that they find useful (source: review meeting, December 2021). Breaking down disciplinary barriers is a prerequisite for integrated health service delivery.

Project Outlook

The first pilot year has created a solid foundation to further explore clinic operations, cost–benefit and the One Health role of crop–livestock clinics. Having crop and livestock officers working together to deliver a service to farmers has been an eye opener and there has been a realization that even within the agricultural sector, the crop and livestock sub-sectors tend to have little to do with each other. In the next phase, project partners will continue to explore ways in which these sectors can further create financial, operational and knowledge synergies, and leverage inputs and benefits for the human health sector.

A key priority in the next phase is to get involved with the public health sector, seeking synergies and joint action to solve some of the major health problems that are linked to farming, beyond zoonoses. The human health sector has a much longer tradition for healthcare service delivery compared to the agricultural sector. Conversely, the human health sector could benefit from engaging more directly with agriculture to address the burden of disease that is rooted in agriculture and agricultural practices. How can the district agriculture and health departments work together to address some of the issues where the health of plants animals and people are obviously linked? There are various delivery mechanisms to be explored; for example, village health teams (VHT) are widely available with around 179,000 VHT members working across the country (Musoke *et al*., 2020). Environmental health practitioners carry out various One Health duties within disease surveillance, prevention and control; food safety; and sanitation and hygiene (Musoke *et al.*, 2016). Another idea could be to target mothers waiting at antenatal clinics with relevant crop–livestock information.

The crop–livestock clinics could provide an entry point for joint actions to address complex One Health issues (such as pesticide risk reduction, mycotoxin contamination and antimicrobial resistance) that are not always evident from problems brought to clinics.

Conclusions

The first pilot year generated vast knowledge and experience about joint clinic operations, farmers' demands for advice in relation to One Health issues and ways in which crop–livestock clinics are adding value to joint service delivery and insights into those issues.

In addition to delivering advice to farmers, the joint clinics are showing their value as entry points for broader action (pest reporting, referral, technology delivery and follow-up), thus contributing to strengthening healthcare systems for crops and animals. There is potential to further expand this role by linking with public health to address some of the major health problems that are linked to crop and livestock production and which impact on human health.

Crop–livestock clinics represent an innovation in service delivery based on existing organizational structures and capacities. They also have the potential to become a practical, hands-on way to put One Health into practice.

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