WFO E-MAGAZINE

F@RMLETTER

ISSUE N°69 JANUARY 2018

SMART LIVESTOCK

Future trends in the use of innovation technologies for animal health management and monitoring

E-Magazine

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GLOBAL TOOLS IN ANIMAL HEALTH MANAGEMENT HELP LOCAL COMMUNITIES

Dr. Berhe G. Tekola
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Livestock plays a major role in world agriculture and contributes to a global average of 40 percent to the national agriculture gross domestic product (GDP). Over 75 percent of the world's 1 billion people living on less than USD 2 a day rely on crop and livestock farming for their survival. Livestock, a rich source of protein and micronutrients, is often the only insurance against crop failure. Sheep and goats, for example, represent a significant part of the global livestock industry, particularly in developing countries. They contribute to food security and nutrition, livelihoods, national economic development and the overall well-being of people. Small ruminants not only provide households with meat and milk, they can easily be sold for cash, allowing families to buy staple foods and cover other expenses such as school fees and are a safety net for emergencies. Similar importance are poultry production systems and swine production (certain regions), especially because of their faster reproduction rates than ruminants. In fact, the historical trend is led by poultry, which has the fastest growing demand followed products from small ruminants. However, in order to take advantage of this opportunity, farmers will have to make significant improvements in livestock production and ensure that

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In 1986, Mr. Tekola started his professional career as Field Veterinarian, then in 1992, he joined the National Veterinary Institute (NVI) of Ethiopia where he worked and led the Institute (Vaccine Production Enterprise) until 2007.

In 2007, Dr. Tekola was appointed to the position of Director, Animal and Plant Health Regulatory Directorate within Ethiopian Government.

Since August 2011, he joined the Food and Agriculture Organization of the United Nations (UN-FAO) as Director of the Animal Production and Health Division, leading the Animal Health Service (AGAH), the Animal Genetic Resources Branch (AGAG) the Livestock Production Systems Branch (AGAS) and the Livestock Information, Sector Analysis and Policy Branch (AGAL). He and his team strive to address the sustainability of the Livestock sector.

Currently he is the technical focal point for FAO on the Tripartite One-Health initiative lead by FAO, OIE and WHO.

livestock products are safe and healthy for human consumption.

One of the major factors restricting efficient livestock production is the presence of high impact animal diseases. This is a particularly serious problem in the developing world, where capacity to cope with the cost and logistics of controlling such diseases is often limited.

Diseases such as foot-and-mouth disease (FMD), highly pathogenic avian influenza (HPAI), classical (CSF) and African swine fever (ASF), trypanosomosis, and *peste des petits ruminants* are endemic in some of the world's important and high livestock producing countries in Africa, Asia, or Latin America. They collectively impede safe trade and deprive poor farmers of access to quality nutrition, lucrative global markets in livestock and livestock products.

The Food and Agriculture Organization of the United Nations (FAO) main mandate is to eradicate hunger and alleviate poverty. To this end, FAO is committed to improve production efficiencies through its animal health and food safety programmes.

FAO emphasizes capacity development of different stakeholders, including producers and government authorities to prevent, detect, and respond to the emerging animal infectious diseases or improved risk-management of endemic diseases.

Since the 1970's, FAO, its reference centres and its joint division at the International Atomic Energy Agency (IAEA) has contributed to improve these capacities through the development and application of new technologies aimed at improving the overall capacities of the country to protect their livestock - from poultry to camels and horses through small ruminants and cattle - and safeguard this natural genetic resource. These technologies are validated through laboratory and field-testing, revised and improved to keep pace with the farmers' constant changing needs and technological advances. Numerous tools are currently available for different stakeholders with input and support from FAO's best experts. Some examples:

The FAO Laboratory Mapping Tool (LMT): Aiming to improve the capacities and capabilities of diagnostic laboratories to detect and characterize infectious agents, and therefore to support the prevention and management of health threats, the LMT, developed with support from USAID, it identifies areas for investment and capacity building. The LMT is based on a standardized format that allows data to be captured in a systematic semi-quantitative manner by external evaluators or through self-assessment. An overall score for the laboratory and summary scores for each of the categories are automatically generated by the tool itself. These scores create a laboratory profile or "map" that can be used to demonstrate functionality and capacity status at the national or regional levels. Yearly assessments allow to measure improvements and regional approaches are especially useful. Since then the LMT core has been extended through its LMT module on Biosafety and Biosecurity and an adapted version is being rolled out to address the laboratory and surveillance efforts to combat antimicrobial resistance. For the future, FAO plans to develop an online page where countries will be able to download, store and analyze their assessments and compare their status on an anonymous basis with others at regional or global level.

EMPRES-*i*, a Global Animal Diseases Information System, is a web-based platform that provides real time information on animal disease distribution and current threats at national, regional and global levels. EMPRES-i makes accessible to

stakeholders epidemiological data on animal disease outbreaks and surveillance such as CSF or ASF, HPAI, FMD, or Rift Valley fever. This platform stores outbreak disease records, tracks, monitor disease events for provision of alerts and awareness on health threats. EMPRES-i adds value to the official reporting mechanisms of the World Organisation for Animal Health (OIE). One of the main and innovative tools of EMPRES-i and developed by FAO to support disease animal disease surveillance efforts of countries is the Event Mobile android application (EMA-i), a digital hand-held tool used by veterinary services that provides real-time disease information from the field. These surveillance and early warning tool allow for a quick and efficient recording and transmission of animal diseases events (including zoonoses – a risk of transmission to humans). The EMA-i app allows collecting and transmitting geo-referenced data on animal health events in the field in real-time with mapping capabilities. All EMA-i data collected and transmitted is stored into EMPRES-i but is of restricted access. The EMA-i system is in use in Uganda, Tanzania, and Mali and expansion is foreseen in other African countries.

> **Livestock, a rich source of protein and micronutrients, is often the only insurance against crop failure.**

The Surveillance Evaluation Tool (SET): The capacity to efficiently and rapidly detect diseases in animals is essential to reduce the impact of outbreaks that can devastate livestock populations and people's livelihoods. With support from the United States Agency for International Development (USAID), FAO developed SET. The SET toolkit provides a systematic way to evaluate countries' capacities to detect and report animal disease. Ninety indicators are used to score a system along several aspects of surveillance including: policies, laboratory capacity, data management, field capabilities and more. The information needed to use the tool is gathered by a team who meets with key ministries officers to local farmers that are relevant to a sound surveillance network. The data obtained is entered and a graph highlighting a country's strengths and weaknesses automatically obtained. This forms the basis from which an action plan for improvement is developed. SET has already been deployed in Tanzania, Liberia, Kenya and Côte d'Ivoire, and future evaluation missions are planned for Senegal, Mali and Ethiopia. Repeated assessments every 2-5 years will allow for a comparative analysis of the progress made in livestock disease surveillance.

The **sterile insect technique** (SIT for short) is an environmentally-friendly insect pest control method involving the mass-rearing and sterilization, using radiation, of a target pest, followed by the systematic area-wide release of the sterile males by air over defined areas, where they mate with wild females resulting in no offspring and a declining pest population. Sterile insects are not self-replicating and therefore cannot become established in the environment. The SIT has been successful in controlling a number of high-profile insect pests, including Tsetse fly and Screwworm . Benefits of using the technology reduces livestock production losses and protection of livestock industries for commodity access to high value markets without quarantine restrictions, protecting and creating jobs and less environmental protection through a reduced use of insecticides.

Another innovative technology recently developed is the **livestock protective fence (LPF)**, which involves the simple but innovative use of environmentally friendly insecticide-impregnated nets to protect livestock. The technology is capable of doubling or tripling milk outputs on smallholder dairy farms, while also reducing mosquito-borne illnesses in humans. The nets drastically cut the numbers of flies, mosquitoes and other disease-transmitting insect vectors by up to 90 percent. Pig farmers using LPFs in a coastal area infested by tsetse flies in Ghana substantially reduced trypanosomosis prevalence in their pigs and obtained higher prices for their animals on the market. Mastitis, which can be spread by flies and poor hygiene during milking, can be halved on smallholder dairy farms. Nevertheless, careful management and monitoring of the expanding use of LPFs will be required to avoid the development of resistance strains in certain populations/species of arthropods.

Finally, some promising innovative tools to enhance animal health management comes from micro and nanotechnologies. Among their uses it is worth mentioning vaccines design, the potential use of specific drugs to act on targeted sites in the body of the animal, the stimulation of certain cells within organs or the early and confirmatory diagnosis in cases of known or unknown pathogens, even in air or sewage.

Thus, in the few example presented above the reader can sense that the future of animal health management - prevention, early detection and control is here! This creates a very exciting dynamic and groundbreaking fields that will allow producers and governments to benefit from a healthy, sustainable and flourishing livestock sector to assure quality nutrition and management of its resources.

Kenya accelerated value chain development program (AVCD)

ELECTRONIC SYNDROMIC SURVEILLANCE SYSTEM FOR LIVESTOCK DISEASES (S3LD)

Dr. Bernard Bett
SENIOR SCIENTIST, INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE (ILRI), NAIROBI, KENYA

Background

The use of technology in Livestock represents a key opportunity to ensure an increased production and to improve animal well-being. The International Livestock Research Institute has been working for years in research to provide new and innovative tools to make production more efficient and effective while respecting animals' needs.

An example of the projects carried out by the Institute is the Electronic Syndromic Surveillance System for Livestock Diseases (abbreviated S3LD) that enables the County Veterinary Authorities to collect, collate and analyse data on livestock diseases in counties participating in the Feed the Future USAID Accelerated Value Chain Development – Livestock Complement (AVCD-LC) project. The system aids the identification of disease indicators, syndromes or clinical signs in real-time or near real-time for early detection and rapid response. S3LD major utility is in the detection of emergent issues that require clinical and/or laboratory confirmation and response.

Components and operations

The system comprises data collection phones that are operated by field veterinarians based at the sub-county locations and an online server where the data is collated and analysed. The veterinarians collect animal health data during their routine active surveillance missions including participatory disease search, or via telephone contacts with community disease reporters (CDRs) who are based at the manyatta/village and have been trained on syndromic surveillance. Using the data collection phones, the sub-county veterinarians record the received information and reports and submit them to the online server. The online server has automated scripts that processes and analyses the data as it receives and generates trends in syndromes or diseases in tables, maps or graphs which can be used by the County veterinarians to guide implementation of responses. It also generates a word cloud which identifies the commonly reported syndrome, clinical signs or phrases using a text mining algorithm.

The system also generates a county-wide biweekly bulletin which is shared among the various stakeholders as well as data collectors within a county.

Benefits

S3LD is expected to substantially reduce the response time as the types of clinical cases and syndromes reported, and their locations, are made available to the disease control agents at the county and national levels. The current system uses automated scripts to analyse the data and produce risk maps, morbidity and mortality trends and syndrome frequencies as word clouds. Risk maps produced can be used for risk-based surveillance and deployment of interventions.

Innovation

The S3LD collates data from multiple sources including sub-county veterinary offices, slaughter houses, livestock markets, and agro-veterinary drug stores, some of which have not been used previously for livestock disease surveillance. The S3LD has also necessitated the establishment of fruitful collaborations between field veterinarians, community wildlife conservancies, agro-veterinary stores, CDRs and pastoralists. The on-line database developed provides the county veterinary staff with a reliable and accessible repository for managing large volumes of data (big-data) which hitherto was being stored without any analyses in the traditional veterinary rumour registers and ledger.

EVALUATING AGROVET SERVICES FOR KENYAN PASTORALISTS: WHAT'S WORKING?

David Galaty
DIRECTOR OF RESEARCH AND INNOVATION IN EAST AFRICA AT TECHNOSERVE, KENYA, A FARMING FIRST SUPPORTER

Across the dry, sparsely populated lands that extend across large areas of northern Kenya, semi-nomadic herding communities – or pastoralists – have survived for centuries by grazing their cattle, sheep, goats, camels and donkeys over vast distances in perpetual rainfall-driven cycles.

Pastoralism has always been challenging and in many ways, it's getting harder. Droughts seem to be growing longer, harsher and more unpredictable as climate change scrambles the meteorological order of these areas.

Offering an economic lifeline that could help stabilize pastoralists are new market opportunities generated by sub-Saharan Africa's rapidly growing demand for meat and milk. But there's a major obstacle preventing many pastoralists from seizing these opportunities: the lack of access to diagnostic, preventative and curative services and products that can help protect their animals against an array of health threats like trypanosomiasis, rinderpest and worm infestations—afflictions that can either kill livestock or make them too sick to be of any economic value.

Veterinary services, vaccines and drugs are available in most parts of the country, but the (mistaken) perception of low demand, sparse population and perceived high investment risk has led to huge swathes of Northern Kenya being severely under-served by nearly all public- and private-sector services. Today, there are government-funded efforts to provide veterinary vaccination services to pastoralists, but these are limited mainly to "trade sensitive" problems—endemic diseases that can harm export opportunities. That means many deadly or debilitating livestock health problems go largely unattended. Further complicating the situation are widespread reports of pastoralists encountering inept or outright fraudulent vendors, leaving them wary of private veterinary service providers.

Bringing Quality Commercial Veterinary Care to Pastoralist Communities

Over the last few years, several new initiatives have been launched to put commercial providers of veterinary services in regular contact with pastoralists and their herds. To facilitate and evaluate these efforts, TechnoServe's Innovations in Outcomes Measurement (IOM) project is partnering with the Nairobi-based International Livestock Research Institute (ILRI), along with Kenya Markets Trust (KMT), to implement and evaluate three different approaches, to determine whether these approaches are improving animal health for pastoralists, and if those improvements are leading to increased profitability.

Equally important, IOM is evaluating whether the increased contact with pastoralists is boosting profits for commercial veterinary service providers. The success or failure of the different efforts will ultimately depend on whether they offer a business model that makes servicing pastoral communities financially sustainable for commercial providers.

APPROACH #1
The Weekly Circuit

In Garissa County, in Northeast Kenya, IOM is assessing ILRI's effort to establish a regular weekly circuit in which commercial service providers—mostly in the company of government veterinarians—travel to watering points, markets and villages where pastoralists often gather with large numbers of animals to offer the full range of animal health services that are allowed by law; tick control, hoof trimming, dehorning, castration, pregnancy diagnosis, treatments, sale of veterinary inputs and dissemination of advice from extension services.

Alow Dahir Ahmed, who owns Garissa AgroVet in the town of Garissa, says there is an incredible demand for veterinary services and inspired him to be more aggressive in seeking out customers. Overall, this new proactive approach is having positive impact on sales, and his business is thriving. In May of 2015, Alow generated US$4400 in sales. One year later, sales had more than doubled to US$9700.

APPROACH #2
Bundling Businesses

In Isiolo and Marsabit Counties, ILRI and IOM are working with the Northern Rangelands Trust (NRT) and Sidai Africa, which operates veterinary health franchises across Kenya, to pilot the packaging of commercial veterinary products and services with government or NGO-operated animal health campaigns. The goal: a cheaper single bundle of products and services that is more attractive to the consumer.

Sidai representatives ended up selling products and services to deal with problems like worms, trypanosomiasis, tick infestation and various bacterial infections, including pneumonia and enterotoxaemia—an often fatal but vaccine-preventable livestock disease. Overall, sales during the campaign helped the Sidai franchise exceed its monthly revenue target by 20 percent.

The bundling effort was not without challenges. There were several herders who were confused by the fact that some services were provided for free from the government, but others required payment. This issue is now on the wane, however, given that as the provision of commercial services in pastoral areas expands, services and products are provided where and when they are needed, and relationships are strengthened between commercial service providers and pastoral communities.

APPROACH #3
Microfranchises

In Turkana County in northwest Kenya, IOM is evaluating a partnership between KMT and a local provider, Silo Agrovet, to improve veterinary products and services offered via a network of small, satellite micro franchises housed within 18 small retail shops that operate in villages across the county.

Silo's new satellite agents also are learning basic book keeping practices to record sales of veterinary supplies and developing systems to track their outreach to pastoralists. Already, some of the agents have been able to either move with the pastoralists to provide veterinary products and services as they migrate to new locations, or meet up with them at watering points on market days.

KMT is also reaching out to manufacturers and distributers of livestock vaccines and drugs to ensure a steady stream of affordable, high-quality products are available to enable Silo to rapidly scale-up its offerings in Turkana. The increased sales volume generated by the satellite stores should allow Silo to negotiate with suppliers for discounts on bulk purchases.

Measuring Benefits for Pastoralists

IOM estimates that the total potential incremental profit of these new models for linking agrovets to pastoralists will exceed US$9,000 annually per household. This translates into nearly US$14 million in benefits across 1,500 households in the first year alone. If these services reach the 60,000 projected households, profitability to pastoralists could exceed a total US$1 billion by the year 2021.

IOM conservatively anticipates a 14 percent reduction in herd sickness and a 13 percent reduction in herd mortality amongst pastoralists accessing these services. These numbers translate into significant, tangible value for pastoralists in terms of increased milk production, the value of the animals themselves and the value of future calves born from surviving livestock. There is also likely to be a reduction in threats to animal health as encounters with counterfeit products and fraudulent services diminish in favour of high quality mobile services. Furthermore, despite increased expenditures on vaccinations, IOM anticipates a net 15 percent in cost-savings based on reduced costs of treating sick and dying animals, and reduced traveling and lodging expenses incurred by pastoralists who otherwise are forced to journey to distant towns to purchase supplies.

Measuring Benefits for Agrovets

Data from the initial set of mobile service circuits is very impressive indeed – agrovet businesses have made over US$10,600 in increased monthly profits from each of the pilot regions alone. This translates into combined incremental profits from all commercial providers of approximately US$385,000 in the first year and nearly US$29 million over five years, assuming a gradual growth in coverage from commercial providers from 1,500 pastoralists to a conservative 60,000 pastoralists by 2021. These numbers were calculated based on feedback from Sidai and other livestock veterinary service providers. They represent the increased profitability potential for all agrovets in the region gained by boosting sales of animal health supplies and services to pastoralists. Profit estimates are based on the conservative assumption that each agrovet will serve approximately 2,000 farmers, and 27 percent of farmers will seek treatment for at least one animal.

SMART LIVESTOCK: WHAT'S HAPPENING IN THE UK?

CIEL & Agri-EPI
HESLINGTON, UNITED KINGDOM

The drivers for development and adoption of technology on-farm are widespread, requiring farmers to take a more transparent approach to animal management and food production. Farming continues to need better on-farm decision-support tools for improved resource management, profitability and sustainability, creating a new market of opportunities for technology providers.

The food value chain has seen significant growth in technology development and investment, from new innovative supermarket models, such as Ocado, or potential major disrupters like Impossible Foods who make plant based burgers that taste like meat. This growth in innovation can be seen on-farm, within food processing facilities, through to the consumer end of the supply chain. Terms commonly heard are big data, sensors, the internet of things, artificial intelligence and blockchain, which are impacting many levels of our farm businesses. But what about in animal health management? Can farmers, consumers and our livestock benefit more from the uptake of emerging technology?

All technological innovations for animal health monitoring and management usually encompass a) a sensor or measurement component (including data capture and analysis) and b) algorithms enabling data translation into meaningful and actionable information. Electronic Identification is a great example of this, where a transponder is embedded in a plastic eartag. This is energised by an external reader, which transmits a unique identifier code relating directly to an animal's ID number. As well as enabling compliance with legislation related to livestock traceability, this data can be used to inform performance records, shedding or other identification purposes, sometimes in combination with another system, for example an animal health treatment.

This article outlines examples of animal monitoring/management innovations across a number of themes; consumer transparency, increasing farm efficiency and producing more food from less inputs. Whilst we mention several different examples of emerging technology within the UK, this is certainly not an exhaustive list!

Benefits of technology development in other sectors

Much of the recent innovation seen in livestock technology is a result of the transfer and development of technology from other sectors. Examples include the widespread use of smartphones and games consoles, which utilise technologies such as accelerometers and 3D cameras. With these technologies being in widespread use, the average cost of many components has reduced to a level that makes for an affordable technology to be adopted in agriculture and for animal monitoring. As an example, at the Newcastle University's C-DIAL unit (Centre for Digital Innovation Applied to Livestock), use of low-cost cameras are being used to investigate herd level behaviour in pigs and poultry to provide useful information about social behaviour, along with serving as an early warning for infectious diseases. Similarly, the Scottish Rural College (SRUC) are

working with an industry-led consortium to use a 3D camera system to take an image of live beef cattle on-farm to predict key characteristics such as carcass conformation, without the need for invasive sampling and stressful procedures.

Computer Tomography (CT) scanning is also routinely used in livestock health (and farm) management - originally designed for human healthcare, CT is now being used as a non-invasive diagnostic tool to inform breeding decisions related to meat yield and carcase conformation. In the UK, CT scanning has become so popular that a CT scanner has been installed in a lorry, as part of an investment made by CIEL and SRUC, to provide mobile CT scanning services to farmers across the country. This reduces the costs of transporting animals and makes the service more accessible, ultimately leading to increased gains in meat traits when utilised in selective breeding.

Welfare and consumer transparency

Livestock farming is in the spotlight globally, with consumers focussing on transparent supply chains, animal health and welfare, environmental sustainability, traceability and ethical production. This was recently supported by trends presented by Wholefoods, calling their focus in this area as "Transparency 2.0", where consumers want to know the story of their food - from animal welfare and sustainable production, to who was the farmer that grew the animal. Applying this ethos, McDonalds Australia have released an app, called "Track my Maccas", which provides information on the origin of the meat in your burger. This approach, whilsy taking transparency to a new level in fast food, also ensures better on-farm practices, making sure that animal welfare is a key priority.

Events such as the European horsemeat scandal in 2013 (where horse meat was marketed as beef) has pushed innovation towards analytical tools that can validate product. Queens University Belfast, in conjunction with CIEL, one of the UK Agritech innovation Centres, has pioneered the use of 'iKnife' technology, originally used in human surgery for the detection of cancerous cells, for meat products. iKnife enables the species, origin, type of product to be identified, as well as if the product has any microbial contamination. This provides a rapid proof of origin technology that can support verification in the supply chain.

There are multiple welfare related innovations that are either being commercialised or in the research and development phase. The UK Agritech innovation Centres for Agricultural Engineering and Precision Agriculture, (Agri-EPI) are working to utilise 3D video systems to predict potential outbreaks of tail biting in pigs, and provide farmers with the chance to intervene in advance and improve animal welfare. Similarly,

auditory and visual data is being captured for measuring animal welfare in other species. The University of Bristol monitors poultry welfare by analysing real-time data, enabling determination of individual animals that may be unwell, by changes in sound and movement. Moreover, at the University of Nottingham's Centre for Dairy Science Innovation, multiple welfare metrics, including lameness and pain are recorded during the automated milking process. In the future, we expect that this data will form an integral part of helping farmers with early intervention, supporting better welfare outcomes for all farmed animal species.

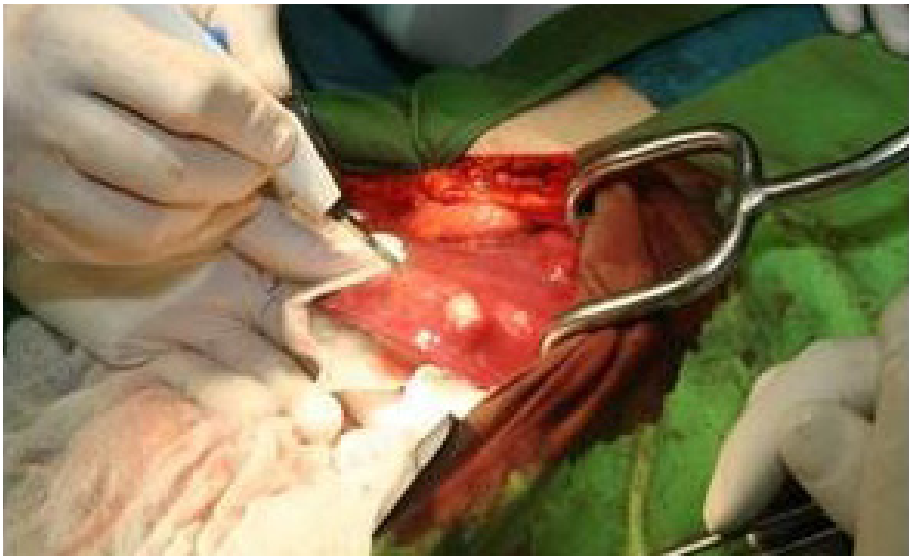
On-farm efficiency and profitability

Whether technologies are developed for animal welfare, product traceability or on-farm decision support, real-time data is being captured, stored and analysed on individual animals in a range of different ways. With many solutions on offer, one of the greatest challenges is integrating multiple data streams, from different technologies, and turning it into usable information.

Reproductive management in dairy cows, with the use of artificial insemination, requires farmers to identify when a cow is on heat and have her artificially inseminated at an optimal time. Technology developed in the UK by AfiMilk (Silent Herdsman) and Ice Robotics (IceQube) uses animal movement recording to predict when the cow is coming on heat, notifying the farmer of the optimal time to be inseminated. This is an example of how data, captured by individual animal sensors, can be used to positively impact the economic performance of a herd. There are many emerging sensor-based solutions which predict different aspects of animal performance, leading to better decision making; ultimately increasing farm profitability.

The link between efficiency and responsible use of medicines can also be made, where the health status of individual animals can be predicted, enabling early intervention and reduction of prophylactic treatment. In addition, pen-side diagnostic tools contribute, providing tools for rapid diagnosis and treatment plans. A range of rapid, low-cost pen-side tests are in development for livestock across the globe which are likely to have a disruptive effect on disease management.

When thinking of farm efficiency, the ultimate measure is feed conversion ratio. Improvements in feed conversion efficiency are primarily applied through genetic selection. Technology advances have helped this, providing the means to precisely measure feed intake and performance outputs. Metabolism chambers can be used to measure diet and rumen efficiency, which when combined with genotype data, allow for new levels of control for farmers to produce livestock in a welfare and environmentally-conscious way. In humans, 'personalised medicine', based on genetic make-up is rapidly becoming a possibility, due to costs of genome sequencing continuing to decline. Could similar levels of treatment become available to animals in the future?



CONCLUSIONS

Driven by global population growth, food production is under pressure, with a need to produce more food, reduce environmental impact and improve product quality and consistency. This creates challenges on-farm to increase production from the same land areas, without sacrificing animal welfare in the process. Automation and robotics, leading to 'Smart farming' can solve many of these problems.

Technology is likely to have a dramatic impact on animal monitoring and management, along with the wider agricultural industry. Redeveloped technology from other industries, including engineering and biotechnological solutions are likely to continue to find uptake within livestock farms as farmers look to reduce costs and improve yield to meet growing demands from the public. In the UK, the Agritech Innovation Centres are dedicated to working with agri-food companies and farmers to undertake R&D and technology validation and to help the livestock industry improve to meet the increased global demand for livestock products.

HOW TO PRODUCE A CHICKEN

Mie Nielsen Blom
CHIEF ADVISOR AT DANISH AGRICULTURE AND FOOD COUNCIL, COPENHAGEN, DENMARK

In 2016, around 215 farms where producing the 205 million broilers that were slaugh-tered in Denmark. The Danish broiler production is based on high standard with focus on food safety, animal welfare and good production facilities. The success behind this production can be found in the Quality Assurance Systems used in Denmark.

The Danish Poultry Meat Association launched the system in the beginning of the 20's century, to serve as the industry's quality concept of "Quality assurance in the chick-en production". The system documents the quality and traceability intensively through all parts of the Danish broiler production, from farm to fork.

The Quality Assur-ance System in the Danish broiler pro-duction was estab-lished and implemented to gather all the information of the total broiler production chain in Denmark in one place. The traceability in the system covers all broilers slaughtered in Denmark. The system en-sures and documents tracea-bility throughout the en-tire production process – start-ing with the chicken feed and ending when consumers buy the end product at the retail-ers. The Quality Assurance System is based on a central and common database into which all pro-duction data on food safety, production meth-ods, quality, animal welfare and environmental conditions is en-tered. This ensures both consumers and retailers full documentation and traceabili-ty for all products from Danish broiler producers. The system is therefore also a fast and ef-ficient system for tracking and stopping a source of infection, feed problems, a rise in num-ber of dead birds, animal wel-fare in total, etc. Everything is covered by the quality system. This guarantees awareness of the problems all the time in the production and in the end, it guarantees the consumers the highest possible level of food safety.

Database Records

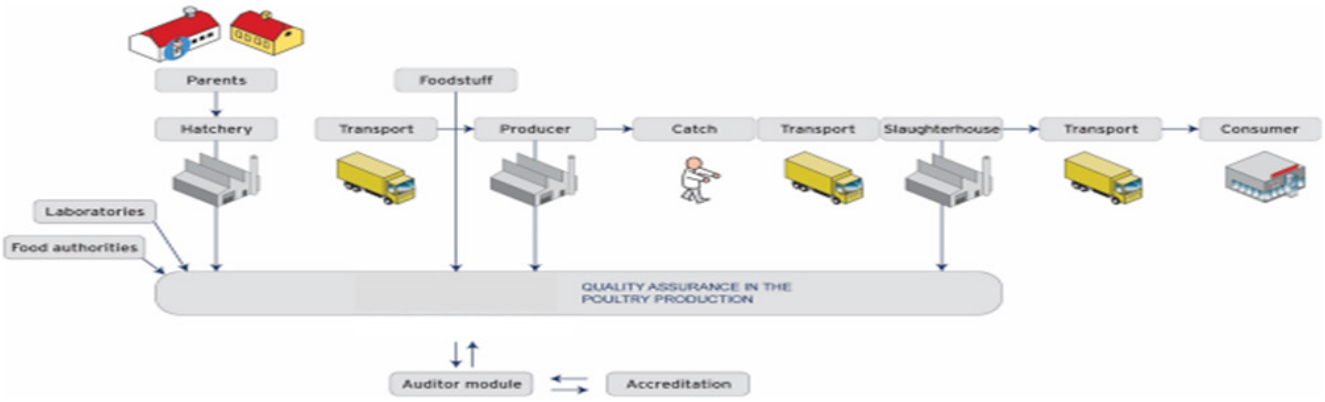


Fig. 1 The Danish broiler production system

The benefits of the system are:

- Full documentation of the production process
- Overview of the supply chain
- One system for all information
- Ability to make statistical analyses to improve earnings or diminish costs in the value chain
- Ability to make statistical analysis regarding the production conditions
- Full accountability of the broiler chickens throughout the production chain. With daily reporting by producers of diseased poultry, a mass balance is established.
- Accredited system allowing veterinarians, slaughterhouses and key customers to monitor the mass balance and general health of a batch of broiler chickens.

The elements of the Quality Assurance System are:

- Quality assurance schemes for all sites in the production chain
- Registration of data on all sites in the production chain
- Education of all players in the production chain
- Audit of all players in the production chain every year by third party

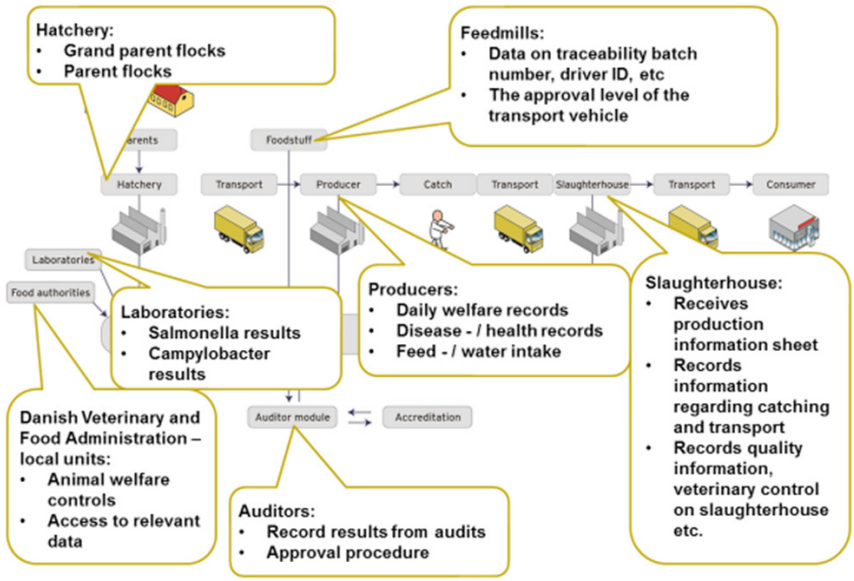


Fig. 2 Where are data collected in the Danish broiler production system

Minimising risk factors and optimizing production

The Danish quality assurance system has been developed by the entire Danish poultry industry to mini-mise all possible risks. It is also an excellent tool used to optimize production results. The system ensures that data from the HACCP-based control systems throughout the production chain are quickly and effi-ciently registered in the central database. This means, for example, that any source of infection can quick-ly be traced and stopped before it reaches the consumers. Both farmers and slaughterhouses use the ex-cellent data collected as a tool for benchmarking, and to identify which production methods give the best results.

Feed Supply

Only broilers that are fed nutritious and healthy feed can become first-class food products. Feed for Danish broilers is subjected to a number of requirements which help to ensure healthy, high-quality products for consumer.

The standardised requirements governing feed production comprise e.g.:

- High standards of hygiene during manufacturing, for example all feed for Danish broilers must be completely Salmonella-free
- Routine cleaning and disinfection of production equipment
- No antibiotic growth promoters since 1998 or meat and bone meal in the feed
- Heat treatment of animal feed to 81°C
- Process control and quality assurance

Only feed mills, which are approved and regularly inspected by experts from the Danish Agriculture and Food Council and by an official audit regime can supply feed for the Danish broiler production.

Poultry slaughterhouses

Danish broilers are slaughtered and processed at modern poultry slaughterhouses and productions plants. The process is continually checked by veterinarians who are employed by the Danish authorities. All Dan-ish broiler slaughterhouses have a minimum of one senior veterinarian per working shift. The veterinarian(s) are assisted by meat inspectors and specially trained slaughterhouse staff. In addition to food safety, these officials also monitor animal welfare.

> **The Quality Assurance System covers all legislation and production regulation for the Danish broiler production. The highlights of the regulation are stated below.**

Additives

Since 1998 Danish poultry breeders have not used antibiotic growth promoters in broiler feed. Feed which does not contain growth promoters minimises the risk of developing undesirable resistant bacteria. The Danish authorities regularly check the broiler producers' feed. This strict control of Danish broiler feed se-cures that Danish broiler meat is free from residues of undesirable substances.

Animal welfare

Danish legislation contains some of the strictest requirements in the world on animal welfare. The Danish act on the production of broilers has been prepared in collaboration between the authorities, animal wel-fare organisations and the poultry industry, and it helps to ensure the welfare of the Danish broilers. Spe-cial emphasis has been put on the issue of foot pad lesions, thereby securing both animal welfare and good quality of chicken feet, an issue which is important to many Asian customers. Danish broilers are caught using a special machine which ensures that the animals are handled as carefully as possible. Catching and transport to the slaughterhouse follows a procedure established in collaboration with the Danish authorities.

Bacteriological Control BEFORE SLAUGHTERING

Danish poultry breeders want to provide consumers with the best and healthiest broilers on the market. As a result of the extensive bacteriological checks and control programmes, Denmark is leading the way in the battle against zoonoses which can transmit diseases to humans.

Feed production, parents stock and hatchery houses are completely Salmonella-free. The very strict re-quirements governing handling and hygiene

also help to ensure that Danish broiler production has one of the lowest incidences of Salmonella in the world, without using vaccines in fighting Salmonella.

Broilers are continuously monitored for Salmonella. Sock samples (samples from the soil in the chicken house) are taken twice during a production period. If Salmonella is found in the samples, the broilers are subsequently slaughtered separately, so there is no risk of the bacteria spreading to other flocks, and the meat should only be used for heat-treated products or be destroyed, which is the Danish way to handle Salmonella positive flocks. All serotypes of Salmonella are included. Additionally, every flock is tested for Campylobacter at the slaughterhouse.

Bacteriological Control AT THE SLAUGHTERHOUSE

Every week 300 neck skin samples are taken from one randomly selected flock. These samples are ana-lysed for Salmonella. The broilers are also examined for other microorganisms. Bacteriological control of the production facilities also contributes to monitoring the quality of the cleaning at the enterprises on an on-going basis. On top of this, end products are tested heavily for Salmonella as a part of the HACCP programme and costumer requirements and this works as a verification for the national test programme.

Quality Security

To enjoy a well-prepared broiler both food safety and product quality must be second to none. Inspectors from the Danish Veterinary and Food Administration help to ensure this. As a supplement to the slaughter-houses' own quality assurance the public inspectors carry out on-going checks and take random samples. The authorities are also controlling that EU marketing Standards for poultry meat are met.

Uniform quality

The Danish broiler slaughterhouses are certified according to international quality standards, just as an ex-tensive control programme has been implemented according to HACCP principles at all the poultry slaugh-terhouses.

Danish Veterinary and Food Administration

Danish food safety standards are among the highest in the world and are governed by strict legislation. This means that the veterinary authorities under the Danish Veterinary and Food Administration control the broilers from farm to fork. The Danish Veterinary and Food Administration carry out regular checks on both food safety and animal welfare in Danish broiler production

End remarks

The extensive Danish Quality Assurance System and the national control systems secures high levels of food safety, welfare and traceability of the broilers produced in Denmark. The high and uniform quality of Danish broilers is the reason why Danish broilers are supplied to some of the leading restaurant and retail chains.

SMART LIVESTOCK: FUTURE TRENDS IN THE USE OF INNOVATION TECHNOLOGIES FOR ANIMAL HEALTH MANAGEMENT AND MONITORING

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The livestock production is based on three pillars: health management, nutrition and genetics. It is possible to see that a good nutrition helps in what refer to the fitness of the herd and the genetic base, sets the direction that the farmer has chosen for his breeding system. Big data storage and analysis is the new tool that farmers have to deal with it to increase in productivity and efficiency.

Health management

For the last few years there have been significant changes for the health management of livestock. The controls of important diseases are carried out professional and consciously by the farmers. A good example is the control of reproductive diseases that have a large effect on the herd productivity. Brucellosis (Brucella abortus) is the main reproductive disease that affects the argentine herd. It is been controlled with the combined work of the public and the private sector. The objec-

tive is to tackle this illness for the sake of the productivity of the country. Farmers and veterinaries carry out a program designed by National agro industrial sanitary service (SENASA) that consist on vaccine all the heifers between the ages of 3 to 8 months.

Another example is the Foot and Mouth disease (FMD), SENASA work together with the farmer, the drug industries and local veterinaries in developing a program that controls this disease. The plan involves for each region of the country the following premises: universal, obligatory and systemic vaccination of all the cattle, use of high quality of drugs, rigorous control of refrigeration of vaccines, control of cattle movement along the country and within the borders, efficient cattle identification and epidemiological vigilance.

Argentina now is a country that, after an effort of the farmers, veterinaries and the sanitation services, has been declared free of FMD with vaccine for over 12 years.

It is very important that SENASA continues working in the latest sanitations demands of the markets, to give the farmer the opportunity to offer a product of high quality, for those new markets.

As a result, we think that the trend is to have not only more effective drugs and vaccines but is also important to have an adequate system of disease diagnoses that will support and work alongside the veterinaries and farmers.

Nutrition

We can also identify that trends in nutrition are based on several points, which I am going to developed some below. It is fundamental to increase the production with technology that allows obtaining more efficiency of the resources available.

The first point would be the improvement on forage harvest by livestock. A practical example of this is to harvest the forage when is at its best nutritional quality, making it more available for the livestock and increase the amount of forage per bit. We have noticed that it is important to take into account the availability of forage not only in the amount of kilograms of dry matter it produces but also in the amount that the animal can take advantage of.

Moreover, improved pastures contribute to increase the availability of forage during those months of the year were the climate conditions are subtropical and makes the natural pastures less productive. In the northern region of Argentina, in the last few years, producers introduced subtropical pastures such as, Grama Rhodes (Chloris gayana), Gatton Panic (Pannicum maximum), Buffel Grass (Cenchrus ciliaris). The main characteristic of this forage is that they adapt to marginal areas and have a high productivity during the summer. This gives the farmers the option to increase their productivity, by adding more heads per hectares, during summer or to storage as hay or silage and use it during winter, where the natural pastures are less productive.

“We have noticed that it is important to take into account the availability of forage not only in the amount of kilograms of dry matter it produces but also in the amount that the animal can take advantage of.

The incorporation of different byproduct as animal feed is starting to be used by farmers as a requirement in order to increase their productivity. In the past years this has advanced and we estimate that it will continue to develop by given new products that can improve the productivity of livestock farmers. An example is the DGS (Distillers Grains with Soluble) a byproduct of the ethanol industry that has as its main characteristic a very high availability of protein and energy for the livestock with great palatability, which forges the agricultural and energetic chain bind with the livestock production. This makes more sustainable not only the industry but also the livestock production as it incorporate feeds from sub products of different industries.

The potential of these types of feed has to go through a long path of research and practical investigations in order to understand it´s productive benefits. As the main system, in many parts of the world, is a combination of crop and livestock production in the same area, a closer integration and bondage of these activities will provide an increase in productivity and soil fertility.

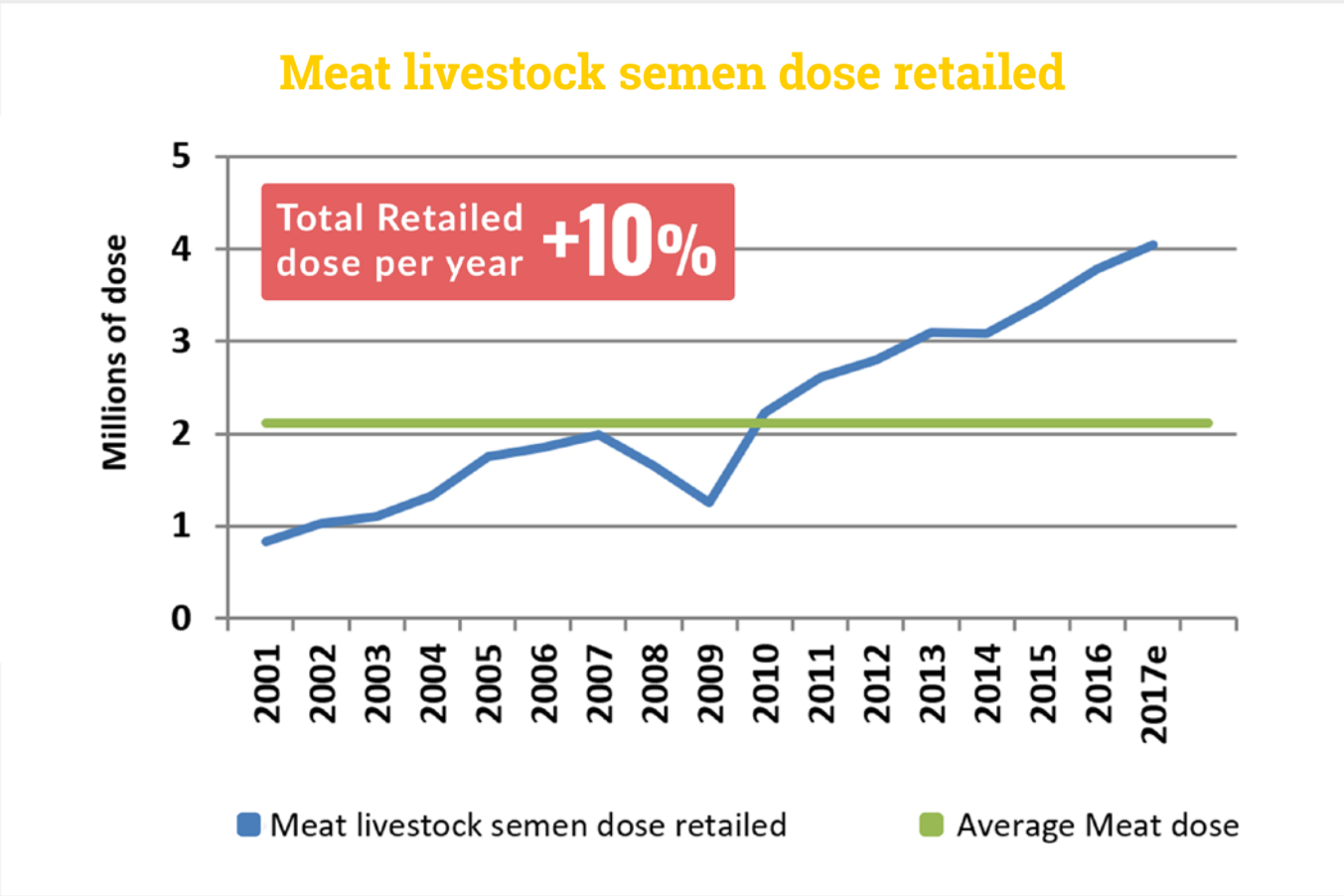
Breeding & genetics

In the past 20 years there has been an important advance in crossbreeding technics and the use of genetics technology. The increase on data storage and its statistical analysis of the animal merit was fundamental to obtain, EPD´S indexes that help farmer to chose what's better for his herd according to the route established, such as good maternal ability of cows, low birth weight of calf's to diminish the dystocia birth, high weight at weaning are some examples.

The wider use of artificial insemination technique has brought new ways for improving the reproductive indexes of the herds. This technology gave the farmer the capacity, with a certain low investment, to obtain progress on the quality of his herd as well as producing animals that can comply with the quality that the consumer is looking for.

The incorporation of artificial insemination in Argentina had a significant expansion over the last 17 year. The growth rate of semen dose retailed for meat cattle was around 10% per year. The dairy livestock incorporated this technology early because of the characteristics of the productive system. Giving for the same period of analysis a growth rate of semen dose retailed of 3.5 % per year. But on the other hand meat livestock farmer, in Argentina, only inseminates the 6% of all the cows and heifer's existence, reflecting that this technology still has a lot of potential.

In graphs below is possible to appreciate the evolution of the use of dose by farmers. The total for 2017 was approximately 6.2 million doses sold a 1% more than 2016.


Meat livestock semen dose retailed
Total Retailed dose per year +10%
Millions of dose
0
1
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3
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5
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2002
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2004
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2011
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2013
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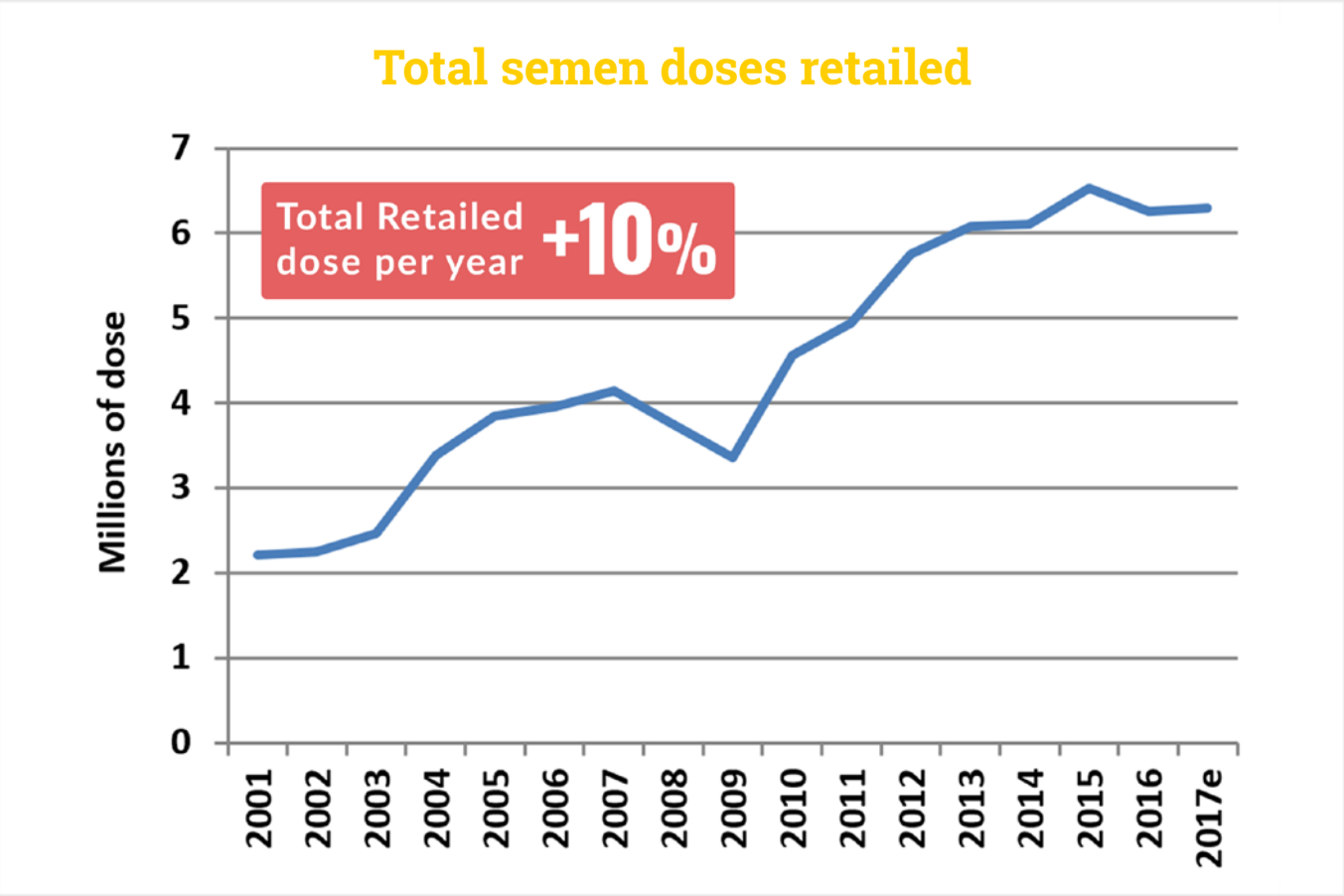
2017e
Meat livestock semen dose retailed
Average Meat dose


Total semen doses retailed
Total Retailed dose per year +10%
Millions of dose
0
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2002
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2004
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The use of new crossbreeding endorsed northern areas of Argentina, to increase its production and produce a higher quality meat. An example is the crossbreeding of Brahman with Angus or Hereford cattle. This generates the synthetic breed Brangus or Braford, which in comparison with the Brahman breed, both show a higher quality of meat and permits to increase productivity on these particular areas. We think that the genetics in cattle still didn't reach its whole potential and the genomic selection will revolutionize animal breeding.

Monitoring and Welfare

In the future monitoring will be more sophisticated, thanks to the large quantity of data that farmers can generate. But this data necessarily needs appropriate statistical analysis to have a positive impact in the productivity. We consider the biggest challenge livestock producers are facing now a day´s is the: data analysis. More data will mean that we can have a better approach and increase productivity with more efficiency.

The introduction of different platforms such as mobile apps is also a change game in the management of big data can guarantee good analysis by improving the first step: data storage.

Farmers consider that the monitoring trends are focusing in the welfare of the animals. This is based on a correct identification, GPS collars notifying latest activities of cattle such as temperature, fore-aft movement, and left-right movement. Monitoring of live weight and health, using sensors and techniques for weight and health monitoring are being developed and are going to improve in the future.

This technology has to be attended with a strong investment, made by the private or public sector, on connectivity and internet to achieve the full advantage of it.

CONCLUSION

As final remarks, we think that there's still road ahead to travel on livestock implementation of technology. The artificial insemination technique has still a big potential especially in the meat livestock farmers. On the other hand subtropical pastures and the generation of synthetic breeds give the farmer the opportunity to incorporate new areas to the productive system. On the health management, we see that with data analysis, pre-diagnose system for diseases and use of different drugs is the key for an efficient livestock production. The collaborative work of political or national sanity services and private sectors is fundamental to achieve the status of sanity that the markets demand. Monitoring trends in livestock production will be a fundamental tool to have a traceability that ensures the welfare of the animals. The innovative technologies in the topics above mention will allow increase productivity according to each geographic characteristic, adding efficiency to it.

LIVESTOCK THE HEART OF RURAL AGRICULTURE SYSTEMS IN UGANDA

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The consideration that livestock is a man enterprise in Africa is not any different as still today in most African Countries equally as it is in most parts of Uganda. Truly in most livestock communities there has always been the indication livestock a key source of wealth among several households through the number of herds. The "bigger the herd" the "richer the household". Livestock in this context includes but not limited to cows, goats, sheep, piggery etc. In cattle communities there are farmers who have the cattle ranging from 3000 to 5000 herds thus considered very wealthy even if they do not have easy access to other basic needs.

At several occasions' livestock is a central part of development process of the communities that believe in it. Livestock is a key source of bride price for marriage, food, milk, finances, manure and many more. For example for bride price/dowry in western Uganda is determined through the number of cows the boy's family brings to the girls family.

For many years, women in the traditional society were not allowed to livestock products like eat goats meat, chicken and its products. Only were they allowed to eat beef (From Cow) which would be availed once in a long while whereas for livestock categories like goats etc would be enjoyed very often.

Despite the fact that livestock tends more to be the man enterprise, the result of several sensitization issues on gender, women have been gradually integrated in the system of ownership and stewardship of livestock.

In some pastoral communities there has sometimes been an increase in the nomadism practices where some of the pastoralists would have to move from one place to another searching for pasture and water for their animals. Mostly these herds were mostly in large numbers like hundreds and sometimes thousands.

With the majority of the livestock breeds being the local breeds, they are tolerant to the tough conditions, could move long distances, some disease resistant etc the key innovations in the rural communities has been to cross breed from the hybrid and the local breeds which has resulted into better yield as far as livestock breeding is concerned.

It has been increasingly trendy and purposeful to have the livestock systems integrated into other farming systems which have been key in feed backward and forward linkages. The integration systems have been between crop systems and animal systems where for example livestock feeds on crop substance like elephant grass, banana vines, maize etc to which it is served to the livestock which cattle provides manure to the crop and the cycle continuous back to crop manure, then crop, then animal feed, then cow dung that can as well contribute to crop health etc.

Clean energy has been result of animal waste mainly the cow dung. With many innovations at hand, there has been a key resource of the bio gas system supporting some rural livelihoods in providing the clean source of energy for cooking lighting etc.

At Naluyima Farm on Entebbe Road- Uganda, has been key in utilizing the pig waste into accumulating poultry feeds in form of maggots which is a healthy protein for the poultry thus a supplementary nutrient for the chicken which later get a better yields of good chicken that sometimes come to 3Kgs to 4.5 Kgs. This has been key in improving the chicken nutrition.

Challenges facing livelihood sub sector

There has been an escalating challenge of Tick resistance for to the acaricides living majority of the farmers with limited options to tick/pest control. This has been in common in South Western Uganda – Kiruhura District though researchers are under the process to find out the detailed analysis on why the resistance.

Changes in Climate conditions leading to shortage of pastures, water and other diseases this has been gradually engulfing the sub sector and we have witnessed hundreds to thousands of livestock die due to scarcity of pastures that are as a result of climate change. Also new pests have come up as a result of increase in temperature.

Postharvest handling of meat, dairy and general livestock products has been a concern to the majority of the farmers. Considering the perishability of the products, it is true that at several occasions there is a far distance between market place and the from which have always left most of these products to go bad and a loss in the sector. This has persistently been a key challenge especially to small holder farmers who are limited on the options of the Post-harvest technologies.

Conclusively livestock still has an opportunity of effectively transforming the agricultural sector in Uganda. More so the process to interdepend with other enterprises still present a great opportunity of innovations to ensure a better balance in farming. The several opportunities coming in from the innovations of the farmers that have lightened the sector for better results. The integrated approach has also been increasingly presented opportunities in which the level of depending on other enterprises to another and has created a good linkage to the systematic approach of sustainably maintaining livestock. The rural farmers need to leverage on such opportunities to create a proper cycle to ensure effectiveness in transforming communities.

BIG FARMER IS WATCHING YOU!

Use of innovative technologies for a smart livestock farming

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If George Orwell would have set his masterpiece 1984 in a modern farm performing smart livestock farming, he would have probably changed the famous expression "Big Brother is watching you!" in "Big Farmer is watching you!".

Smart Livestock farming (SLF) is based on the philosophy that automated, continuous monitoring through technological tools enables farmers to constantly check the health and welfare status of livestock. Following this idea, cameras, microphones and "smart" sensors can replace and enhance farmers' eyes and ears in everyday farming, thus making farming operations easier and more effective.

When applying SLF to single animals, the result is the so-called Precision Livestock Farming (PLF), in analogy to precision farming. For instance, through a high technology input, it is possible to monitor the nutritional and health status of both soil and crops, thus allowing to match farming practices more closely to crop needs, as well as to reduce water and fertilizer inputs. Likewise, thanks to the use of sensors, cameras and advanced software, PLF tools can automatically collect and elaborate data, such as physiological parameters, production measures and behavioural traits. Such data can potentially help the decision-making process, enabling early detection of health or wellbeing problems in individual animals and hence the application of appropriate corrective husbandry practices. In this way, animals are given the very best of care whilst optimising their production cycles and performances in a cost-effective and environmentally friendly way.

Having said that, PLF can effectively contribute to the big challenges the livestock sector is facing nowadays, such

as achieving the best possible standards of animal health and welfare, high production performances and minimal environmental impact. These goals are intimately interconnected with each other; for instance, high welfare status is well known for positively influencing livestock immune response and general health status, thus leading to higher yields and quality standards. On this matter, animal well-being is becoming a top priority in the current livestock policy of the European Commission and it is one of the topics included in the Horizon 2020 programme. Nevertheless, PLF can support and enhance welfare assessment protocols proposed by the EU, such as Welfare Quality®.

PLF can also help in minimizing waste production, thanks to adequate feeding rations and, broadly, a more efficient resources allocation.

In this scenario, new "smart" farming systems can help achieve a more productive, efficient and sustainable farming, in a win-win approach where farmers, animals and (last but not least!) consumers can all take advantage.

The key role of PLF in contributing to the improvement of livestock farming is also proved by the funding of several European projects, such as EU PLF (Precision Livestock Farming).

In addition, a researcher network called DairyCare has been established as well. This network focuses on dairy animal health and welfare, and has as its main objective the improvement of dairy animal well-being through scientific and technological advance within the EU dairy industry.

In the frame of these European projects, several experiences have been done so far: In a farm in Kessel (Netherlands), about 20-thousand chickens are under close monitoring being their moves carefully tracked by cameras and microphones. Data obtained help to detect in real time when and for whatever reason animals are stressed. In this way, farmers can find solutions faster and in more efficient ways, without being constantly and physically there. For example, fast and chaotic animal movements could indicate temperature-, feeding- or drinking-related problems.

In another Dutch area (Meijel), pigs are being monitored for coughing – a possible sign of a highly infectious respiratory disease. With the cough monitoring system, their health is checked 24 hours a day, seven days a week, limiting in this way the spread of diseases, which could be extremely dangerous in intensive pig farms.

A great deal of research on this matter is going on as well. Recent findings from a research performed at the Universities of Leuven, Milan and Wageningen suggest that the incidence of foot pad dermatitis and hock burns in broilers could be predicted from data collected by PLF tools. As a matter of fact, according to this study, monitoring the distribution and activity of the birds through camera-based technology can provide information on the incidence and severity of foot pad lesions and hock burns in broilers.

However, most farmers and other stakeholders (e.g. vets) do not currently have the skills to utilise these technologies effectively. In the future, a lot can be done in terms of making data visualisation and interpretation more accessible to farmers. For this purpose, training of farmers is of paramount importance to spread such technologies widely. In addition, universities and industries can contribute to this process with the creation of new professionals, specifically trained to support the farmers throughout the process.

NEWS

The United Nations General Assembly adopted the Decade of Family Farming 2019-2028

Following the success of the International Year of Family Farming in 2014, on December 20th the United Nations General Assembly, in its 72nd session, adopted the Resolution establishing the Decade of Family Farming 2019-2028.

http://www.wfo-oma.org/news/the-united-nations-general...

Mr. David George Velde is the new Vice-President of the World Farmers' Organisation

During the last Board Meeting held in WFO Headquarters, Mr. David George Velde, WFO Board Member for North America, was elected new Vice-President of the World Farmers' Organisation.

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