GALVmed
Protecting Livestock – Saving Human Life

newsletter

VACNADA special

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GALVmed is a not-for-profit global alliance of public, private and government partners. By making livestock vaccines, diagnostics and medicines accessible and affordable to the millions for whom livestock is a lifeline GALVmed is protecting livestock and saving human life. GALVmed is currently funded by the Bill & Melinda Gates Foundation and the UK Government's Department for International Development. The VACNADA project was funded by the European Union Food Facility through the African-Union Interafrican Bureau for Animal Resources.

This special edition of the newsletter is focused on GALVmed's work on the recently completed 2-year *Vaccines for Control of Neglected Animal Diseases in Africa* (VACNADA) project.

In this issue:

What is VACNADA?:
The €20million VACNADA project, funded by the European Union Food Facility and with overall coordination of the implementing partners by AU-IBAR, was an intervention aimed to enhance food security through reducing the impact of animal disease by increasing access to and use of quality vaccines. GALVmed led the implementation of a component to improve the capacity of selected African laboratories to make quality assured vaccines in more efficient ways that meet internationally recognised quality standards and best practices.

VACNADA in numbers:
reveals the size, complexity and impact of the €6.9 million, 2-year GALVmed-led project component which targeted 8 laboratories, 4 priority neglected diseases, utilised about 100 suppliers and increased production capacity for some of the target vaccines by up to 4-fold

Summary of VACNADA support to the labs:
Support included: enhancing human capacity, improving quality assurance and production processes, providing better information on markets, strengthening distribution systems, providing management training and upgrading facilities and equipment.

Step-by-step guide to Newcastle disease vaccine production:
showing how the inputs provided through VACNADA improve quality and efficiency.

Project management:
GALVmed worked in 8 countries and 2 languages (English & French), procuring over €4m worth of sophisticated equipment and over €2m of advice and training support, and observing EU and national procurement and import regulations. Fortunately, GALVmed was able to utilise an expert management and delivery team drawn from more than 16 countries.

Tapping into pharmaceutical industry expertise:
GALVmed's friends in the pharmaceutical industry together with independent consultants played critical roles in working with the teams from the national laboratories to undertake needs assessments and to specify exactly the right equipment. They also ensured staff were trained in the use of the equipment and that preventive maintenance systems were put in place.

Market assessments and distribution strategies:
A team of national consultants provided the labs with comprehensive vaccine market assessments. Another group developed a sophisticated spreadsheet model to help the laboratories better plan their marketing and production.

A legacy of skills and knowledge from management training:
A team led by Wellspring DC, including members drawn from the UK's Open University (OU) and business consultants, delivered a bespoke programme of facilitated learning to both managers and board members at the laboratories. The facilitative training style focused on problem solving and team work. Initially this came as a culture shock to some, but was ultimately viewed as being liberating and empowering. More than 50 trainees received certificates from the OU recognising their achievements.

Implementing quality assurance systems:
Following audits of current quality assurance systems in each of the laboratories, a team of experts made recommendations for improvements and supported training in quality assurance, which was mainly held on site. Several of the labs are now working towards attaining internationally recognised quality standards to enhance customer confidence in their products and some have recruited specialist quality assurance staff for the first time.

Building-in sustainability:
The project's design emphasised sustainability: this influenced the design of the management training, equipment maintenance, quality assurance, optimisation of vaccine production and the development of improved vaccine production processes.

Provision of equipment and refurbishments:
a summary of the major physical inputs received by each laboratory.

Lab-by-lab impacts:
Ministers, board members, managers and staff explain the difference VACNADA has made to the 8 laboratories. And, although VACNADA primarily targeted 4 diseases, many of the inputs – such as management training and development of improved quality assurance systems, as well as some of the equipment and facilities – will bring benefits across the entire range of the labs' vaccines.

Main challenges and lessons learnt:
Meritxell Donadeu, GALVmed director of operations, shares the lessons learned. Key amongst these is the necessity of obtaining the services of specialist procurement, shipping and clearing agents for projects like this which involve the purchase and delivery of a lot of highly complex and expensive equipment.

Next steps:
The VACNADA project came to an end in December 2011. Each of the laboratories has identified further improvements they wish to undertake and GALVmed is committed to finding ways of continuing to support the laboratories as they continue on their quest to become more commercially sustainable and to implement improved quality assurance and production processes.

Last word:
VACNADA coordinator Fred Musisi reflects on 2-years of challenging but rewarding work, while acting CEO Peter Wells looks to the future.

The VACNADA team:
More than 70 people from 20 countries were involved in the delivery of the GALVmed-led component of the project.

Head Office: **Doherty Building, Pentlands Science Park, Bush Loan, Edinburgh EH26 0PZ, UK** Tel: **+44 (0)131 445 6264** Email: **newsletter@galvmed.org** Web: **www.galvmed.org**
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What is VACNADA?

"Livestock diseases have a devastating impact on the lives of millions of people who rely on their livestock for daily needs and cash in crisis. Livestock vaccines have a crucial role to play in preventing disease yet lack of investment in veterinary vaccine production in Africa has long been a concern. It is therefore a cause for great celebration that VACNADA represents one of the biggest investments in this sector for decades. I commend the insight of VACNADA's donors and the dedication of everyone involved in the inspiring stories which follow. Looking ahead, as the transformational changes in vaccine production impact on animal health, this commitment will pay huge dividends in sustainability – protecting livestock and saving human lives and livelihoods." Baptiste Dungu, GALVmed's Senior Director: Research & Development

This special issue of the GALVmed newsletter is focused on the recently completed two-year Vaccines for Control of Neglected Animal Diseases in Africa (VACNADA) project.

Funded by the European Union Food Facility, the overall goal of the €20 million (US$ 25.9 million) VACNADA project was to enhance food security through reducing the impact of animal disease by increasing access to and use of quality vaccines.

VACNADA was implemented by the African Union-Interafrican Bureau for Animal Resources (AU-IBAR) in partnership with the Global Alliance for Livestock Veterinary Medicines (GALVmed), the African Union-Pan African Veterinary Vaccine Centre (AU-PANVAC) and the French Centre for International Cooperation in Agronomic Research for Development (CIRAD).

A €6.9 million (US$ 8.9 million) component of the VACNADA project, led by GALVmed, set out to improve the capacity of selected African vaccine production laboratories to make quality vaccines in the quantities required to impact on four prioritised neglected diseases of cattle, sheep and goats, and poultry: contagious bovine pleuropneumonia (CBPP), contagious caprine pleuropneumonia (CCPP), peste des petits ruminants (PPR) and Newcastle disease.

VACNADA project components delivered by other partners included increasing awareness amongst African livestock keepers of the importance and value of vaccinating their animals, procuring vaccine from African laboratories and implementing large-scale vaccination campaigns. This entailed the procurement of 65 million AU-PANVAC certified vaccines from various institutions and the vaccination of around 45 million animals in 28 African countries.

Ahmed El-Sawalhy, director of AU-IBAR, Fred Musisi, GALVmed VACNADA coordinator, and Baptiste Dungu senior director R&D, in conversation at the marketing workshop in Nairobi in June 2011

The vaccine laboratories

The GALVmed-led component of the VACANDA project supported eight national vaccine laboratories (an increase from the six in the original plan) and in collaboration with the AU-Pan African Veterinary Vaccine Centre (AU-PANVAC) established a process development laboratory at Debre Zeit in Ethiopia.

AU-PANVAC, located next to the Ethiopian National Veterinary Institute at Debre Zeit, provides quality control and other support functions for African vaccine producers to ensure that quality vaccines are produced and used in Africa.

The criteria used to select the national labs to be supported through VACNADA were:

- Sub-regional representation: manufacturers were selected from the 4 sub-regions covered by the project: East Africa (Kenya, Ethiopia), Southern Africa (Botswana), Central Africa (Cameroon, DRC) and West Africa (Senegal, Ghana and Mali).
- Balance between Anglophone (Kenya, Ethiopia, Botswana and Ghana) and Francophone (Mali, Senegal, Cameroon and DRC) countries.
- Envisaged likelihood for the investment in the vaccine laboratory to bear fruit and to be sustained beyond the VACNADA project.
- Interest by the laboratory in participation in the project.
- Local conditions, namely prevailing circumstances that might have prejudiced uninterrupted project implementation, such as civil unrest.

Details of the vaccine manufacturers and which of the four prioritised vaccines they produce are shown opposite.

	CBPP	PPR	CCPP	Newcastle disease
Botswana Vaccine Institute (BVI) Gaborone, Botswana	√	√		
Laboratoire National Vétérinaire (LANAVET) Garoua, Cameroon	√	√		√
Laboratoire Central Vétérinaire (LVC) Kinshasa, Democratic Republic of Congo (DRC)				√
National Veterinary Institute (NVI) Debra Zeit, Ethiopia	√	√	√	√
Accra Veterinary Laboratory Accra, Ghana				√
Kenya Veterinary Vaccines Production Institute (KEVEVAPI) Nairobi, Kenya	√	√	√	√
Laboratoire Central Vétérinaire (LVC) Bamako, Mali	√	√		√
Institut Sénégalais de Recherché Agronomique- Laboratoire National d'Elevage et de Recherches Vétérinaires (ISRA-LNERV) Dakar-Hann, Senegal	√	√		√

What is the EU Food Facility?

Concerned by the impact that rapidly rising food prices was having on poor people in developing countries, in late 2008 the European Union (EU) approved the creation of a € 1 billion (US$ 1.3 billion) Food Facility. The facility was intended to provide a rapid response to the food crisis.

Operating for a 3-year period from 2009, the fund aimed to bridge the gap between emergency aid and medium to long-term development. Specifically it aimed to encourage food producers to increase supply, deal directly with the effects of volatile food prices on local populations and increase food production capacity, and improve the way agriculture is managed in the longer term. One way it planned to do this was through measures to improve access to agricultural inputs and services, with special attention to local facilities and availability.

The € 1 billion was distributed through a range of channels, with most going to international organisations such as United Nations agencies.

Following initial discussions between the European Commission (EC) Development Directorate and GALVmed, and several meetings with EU officials, including members of the European Parliament, in principle it was agreed to fund a project looking at neglected diseases of livestock in sub-Saharan Africa.

Baptiste Dungu, GALVmed senior director R&D, who put together the initial concept note, recalls: *"It was a humbling experience to see the commitment of the EC officials who pushed for the establishment of the project. Philippe Steinmetz was very instrumental. I would also like to acknowledge the support we got from the MEP Gay Mitchell, who believed in the concept and organised meetings with other MEPs, and Joris Vandeputte who facilitated most of the discussions in Brussels".*

With the need to have the programme managed by an African organisation, AU-IBAR, on behalf of the African Union Commission, took the leadership to drive the VACNADA consortium, which included the AU-PANVAC, Ethiopia, GALVmed and the Centre for International Cooperation in Agronomic Research for Development (CIRAD, France).

The proposed project focused on improving availability of and access to vaccines against four neglected diseases of livestock in sub-Saharan Africa, through strengthening vaccine production capacity, distribution systems and enhancing the quality and quantity of vaccines produced in Africa and vaccinating animals against four prioritised diseases: CBPP, CCPP, PPR and Newcastle disease.

The rationale was that long-term food security could be enhanced through reducing the impact of animal disease by increasing access to and use of quality vaccines.

A €20 million (US$ 25.9 million) grant was awarded for the project *Vaccines for Control of Neglected Animal Diseases in Africa* (VACNADA) to the AU-IBAR led partnership in December 2009. From the overall grant, €6.9 million (US$ 8.9 million) was awarded to GALVmed for the programme of work to support eight African vaccine manufacturing laboratories.

CCPP vaccine production unit at NVI, Ethiopia

What are neglected animal diseases?

Neglected animal diseases are infectious diseases affecting livestock and poultry that occur only or mainly in poor countries, which are often in the tropics. Because these diseases do not usually represent a threat to developed countries there are few incentives for Western veterinary pharmaceutical companies or research organisations to prioritise or address them. The result is that for many of these diseases there are either no vaccines available or, where these do exist, they tend to be relatively ineffective, to have undesirable side effects or not to be available in the right quantity and/or quality.

The four 'neglected' diseases

Three of the four diseases targeted by VACNADA are classic neglected diseases: CBPP, CCPP and PPR.

Contagious bovine pleuropneumonia (CBPP) is a highly contagious disease caused by a class of bacterium, a Mycoplasma, which has special preference for cattle. It impacts at both the household and national levels, principally in Africa. Besides causing death of cattle, CBPP affects productivity of infected animals by decreasing milk production, fertility, growth rates and capacity to work in the case of draught animals. Presence of CBPP limits opportunities for livestock trade. Estimates of the economic impact of CBPP vary widely: the cost of cattle deaths alone attributable to the disease has been estimated at US$ 2 billion per year.

Vaccines currently used against CBPP are freeze dried, live attenuated vaccines. That is they are made from cultures of carefully selected strains of the causative organism that have been shown to be much less dangerous than the original infectious agent. After culture the organisms are freeze dried and packed in vials such that each dose contains a specified number of live bacteria. The duration of protection engendered by the CBPP vaccines is short and repeat vaccinations are required which is not easy to implement within the current animal health infrastructures.

Contagious caprine pleuropneumonia (CCPP) is a highly contagious disease of goats caused by a class of bacterium, a *Mycoplasma*, which has special preference for goats.

CCPP poses a serious constraint to goat production and is of major economic importance in Africa. At the household level, direct losses result from high mortality rates, reduced milk and meat yield, and cost of treatment: the disease causes loss of income and worsens food and nutritional security. There is little information on the true extent and economic impact of CCPP: because the disease affects only goats it is even more neglected than CBPP.

Vaccines currently used against CCPP are inactivated *Mycoplasma* (i.e. not living) that have been treated with a chemical, saponin, in a saline solution. The saponin has two functions: it inactivates the Mycoplasma bacteria and also acts as an adjuvant – that is an agent that enhances the immune response caused by the vaccine. Although the CCPP vaccine is effective the yield from conventional production process is low.

Peste des petits ruminants (PPR) is a highly contagious, often fatal, viral disease of sheep and goats. PPR outbreaks have a profound impact on the livelihoods and food security of pastoral households in affected areas: its high mortality and morbidity rates decimate herd and flocks, and drastically reduce productivity levels.

The vaccine currently used against PPR is an attenuated live virus vaccine. After culture the vaccine virus is formulated and freeze dried in bottles that are stored for future use. Access and use of the PPR vaccine could be enhanced if availability and maintenance of the freeze drier machines at the production facilities are assured; moreover, production of a thermostable version of the vaccine would boost access even further since this version would require less stringent cold chain facilities than the conventional freeze dried PPR vaccine.

Newcastle disease is different. Although it is an important disease of poultry worldwide, in developed countries, where most poultry are kept in large-scale commercial systems, it is very effectively controlled by the routine use of highly effective vaccines. In contrast, in developing countries the vast majority of birds are free ranging and kept in small flocks by poor people, very few of whom vaccinate their birds.

The vaccines produced for use in large-scale commercial flocks are poorly suited to the needs of small-scale poultry keepers in developing countries: the pack size provides hundreds of doses and the vaccine needs to be kept in refrigerated conditions to ensure it remains viable. Different sorts of vaccines that can be stored at room temperature and that are provided in small packs are needed in developing countries. So, in this case it is the market needs in the developing world which have been neglected.

Newcastle disease is the most common disease affecting village and back-yard poultry in developing countries. Free-ranging, scavenging poultry are the commonest form of livestock kept throughout the developing world. For the poorest households they are likely to be the only type of livestock kept, an important source of high-quality protein and essential micro-nutrients, and their most readily saleable asset. Newcastle disease is currently one of the most important constraints to village and back-yard poultry production, impacting on household nutritional security and income generation. Typically Newcastle disease, which is caused by a highly contagious virus, sweeps through a village killing a very high percentage of the poultry. A number of different types of Newcastle disease vaccine are currently produced by the African laboratories, including live and inactivated vaccines.

VACNADA in numbers

6,900,000: total grant in Euros managed by GALVmed

8: number of national vaccine labs supported

50: number of lab staff who received management training certificates from the Open University

100+: number of suppliers from more than 20 countries

4: number of focal neglected diseases

4-fold: increase in production capacity at Ghana lab

4,400,000: amount in Euros invested in equipment and facilities

5: number of ministers (from Cameroon, Kenya, Mali & Senegal) who attended the commissioning events

Summary of VACNADA support to Africa's vaccine laboratories

The VACNADA investment in the eight African laboratories was designed to support in a sustainable way efficiency, quality and quantity improvements in vaccine production, in line with internationally recognised quality standards and best practices. This was achieved by enhancing skills and knowledge, improving quality assurance and production processes, providing better information on markets, strengthening distribution systems, providing management training and upgrading facilities and equipment.

This work was carried out by a multi-national team of experts drawn from the veterinary pharmaceutical and allied industries and academia, and consisting of vaccine production specialists, animal health professionals, business and marketing experts, engineers, quality assurance and process development specialists. This team was coordinated by Fred Musisi, a veterinarian with more than 30 years experience of livestock disease control and vaccine research and development, production and utilisation in Africa. See page 23for the VACNADA team list.

The funding provided through the EU Food Facility was leveraged by GALVmed which brokered additional specialist in-kind support from the pharmaceutical industry, notably a team of Pfizer Global Health Fellows and also vaccine production specialists from Ceva Santé Animale (see *Tapping into pharmaceutical industry expertise*, page 7).

An essential first step was a comprehensive needs assessment to enable the support provided to be matched to the constraints and opportunities the different labs were facing. The role played by Stephane Chesneau, Kevin Schultz, Mary Young and Paul Dominowski in the needs assessments at that stage of the project was very much appreciated. Following the assessments, the needs of the eight labs were prioritised through joint discussions between senior staff of each laboratory and the GALVmed VACNADA project team after which an implementation plan was developed. Some examples of the support provided under the GALVmed-led component included:

Strengthening distribution systems and providing better market information: Local consultants, led by Brian Perry, were contracted to undertake comprehensive vaccine market surveys in Ethiopia, Ghana, Kenya, Southern Africa, Cameroon, Mali and Senegal, and their findings were shared with the relevant national laboratories in each country or region. This information was also used to develop a spreadsheet-based market model by Vetnosis, an Edinburgh based research and consulting firm specialising in global animal health and veterinary medicine. The information gathered and the market models were the basis for a marketing workshop and training that was held in June 2011 and was lead by the Open University. It is anticipated that this marketing training will help the laboratories to improve the planning of their marketing and production. More information on this component is provided on page 10.

Improving vaccine operation management and production: Following initial needs assessments in each of the eight laboratories tailor-made training programmes were designed and conducted at each site. This component was managed by Wellspring DC Ltd (led by Michael Shaw), a Malawi-based consultancy company, in collaboration with the UK's Open University (Francis Cattermole) and a team of international business management consultants (Oliver Clark and Andrew Sergeant). The training included business planning, finance, human resources, problem solving, cost of goods calculation, operations management and marketing. The various parts of the programme were designed to lead towards a 'Work-Based Activity' (WBA) – a task that participants would be required to undertake after the training involving the application of their knowledge in their workplace. They received developmental feedback on their WBA reports and a certificate from Wellspring and the Open University.

In addition, Ceva Santé Animale hosted and ran a training course which focused on costing of vaccine production at their state-of-the-art vaccine production facility in Hungary. See page 7. The Wellspring DC team also attended this training and then worked with the different laboratories to adapt the information to the local and individual conditions.

Essential upgrading of laboratory facilities and equipment: Following comprehensive needs assessments at each of the eight laboratories, lists of equipment that needed upgrading or replacing and general laboratory refurbishment requirements were drawn up. See page 13.

A major need was to provide new freeze driers for many labs: lack of functioning freeze driers was identified as a key bottleneck in vaccine production and so new units were supplied to the labs in Cameroon, DRC, Ghana, Ethiopia, Kenya and Senegal.

Other major and critical pieces of equipment supplied included: refrigerated centrifuges (supplied to DRC, Ethiopia, Ghana, Kenya & Senegal); ultra-freezers for storing vaccine seed material (Cameroon, Ethiopia & Kenya); machines to semi-automate production and harvesting of Newcastle disease virus from chicken eggs (Ethiopia & Kenya); bioreactor for cultivation of bacteria (Ethiopia); laminar flow hoods, i.e. cabinets with sterile air supply to prevent contamination (all laboratories); vaporized hydrogen peroxide portable room sterilizers (Cameroon, Ethiopia, Kenya & Senegal); vial filling machines (Ethiopia, Kenya & Senegal) and vial labelling machine (Botswana).

Examples of refurbishment include: establishment of the process development laboratory at Debre Zeit in Ethiopia, which involved re-designing and refurbishing an existing old building and equipping the facility; conversion of existing buildings into Newcastle disease vaccine production units (DRC & Ghana); rehabilitation of bore holes, water distillation/deioniser equipment and/or provision of reverse osmosis water treatment plants (Cameroon, Ethiopia, Ghana, Kenya, Mali & Senegal); construction of +4°C and –20°C cold rooms for storage of vaccines (Ethiopia & Kenya); emergency power generators (Cameroon, Ghana & Mali); power supply and electrical equipment upgrade (Kenya & Senegal); clean air flow over vaccine production and filling areas (Kenya & Senegal); construction of animal accommodation (Ghana & Mali); construction of an incinerator house together with installation of a new incinerator (DRC); and replacement of a non-functioning goods lift (Kenya).

Jane Wachira, deputy director, and Geoffrey K Muttai, CEO, lead the VIP tour at the commissioning of the VACNADA inputs at KEVEVAPI

Implementing quality assurance systems: Following audits of the existing quality assurance (QA) procedures by specialised consultants (Pascale Sierra, Anne Jones and David Jones) who worked closely with the labs, recommendations for improvements in their QA systems were made and appropriate in-situ training given. In subsequent missions the consultants evaluated progress made in implementing the QA system and provided further training when required. As a result several of the laboratories are now working towards being awarded internationally recognised quality standards, including ISO 9001 and ISO 17025.

Optimising production processes: Work here focused on CCPP and PPR vaccines, but also encompassed CBPP and Newcastle disease.

CCPP vaccine is produced only at the labs in Ethiopia and Kenya and current production does not meet demand. Although the vaccines currently being produced are considered to provide good protection, the processes used have not changed for the past 30 years, during which time there have been major advances in vaccine production technology. Opportunities have been identified and implemented to improve yield and quality of the vaccine, facilitated by Keith Heffer of Advantage Bio Consultants, Inc. and Nico Oosterhuis of CELLution Biotech BV.

Also for PPR, opportunities to introduce an alternative production process that allows a heat tolerant PPR vaccine product at the BVI in Botswana and resumption of a similar production process, which had been stopped due to a malfunctioning freeze drier but now replaced by a new and bigger unit at LANAVET in Cameroon, were realised.

Support for Newcastle disease thermotolerant I-2 vaccine production was provided by Mary Young from KYEEMA, an international foundation; Mary has led the supply of and training on production of I-2 vaccine in developing countries. She assisted in the initiation of production activities for the Ghana and DRC laboratories, and in reviewing and advising improvements on current processes (Senegal & Ethiopia). Freeze-drying processes for the I-2 vaccine, initially developed by the FAO, were made possible with the new equipment and improved production processes.

As mentioned under the upgrading of laboratory facilities section, a vaccine process development laboratory has been established in Ethiopia to be run and managed jointly by the national laboratory, NVI, and AU-PANVAC, which supports animal vaccine production throughout Africa. Once improved processes have been validated, they can be introduced to other vaccine laboratories in Africa.

Step-by-step guide to Newcastle disease vaccine production

The Newcastle disease vaccine production unit at NVI, Ethiopia

The table below outlines the major steps in the manufacture of the live, freeze-dried I-2 strain of Newcastle disease vaccine. The third column illustrates where the equipment and facilities provided under the VACNADA project fit in the production cycle. The processes have been supported by technical specialists (Mary Young from KYEEMA) and the QA specialists.

Vaccine production step	**Step for production of freeze-dried, live I-2 strain Newcastle disease vaccine**	**VACNADA project inputs**
Virus storage	Storage of master and working seed at ≥ -70°C	**Ultra-freezers** (Cameroon, Ethiopia & Kenya)
Virus cultivation	Inoculation of working seed into 9–10 day-old embryonated chicken eggs	**Egg incubator** (Kenya) **Machines to automate inoculation, decapping and harvesting of virus from chicken eggs** (Ethiopia & Kenya)
Virus harvesting	Harvesting of virus in allantoic fluid from inoculated eggs after 96 hours incubation; centrifugation and addition of stabiliser	**Refrigerated centrifuges** (DRC, Ethiopia, Ghana, Kenya & Senegal)
Testing of harvested virus	Haemagglutination test on allantoic fluids (to confirm presence of Newcastle disease virus) Test sample of allantoic fluid for bacterial and fungal contaminants	**Laminar air flow units**, i.e. cabinets with sterile air supply to prevent contamination (all countries) **Microscopes** (Botswana & Kenya)
Freeze drying	Freeze drying to reduce bulk and extend storage life	New **freeze driers** (Cameroon, DRC, Ghana, Ethiopia, Kenya & Senegal) Modified **freeze drier** to introduce thermostable technology (Botswana)
Vaccine testing	Measure infectivity titre of vaccine Test samples of vaccine for bacterial and fungal contaminants	**Laminar air flow units**, i.e. cabinets with sterile air supply to prevent contamination, supplied to (all countries)
Vaccine packaging	Packing into vials and labelling vials	**Vial filling machines** (Ethiopia, Kenya & Senegal **Vial labelling machine** (Botswana) **Refurbishment of clean air flow over vaccine production and filling areas** (Kenya & Senegal)
Vaccine storage	Maintenance of low temperatures	**Construction of +4°C and -20°C cold rooms** (Ethiopia & Kenya)
Good manufacturing practice	Maintenance of good hygiene and adherence to and documentation of standard operating procedures	**Washing machines for lab linen** (Ghana & Kenya) **Portable room sterilisers** (Cameroon, Ethiopia, Kenya & Senegal) **Reverse osmosis water purification units** (Cameroon, Ethiopia, Kenya, Mali & Senegal) **Emergency power generators and refurbished power supply and electrical equipment upgrade** (Cameroon, Ghana, Senegal & Mali) **Laptops and printer** (Kenya)

Project management

Managing and implementing the VACNADA project was complex and demanding. The project covered vaccine laboratories in eight countries throughout Africa; comprehensive needs assessments were carried out in each laboratory; more than € 4 million worth of highly specialised equipment had to be specified, tendered, shipped, cleared, installed and commissioned; technical and business training needs were identified and bespoke training programmes developed and delivered in each country; in each laboratory quality assurance procedures were reviewed and recommendations developed to improve these; a vaccine process development laboratory was designed and installed; vaccine market studies and modelling tools were commissioned and delivered; and actions were identified and implemented to improve vaccine production processes. And all of this had to done in both Anglophone and Francophone Africa, in accordance with both rigorous EU procurement rules and regulations and different African national import requirements, and in a timeframe of less than two years. To add to the difficulty, some of the labs are situated in relatively remote and hard to access locations: for example, LANAVET in Cameroon is situated at Garoua which is more than a thousand kilometres from the port.

To achieve this GALVmed had to draw deeply on its experience, comparative advantages and network. For example, much of the expertise and equipment needed was highly specialised and GALVmed's contacts in the veterinary pharmaceutical and allied industries proved invaluable in identifying and securing these.

To manage the VACNADA project GALVmed recruited a full-time project coordinator, Fred Musisi, and an administrative assistant, Keziah Kamau, both of whom were based in Nairobi, and a project accountant, Thomas McCusker, who was based at GALVmed's headquarters in Edinburgh.

The Nairobi office was also supported by the GALVmed headquarters team, especially in the areas of finance, logistics and communications, with oversight and leadership provided by senior director for R&D Baptiste Dungu, and director of operations Meritxell Donadeu.

Tapping into pharmaceutical industry expertise

When US-based vaccine process engineer **Paul Dominowski** realized he had accumulated annual leave his priority was to get back to Ethiopia. His goal was to attend the commissioning of the improved vaccine facility he had worked so hard to shape during his 6-month stint as a Pfizer Global Health Fellow.

He explained: *"I never thought that my fellowship placement would have such an impact on me. I wasn't sure I wanted to go to Ethiopia – but when it was time to go, I sure didn't want to leave".*

Pfizer Global Health Fellows are Pfizer employees, representing top talent from all around the world, who are seconded to health NGOs, like GALVmed, for 3 to 6 month fellowships to provide expertise and capacity building that is carefully tailored to meet the host organisation's needs. They have played an especially important role in GALVmed's work to strengthen the capacity of African vaccine manufacturing labs. To learn more about the Global Health Fellows visit **www.pfizer.com/ghf**

Paul had a background in immunology and engineering, and he has installed new laboratory facilities around the world. He therefore had the perfect combination of skills for African veterinary vaccine production labs looking to modernize.

Paul had a clear vision for NVI: the VACNADA investment had to make a seismic change in the organization, not just remove a few bottlenecks and leave others in place. So first he helped to set up a comprehensive audit of needs. By asking questions and listening carefully he helped NVI personnel work out exactly what needed to be done.

By the end of his first week at NVI Paul had produced drafts reports which set out a blueprint for comprehensive modernization of the facility.

During the audit Paul unearthed equipment that had been purchased by previous well-intentioned NGOs and international donors. Some equipment was still in its box because it had been purchased without fully thinking through the implications for the organization: the equipment could not work without improvements elsewhere in the processing plant. He saw how a relatively small issue became an insurmountable problem and so the equipment could not contribute to the proposed improvement of the lab.

Paul was determined to do better. He worked on highly detailed specifications for each piece of equipment and the other proposed improvements. The detail in these specifications went way beyond the expectations of GALVmed or the NVI. But Paul knew that once the procurement process started this level of detail would make a huge difference by preventing the inevitable long lists of detailed questions from potential suppliers.

There were other procurement challenges too. For example, NVI sourced some of their vaccine inputs, such as adjuvants, from India and China and this was a new experience for Paul. But as a result reagents and other essential inputs were sourced at highly competitive prices.

Some of Paul's proposals were radical and would impact on the working life of every member of staff. Paul explains: *"The staff were really nervous about what I was trying to do. Whenever I discussed purchasing a machine that would replace routine labour – for example the egg de-capper, which could process 8,000 eggs an hour - I had to start by reassuring them that this would not mean they would become redundant. I had to say look, you will need to do different work. Quality vaccine production requires clear document of every process and the time needed for this would now be available as a result of such efficiency savings."*

Paul concluded by describing the broader impact of the VACNADA investment: *"Whilst I was aware that VACNADA had targeted four diseases, I knew that most of what we were doing would impact on the current catalogue of 17 vaccines. Furthermore, we were creating a climate which would see the quality of the current vaccines improve and new vaccines added to the catalogue. So the true impact of the investment will take years to become fully apparent."*

Nancy Ng, a senior process engineer at Pfizer's Andover, Massachusetts site and a Pfizer Global Health Fellow, adds her insights from her time at KEVEVAPI.

One of the Kenya lab staff told Nancy: *"You are the first ones to help us with these machines"*. They were commenting on the fact that donors had given equipment to the labs over the years, but they had not helped to ensure the equipment worked. As a result equipment sits idle, often written-off as broken, and not supporting the productivity increases everyone had hoped for.

Nancy also noted that African laboratories have a tendency to run equipment until it no longer functions and then try to figure out how to fix it. She explained this means that routine preventative maintenance on equipment is not effectively factored in. By Western production standards, some of the laboratory equipment would have been decommissioned. However, the African laboratories have not been in a position to purchase new replacements; therefore, the maintenance staff is challenged with trying to figure out how to fix the broken equipment.

In the Kenya laboratory, the main freeze drier was broken for more than six months. Freeze drying is critical to the production of several of the vaccines, so the laboratory was not able to produce certain vaccines. Luckily, Pfizer Fellow **Seamus Pender**, a process engineer from Pfizer Ireland, helped the maintenance staff troubleshoot the problems and got the drier running again. Seamus also spent a considerable amount of time and effort supporting the engineer and maintenance team at LANAVET in Cameroon. This was not an easy assignment for him; language was a barrier he had to overcome, but he did so, and his inputs were very much appreciated by the LANAVET staff.

In the Ethiopia laboratory, the fermenter agitators were repeatedly breaking down. Many of the staff in Ethiopia do not have strong English language skills which caused communication troubles compounded by the fact that the supplier did not respond. Nancy assisted the maintenance staff by reiterating the technical issues to the supplier and identifying the required spare parts. A further problem was getting the spare parts as these had to come from overseas and so significant delays still occurred.

Maintenance is not just a problem for old machines: machines that were only a few years old were reported to Nancy as having *"never worked properly."*

Staff at one of the VACNADA-supported laboratories manually capped and crimped the vaccine vials instead of using the machine they had acquired for the job. After a thorough inspection of the unit and watching it run, Nancy made several recommendations to fix the system. This included obtaining consistent quality caps, adjusting the machine's alignment, reinstalling some components, lubricating the capping cylinders, and drafting a comprehensive set-up and operations procedure.

Nancy noted: *"In conversations with NGO employees working in Africa, the consensus regarding equipment maintenance is that it is a real problem for the local people. Fred Musisi, who has worked on many projects, pointed out that the people sometimes fear or have no interest in new equipment because they have no practical experience with the machines. Another colleague said that there are warehouses in Africa full of new equipment donated by foreign agencies that is unopened. Both were making a common statement that the machines are of no use to the recipients if the donors do not assist with equipment integration, operation and maintenance".*

Pfizer global health fellow, Seamus Pender with (left) refrigeration technician, Haman Halidou & (right) Electrician, Dieudonné Awoulassa both employees of LANAVET, Cameroon with their training certificates.

Nancy continued: *"GALVmed had proactively identified and addressed this problem through the VACNADA project. They paid for suppliers to install and commission new equipment, and train the lab staff. Spare parts were purchased for many machines. The labs are also supplied with follow-up maintenance service plans with the specific original equipment manufacturers. Seamus and I were recruited to train the maintenance staff about equipment preventative maintenance and record keeping. We worked with other VACNADA supported consultants to integrate new systems into existing vaccine processes. This knowledge and continued technical support will ensure that the machines keep running and the recipient labs will keep on producing quality vaccines."*

The project also benefitted from expertise of staff at Ceva Santé Animale in Hungary where places were provided on an internal training course focused on determining the true cost of vaccine production.

Market assessments and distribution strategies

Effective management of any vaccine manufacturing laboratory requires intelligence on the size and nature of actual and potential markets and effective distribution systems to be established. GALVmed commissioned studies to address these issues. This work was led by Brian Perry, a Kenya-based veterinary epidemiologist, together with a team of expert consultants from seven African countries.

A major output was a series of national and regionally focused reports that integrated published and grey literature, information from key informants and expert opinion. These were supplied to the laboratories to help inform their business planning and marketing activities. They were also used by Vetnosis to develop the marketing models and by Wellspring DC for the marketing training so that real examples could be used.

In addition, a synthesis of these studies brought to light a number of important issues that impact on the marketing and distribution of vaccines against the four target diseases.

Clear differences emerged between the markets for Newcastle disease and the three transboundary animal diseases (TADs): CBPP, CCPP and PPR. Government veterinary services retain responsibility for the control of TADs. This effectively excludes livestock keepers or the increasingly important private animal health sector from accessing and using these vaccines directly, or even through private suppliers. Also, CCPP vaccine is produced by only two laboratories while CBPP and PPR vaccines are manufactured by a relatively small number of suppliers.

Most of the laboratories benefitting from the VACNADA project are wholly owned by their respective governments, although a number are beginning to embark on processes that may lead to eventual privatisation or at least less rigorous government control. In most cases, therefore, currently governments both control the price that can be charged for the vaccines the laboratories produce and are their major customer.

Demand for these TAD vaccines is largely influenced by availability of funds – either national (or sub-national in federal systems) budgetary allocations or donor funding. In neither case is there any real opportunity for the labs to pro-actively market their products; rather their challenge is to be able to anticipate and meet the likely demand. In light of this it is perhaps not surprising that most of the laboratories have relatively little capacity for marketing vaccines.

Governments exert much less influence over the control of Newcastle disease. Vaccines are more readily accessible to both poultry keepers and private animal health service providers. Also, a large number of different vaccines are available against Newcastle disease, including from the major multinational veterinary pharmaceutical companies.

The larger-scale poultry producers in Africa tend to obtain their vaccines from these companies because the products and support they provided meet their needs: quality assured vaccines are provided in pack sizes appropriate to the scale of their operations; combination vaccines are available that address a range of potential diseases; and expert technical support is provided as part of the package.

The Newcastle disease vaccines produced by the national laboratories which were supported through the VACNADA project are best suited to the small-scale backyard and village poultry sector, but very few poultry keepers in this sector vaccinate their birds.

Management trainer Oliver Clark leading a breakout group at the marketing workshop in Nairobi in June 2011

Awareness of the benefits of vaccination amongst livestock keepers is a broader problem that limits demand for vaccination across the African continent. This is exacerbated by legitimate concerns amongst livestock keepers about possible side effects from some of these vaccines. In addition the strict controls on the use of many of the vaccine and limited appetite for and investment in preventive veterinary medicine approaches by governments, all conspires to limit use of and demand for the vaccines.

Commenting on the market studies and training for Cameroon, Christian Ndamkou Ndamkou, marketing and sales manager at LANAVET, said: *"The market study has pulled together really useful data and we are now in the process of developing an action plan for the business to increase our income and double our domestic market over the next five years. This will require us to work through some of the barriers to distribution of vaccine, in particular the opening up of the vaccines to veterinarians in private practice, not just the vets who are part of the government service as it is the case at the moment. We also have plans to grow our export markets once we have consolidated our home markets."*

The synthesis study revealed some other findings that raise concerns as to the way some of the laboratories are managed. In one case the price of vaccines had been reviewed only once during a 20-year period. In another case there was just one set price for vaccines irrespective of the quantity purchased – by failing to provide any margins along the supply chain, this precluded private sector distributors. The project component which provided training on real costs of vaccine production appears to be very relevant to addressing these issues.

In the overall conclusion the study emphasised that vaccination can play a key role in the progressive control of infectious diseases of livestock. However, to increase vaccination coverage of livestock owned by poor and small-scale farmers both market 'push' and 'pull' forces are required; the report made the following recommendations:

- **Need for increased awareness of the benefits of preventive vaccination.** Currently the livestock keeper is not an effective player in creating market demand. Greater engagement with poor and small-scale livestock keepers will make them more knowledgeable and vocal in demanding vaccines from state and private veterinary services. In the event that government policy changes and vaccines, including CBPP, CCPP and PPR, can be administered by private animal health service providers, this will also increase demand for vaccination. GALVmed has a potential role to play in raising awareness.
- **Development of clear national strategies and policies for the control of these neglected diseases.** The development of strategies and policies which clearly spell out the roles and responsibilities of government veterinary services, vaccine manufacturers, private animal health service providers and livestock keepers are urgently required.
- **Differentiation between infection and vaccination prevalence.** One argument in favour of governments maintaining strict controls on the use of the TAD vaccines is that allowing anyone to use them would potentially compromise disease surveillance measures. A solution to this problem is to develop marker vaccines that enable Differentiating Infected from Vaccinated Animals (DIVA).

A legacy of skills and knowledge from management training

At the commissioning event in Kenya in November 2011, the KEVEVAPI management and board acknowledged that the skills and knowledge support provided through the VACNADA project was as important as the equipment supplied in delivering the transformative effect they had experienced.

Michael Shaw of Wellspring D C Ltd, who was responsible for the business and management skills training element, explained how this was delivered: *"We made visits to each of the labs to ensure that the programmes we developed were appropriate to the needs and priorities at each location. We knew that we wanted to create a programme that facilitated the managers thinking – rather than giving them a series of lectures or instructions.*

Our delivery partner was the Open University (OU) in the UK and business consultants Oliver Clark and Andrew Sergeant. We worked very closely with the OU's Francis Cattermole, who brought a wealth of experience and access to OU resources and pedagogies. For example, Francis had been responsible for delivering an MBA to members of the cabinet in Ethiopia and this experience proved invaluable."

One of the highly appreciated aspects of VACNADA was that training in use of new equipment was done on site. This in situ training, as seen here at KEVEVAPI, was seen to be much more effective than sending an individual away for training. Left to right: Jean Pierre Bardawil an engineer from Rame-Hart Inc, and KEVEVAPI team members Nashon Kinyaka, production manager, Alice Musau the senior technician, and technician Rose Ochieng

Linking with the Open University also meant that the management development programme could be certificated. The programme included:

- Business and strategic planning
- Finance for non-finance managers
- Marketing for non-marketing managers (relationship marketing)
- Organizational culture
- Problem-solving and change
- Managing the business – value chain approaches

As each training session concluded the teams were challenged to think about what they needed to do differently using a 'stop, start, continue' exercise to focus their thinking. One of the team or a laboratory working group then took responsibility for carrying forward the thinking and planning that had been agreed upon. And those managers who wrote up their plans in a 2,000-word essay qualified for the OU certificate. A total of 50 were awarded.

Francis explained: "Our philosophy is that the course concepts and ideas can and should be applied directly in the workplace. Simply knowing theory and techniques doesn't make better leaders or managers: applying them to real work situations and learning from that experience does."

Francis also reflected on the experience of delivering facilitated workshops with the management teams: *"Something we had not expected was that the management teams thought we would spend the whole time delivering lectures to them. We were prepared for the difference in learning methods between the UK and Africa but we did not anticipate that the managers' experience of development projects was that we would tell them what to do.*

To be presented in the first session with some core models around strategy and then be asked to break into small groups to use them to critique strategy in their own organization was a real culture shock for the management teams at first. Once they got used to the process the fact that we took it as a given that they could be trusted and empowered to make a real difference to their own business was truly liberating and led to a real buzz of excitement and learning."

GALVmed was also able to access places on a training course run by the veterinary pharmaceutical company Ceva. The course, held at their vaccine plant in Hungary, focused on calculating the true costs involved in making vaccines. Whilst most laboratories understood fully the cost of materials going into their vaccines, they struggled to apportion overheads in a coherent way. Five of the vaccine laboratories worked through their costs in great detail.

Mike explained: *"Detailed information on costs is important because it helps a management team to take full control of a business. For some products this information may be used to maximize profit and sustainability; at other time this may be used to find the lowest cost route for production. With improved storage solutions provided in the labs, production runs can now get larger, reducing the overall downtime between vaccine production runs."*

Mike reflected on what they had learned from delivering the programme: *"We worked with the boards of directors of most of the labs at the beginning of the training and at the end. This gave a real purpose to the final sharing event which was based on the management teams' perceptions of the needs of their specific organization. This led to a deepening of respect between the managers and the boards. In some cases it really helped the board to understand what was expected of them – and help identify skills gaps and personnel changes that were needed. Those who thought they could be passive stewards of the laboratory woke up to their responsibilities to develop and grow the business. This was very gratifying to see."*

Francis Cattermole from the UK's Open University at the Nairobi marketing workshop in June 2011

On reflection Mike considers that five consecutive days of training was a big ask, especially when so much else was going on, both as a result of VACNADA and the day-to-day vaccine production work. Although additional costs would have been incurred for the trainers to deliver a few days training on several occasions, rather than a whole week, the benefit would have been that this was less disruptive to the production processes and would have allowed more time to reflect on the learning.

"The big change" continued Mike *"came as a result of the facilitated learning. This brought in a different culture of sharing and exploring ideas which has stuck. Previously meetings tended to be on functional lines. Now management teams are meeting regularly and they are using the techniques they learned to drive continual improvement in their organizations.*

In addition there is great potential for locally sourced training to help drive further efficiencies. A number of the labs now have new suites of laptops and are moving to more digital capture of information. There is a training need in many of the teams to be able to use tools like Excel to full effect.

One of the key issues about training leaders and managers to deliver change is timing and for a number of the labs the timing of this training coincided with a drive to commercialize. The training has helped to drive forward the skills agenda, but for a number of the labs the next step will be to get better pay and conditions in place to ensure that these human resource assets are not lost to other sectors."

Implementing quality assurance systems

Ndèye Fatou Tall, the head of viral vaccine production at ISRA Productions, Dakar is being assisted by Marie-Laure Mainsant, a VACNADA consultant, on writing up standard operating procedures for viral vaccine production

Following reviews of the existing quality assurance procedures, consultants Pascale Sierra, Anne Jones and David Jones worked with the quality assurance teams in the labs to produce recommendations for improvements in their systems.

According to Anne Jones: *"Quality is an essential part of vaccine production, but for successful export markets it is paramount. There has been a significant change in the attitude towards quality standards in some of the laboratories we visited. In Kenya, all elements of VACNADA – equipment, management training and improvement of the quality systems – are coming together.*

One tangible legacy of the work on quality is KEVEVAPI's commitment to seek registration to the international quality standard ISO 9001, Quality management systems – Requirements. The GALVmed investment has helped to move this within their sights. The computers supplied by the project mean that procedures are now being developed and documented throughout the organisation. The efficiency gains from the new equipment can also help free-up time for more work on developing the processes and quality system."

Two other labs are exploring ISO/IEC 17025, General Requirements for the Competence of Testing and Calibration Laboratories. This is particularly relevant to PANVAC which is the African reference laboratory.

Anne reflected on some of the lessons learned: *"I think there are some clear lessons for the future. We were one of the last teams of consultants to be put in place and ideally the quality consultants should have been working from the start of the project. This could have helped with some of the investment decisions but it would also have allowed more time for the change management process and quality assurance principles to be absorbed."*

David K Kirini updating the operating procedures in the labs at KEVEVAPI

Anne found that the introduction of the quality assurance systems was happening concurrently with the arrival of new and complex equipment, the management training and whilst vaccine production was on-going. This put a great deal of pressure on the laboratory staff.

Anne also reflected that the labs that have moved towards a more transparent style of leadership are the ones that will make the fastest improvements to the quality system. She feels that traditionally hierarchical models of leadership do not fit well with trying to drive up quality throughout an organization. It has to be led from the top, but staff need to be empowered and supported to implement quality systems.

Anne continued: *"We found that as trust was built, asking peers for help was no longer seen as a weakness. In cases where the staff have written the documentation under guidance, they are more likely to understand what is involved and what it means. They are also more motivated to improve.*

The best of the labs we visited have a clear idea about what they want to achieve in terms of quality. They have staff very capable of delivering quality – but often that knowledge is not shared throughout the organization.

It would be great to see further resources employed to help improve quality in the laboratories on an ongoing basis. Quality assurance systems are essential to improve vaccine production in Africa."

Nashon Kinyaka, production manager at KEVEVAPI shows how the bioreactor has delivered cleaner, quicker production and significantly increased vaccine productivity over the previous production techniques

Built-in sustainability

The GALVmed-led VACNADA component and was carefully designed to ensure sustainability and long-term viability.

Management training: Management training was focused on the sustainability of the laboratories and included how to set up a business plan, organisational culture, managing the business, human resources, calculation of the cost of goods and problem solving. It was also one of the activities most appreciated by the laboratories.

Equipment maintenance: A number of actions were undertaken to ensure that the equipment provided will be properly used and maintained. These included:

- training was provided in-situ at the time of commissioning
- equipment was purchased with one year warranties
- Pfizer Global Health Fellows provided additional training and support in Cameroon, Kenya and Ethiopia
- maintenance and calibration training was provided as part of the support on quality assurance
- cost of goods training included how to factor in maintenance and depreciation
- service agreements for maintenance have been set up for the largest equipment

Quality assurance: This focused on achieving long-term improvements; this will impact on many more vaccines which were not covered by the project itself.

Optimisation of vaccine production: The activities in this area also focused on training of staff, so activities can be continued after the end of the project.

Process development laboratory: The setting up of this laboratory in conjunction with AU-PANVAC will ensure that future improvements in vaccine production can be developed and eventually cascaded to all the African vaccine producing laboratories. In addition to funding from the VACNADA project, the laboratory benefited from support from GALVmed's grant from the Bill & Melinda Gates Foundation and the UK government's Department for International Development (DFID) and it will continue to be supported beyond the lifetime of the VACNADA project.

Equipment supplied to the 8 labs included:

	Kenya	DRC	Ghana	Cameroon	Mali	Senegal	Botswana	Ethiopia
Animal houses		√	√		√			
Autoclaves					√	√		
Bioreactor								√
Borehole/ water distillation plant/reverse osmosis water treatment & storage systems	√		√	√	√	√		√
Cold storage facility +4°C and – 20°C for storage of finished &vaccine in preparation	√							√
Egg incubator	√	√	√					
Freeze driers	√	√	√	√		√		√
Goods lift	√							
Incinerator		√						
Lab incubators				√	√		√	√
Laminar air flow units/ bio safety cabinets	√	√	√		√	√	√	√
Laptops for standard operating procedures and other documentation	√	√	√					
Laundry machine for lab linen	√		√					
Microscopes	√						√	
New boiler which has supported an increase in production of CBPP vaccine						√		
Other centrifuges		√	√					
Refrigerated centrifuge	√	√	√			√		
Refurbishment of clean air system over vaccine production area	√					√		
Security system						√		
Semi-automatic egg inoculator, decapper and manual harvester machines	√							√
Standby power generator/power supply upgrade			√	√	√	√		
Thermo Cycler (polymerase chain reaction): testing for sterility and microorganism identity tests							√	
Ultra freezers (for storing master seeds &working seeds)	√			√				√
Vacuum pump to speed up suction of allantoic fluid from eggs to improve Newcastle disease I-2 production		√	√			√		
Vaporized hydrogen peroxide room sterilizers	√			√		√		√
Vial filling machine	√					√		√
Vial labelling machine							√	

Lab-by-lab impact

KEVEVAPI moves towards having stock of all its vaccines

By June 2012 the **Kenya Veterinary Vaccine Production Institute (KEVEVAPI)** will, for the first time ever, have a stock of all the vaccines they produce – including all four of the diseases targeted by VACNADA.

Arina Odek, the sales and marketing manager, explained: *"VACNADA was a good project. It solved a lot of problems. We know the markets for the vaccines are there. But if you cannot meet an order when people need it they forget about it. The farmers may miss out on a whole round of vaccinations."*

Jane Wachira, deputy director of KEVEVAPI, explained the VACNADA investment in business terms: *"There was a very strong business case for the VACNADA investment. Through our increased productivity we will increase our trading levels to the point where we could pay back the investment in 12 months."* However, because the VACNADA inputs were grant in aid, KEVEVAPI can instead continue to invest in its own growth and development, supported by its partners.

The KEVEVAPI commissioning event held on 29 November 2011 celebrated the VACNADA inputs. At the event, the skills of the consultants and the training programme were acknowledged as being as significant as the capital equipment purchased.

World-class skills, such as those of Paul Dominowski, a Pfizer Global Health Fellow, were utilized. Paul observed: *"The package of investment at KEVEVAPI means that production processes that would have previously taken a year are now taking a few months. This is because we started with a comprehensive site plan and did not make a piecemeal attempt to change things."*

This high level of pre-planning and work on highly detailed equipment specifications helped the GALVmed-led procurement process stand out from other investment programmes. Paul continued: *"There are clear lessons here for others on how to achieve significant changes in production capacity. I have led a great many lab refurbishments and constructed new labs – it takes only a few days for me to work out what's needed. This is a creative process of seeing what's already in place, working out how to maximize its use and filling in the gaps with the most appropriate and robust solutions.*

The first stage is quick but then there are weeks of patient work getting the equipment specifications and the procurement right. This approach is often at odds with time-limited public investment programmes where the pressure is on to spend money fast. We made full use of the project extension period to December 2011. There are no short-cuts to successful projects."

The attention to skills and training really impressed and empowered the staff. In the past, training in the use of new equipment was typically given to one or two staff, who were usually sent abroad for training. VACNADA tried, wherever possible, to train the staff in situ once the equipment was installed. This built a greater level of confidence and competence and helped everyone in the team understand the implications of the new equipment and different working practices that are required.

The equipment provided through VACNADA has delivered greater flexibility and systematically reduced bottlenecks. So, for example, the new state-of-the-art freeze drier works alongside the two machines that KEVEPAI already owned. With three machines, routine maintenance and breakdowns will not bring the plant to a halt, as they did previously.

Before VACNADA, the 500 litres of distilled water that KEVEVAPI got through each day had to be collected on a 20 mile round trip through Nairobi's notorious traffic. All too often the production stopped when the suppliers did not have enough water available.

Mohamed Abdi Kuti, Minister for livestock development, unveils a plaque to celebrate the vaccine production inputs provided to KEVEVAPI

Demand for distilled water at the laboratory is growing as production scales up, but the new in-house facility means they can now even supply others; never again should lack of distilled water close down vaccine production.

KEVEVAPI was already the main producer of inactivated CCPP vaccine worldwide. Now CCPP and also CBPP vaccine production has been significantly enhanced with VACNADA project supported modifications that allowed use of the existing bioreactor and an automated production process. This has replaced a system of cultivating goat *Mycoplasma* in jars in a hot room. In combination with the new faster refrigerated centrifuge, 3 days of processing has been reduced to just a few hours work.

The VACNADA investment means that master and working 'seed' stock vaccine have separate storage in ultra-freezers, and purpose-built industrial storage facilities have been created with controlled temperatures at +4°C and –20°C for vaccine under production stages and finished product. This means that the vaccine seed material is now more secure and the faster, larger production runs can be easily stored helping the lab to reach the target of a full stock of vaccines by June 2012.

KEVEVAPI, along with a number of other labs, received portable vaporized hydrogen peroxide room sterilizers. The old system using fumigation was potentially hazardous for the people and took 24 hours to decontaminate a laboratory. Using the new equipment means a monthly cleaning regime could be put in place in around two hours and the automation eliminates mistakes. This equipment will drive quality, efficiency and safety, and will impact on all the vaccine production carried out on site. It will also help the lab move closer to attaining ISO certification.

Laboratory technologist Silus Kanani joined KEVEVAPI in 1979 and is due to retire in about five year's time. He observed: *"This kind of change has never happened before. I want to work longer. But I am really pleased that when I leave KEVEVAPI it will be a much better place then when I joined it."*

Mohamed Abdi Kuti, MP, Minister for Livestock Development, speaking at the commissioning event said: *"The diseases identified for the VACNADA project have been spreading faster than they are being controlled. Besides problems with provision of veterinary services, the current vaccines and delivery systems are not adequately addressing the needs of the poor livestock keepers.*

To address this, my ministry through relevant policies and in partnership with development partners the European Union, GALVmed, AU-IBAR, AU-PANVAC and CIRAD has put in place mechanisms to improve livestock health and productivity in the country.

The VACNADA project aims to deal with the effects of volatile food prices on local populations; to increase food production capacity and to improve the way agriculture is managed in the longer term. In particular, the VACNADA project aims to improve livestock health amongst vulnerable rural African communities in selected countries in order to contribute to poverty alleviation and to tackle the consequences of the soaring food prices.

My ministry would like to thank the European Union and the implementing partners GALVmed, AU-IBAR, AU-PANVAC and CIRAD for the support given to the Kenya Veterinary Vaccines Production Institute."

KEVEVAPI chairman Joseph O Musaa said: *"The future of KEVEVAPI is very bright. Our focus is to work closely with stakeholders in livestock health delivery and forge strong linkages with partners to create a vibrant livestock industry that will improve the livelihoods of Kenyans in attainment of Vision 2030."*

The managing director of KEVEVAPI, Geoffrey Muttai, said: *"The impact of the VACNADA project is well demonstrated by the now improved capacity and quality of the selected vaccines of the neglected animal diseases, namely CBPP, CCPP, PPR and Newcastle disease, and also the strengthened distribution system and markets. Our human resources were capacity built through the project and are more comfortable with the introduced technologies and production systems."*

Newcastle disease vaccine production starts in DRC

The **Laboratoire Central Vétérinaire (LCV), Kinshasa, DRC** was supported through the VACNADA programme to begin full-scale production of the I-2 strain of Newcastle disease vaccine.

In addition to provision of technical assistance for I-2 production, equipment and a programme of refurbishments, LCV benefitted from a comprehensive programme of vaccine operations and quality assurance training. This involved five visits from experts and training session covering marketing and vaccine production.

The tools and techniques learned are now being applied across the lab to drive efficiencies and productivity gains. The support and advice on quality assurance and quality control has inspired LCV to better document their standard operating procedures and they are now working towards computerization of diagnostic and vaccine production activities. Staff have produced inventories of reagents and equipment and set up procedures for closer monitoring of all equipment.

Central to the improvements at LCV is the work to strengthen distribution systems with key partners. This process has stimulated a great deal of stakeholder interest. Meanwhile the laboratory is working on vaccine promotion, and sensitization and involvement of veterinary and other livestock development NGOs and stakeholders as they work to implement their new marketing plan.

Refurbishment included preparation of a secure purpose-designed facility for Newcastle disease vaccine production and a new incinerator. The I-2 master seed for Newcastle disease vaccine production was also supplied.

Fred Musisi commented: *"The major legacy of VACNADA is an on-going commitment to quality assurance within the lab. This will have an impact on their vaccine production beyond Newcastle disease, including brucellosis, rabies, fowl pox and capripox."*

Ali Ramazani, director general of the Ministry of Agriculture (centre); LCV director Leopold Mulumba and GALVmed senior director R&D Baptiste Dungu with the team who will be operating the freeze drier and -90 °C freezer in Kinshasa

Ghana: fourfold increase in Newcastle disease vaccine production capacity

The **Accra Veterinary Laboratory (AVL)**, Ghana was supported by VACNADA to begin full-scale production of I-2 Newcastle disease vaccine.

The starting point for the VACNADA capital equipment programme was a needs assessment. Mary Young, a Newcastle disease vaccine expert at the KYEEMA Foundation, supported AVL in this process. This collaboration led to a plan for a number of significant investments being approved by the VACNADA team. Now a modern, efficient vaccine production unit has been constructed and commissioned in what had previously been a general storage facility, with all the key essential equipment and consumables supplied.

The chicken housing has also been refurbished. And a new standby power generator ensures uninterrupted power supply for the operations, which is essential for quality vaccine production.

Consultant Andrew Sergeant helped AVL to identify their management training needs. Mary Young together with Theodore Mwabi and Zuhara Bensink conducted two weeks of intensive bench training to upgrade the staffs' skills in vaccine production. This has led to improved productivity and a more empowered workforce. Many of these new approaches have also been adopted into routine operations and procedures.

The lab is now fully prepared for expanded production of the I-2 vaccine, as was seen by guests at the commissioning event held on 10 November 2011.

AVL also benefitted from a Newcastle disease market survey conducted by a consultant, William Amanfu. This helped to model the size of the market for the vaccine and provide better information on target beneficiaries and their specific requirements in terms of vaccine delivery. The information forms the basis of a marketing plan for the lab. As production of Newcastle disease vaccine is expanded, the lab will embark on an extensive public awareness campaign promoting vaccine use.

AVL is making incremental progress in quality assurance processes in both the vaccine unit and the general diagnostic laboratory. David and Anne Jones undertook an initial review of the quality assurance systems and helped to develop an institution-wide training plan. There is now a quality policy statement in place and a number of standard operating procedures have been drafted. This work should be consolidated as a result of the recent appointment of a quality assurance manager at AVL.

The VACNADA investment has led to a fourfold increase in the capacity of the laboratory with regard to Newcastle disease I-2 vaccine production.

Over 10 million doses of I-2 Newcastle disease vaccine have recently been produced with appropriate internal quality control procedures in place. Plans are now well underway for registration of the vaccine with Food and Drug Board of Ghana once initial batches have been tested by AU-PANVAC.

Head of AVL Joseph Awuni said: *"The VACNADA project has greatly enhanced the efficiency and capacity of the laboratory in the production of the Newcastle disease I-2 vaccine. AVL now has a well equipped new vaccine production unit, which is separated from the quality control area. And staff have had professional development in all aspects of vaccine production and quality control. AVL is now in the position to produce a high quality vaccine to enable the effective control of Newcastle disease in Ghana.*

Vaccine production is now undertaken in a more business like way. In addition to the improved efficiency, quality improvements are minimizing losses from cross contamination."

Jopseph Awuni, head of the Accra Veterinary Laboratory, takes possession of the newly completed Newcastle disease vaccine unit

Cameroon: freeze drier kick starts vaccine production

Laboratoire National Vétérinaire (LANAVET), Garoua, Cameroon was established by the government in 1983 to produce livestock vaccines and for the diagnosis and study of animal diseases and to carry out training. It is an important regional resource: around half of its production is exported to Benin, Burkina Faso, Chad, Central African Republic, Cote d'Ivoire, Ghana and other West and Central African countries and there is potential for further growth in these markets.

LANAVET produces vaccines against CBPP, PPR and also the I-2 strain of Newcastle disease. Prior to VACNADA little had happened by way investment in new plant and equipment for nearly 30 years: the freeze drier had not been working for many months, severely impacting on vaccine production.

Christian Ndamkou Ndamkou, marketing and sales manager at LANAVET, said: *"We were very pleased to see how responsive and unbureaucratic the VACNADA programme was because usually development grants are very prescriptive. The emphasis was always on how we could be supported to get the best out of this experience and investment.*

So, we worked with an engineer called Seamus Pender. He was on assignment in LANAVET as part of Pfizer's Global Health Fellows programme. The assignment goals were to help us put in place a regime of preventative maintenance that will support us to have continuous production runs of vaccines. In addition to the support to help us to assess the equipment, we needed to move forward and build our business.

We also had a great deal of support from Fred Musisi, the GALVmed VACNADA coordinator. He came to Cameroon to visit the lab and he has been touch with us frequently – offering advice from his considerable experience and helping us to keep the project on track.

The market study has pulled together really useful data and we are now in the process of developing an action plan for the business to increase our income and double our domestic market over the next five years. This will require us to work through some of the barriers to distribution of vaccine, in particular the opening up of the vaccines to veterinarians in private practice, not just the vets who are part of the government service as it is the case at the moment. We also have plans to grow our export markets once we have consolidated our home markets.

Finding water: the engineer at LANAVET completes exploration of the borehole to provide clean water to the laboratory

Eleven members of the LANAVET team participated in the vaccine operations management training conducted by Oliver Clark under the auspices of the UK's Open University. This training, based on practical issues at LANAVET, helped the managers implement improvements in their planning of vaccine production and also whetted their appetite for further training in this area. This led to LANAVET appointing a consultant to work with the team to further refine their knowledge of the production costs of vaccines.

Pascale Sierra and her team helped LANAVET review their quality assurance systems and provided training to strengthen these.

Some of the impacts of the VACNADA investment at LANAVET have been:

- doubling of production capacity for PPR and CBPP vaccines
- improvement of staff management skills and motivation
- significant headway in the implementation of quality assurance systems: a quality assurance manager was appointed in mid-October 2011
- improved knowledge on the implementation and the management of preventive maintenance regimes for equipment.

Mali: Vaccine production up by over 15%

The support that the **Laboratoire Central Vétérinaire (LCV)**, Bamako, Mali received through the VACNADA project has meant that much of their old and unreliable equipment has been replaced. It also means that equipment no longer needs to be moved between production and quality control labs, which took time and introduced the risk of contamination. This has improved both productivity and quality.

Refurbished facilities included a newly upgraded small animal laboratory facility and a standby generator.

The LCV team really valued the support they received through the VACNADA market survey report. This was followed up with the management training course covering aspects of market surveys and distribution, which was delivered in Mali, attended by management, directors and representatives from the procurement and accountancy team.

An assessment of the priority management training needs resulted in a programme which helped foster a better understanding of management roles and responsibilities within the team. The management team also found it useful to participate in the marketing workshop in Nairobi where the participating labs shared their experiences.

Back-up power generator being installed in LCV, Mali

Saidou Tembely, director general of LCV, Bamako noted: *"We had a great deal of support from Pascale Sierra in terms of quality assurance and control. This covered areas of biosecurity, measuring errors and metrology, good laboratory practices and records to be made during the manufacturing process, the requirements, control and records on packaging material and labelling, and vaccine stability.*

This work has helped with our progress towards standards of Good Manufacturing Practices, Good Laboratory Practices and Good Clinical Practices. This has involved some changes to our routine and better calibration of our equipment for the routine checks, for example logging freezer temperature.

This was part of a comprehensive package of support and investment in people and equipment. The improvements to quality assurance coupled with the new equipment enhance quality assurance by minimising opportunities for contaminations by eliminating the need to move equipment between labs. This also impacts on efficiency. LCV is now much better placed to produce the quality vaccines that the customers need. With a 15-20% increase in volumes of vaccine produced, we will increase our sales income. This will help fund ongoing improvements and developments. We will also have more vaccine available to vaccinate more animals than hitherto possible".

Saidou Tembely, director general of LCV, said at the commissioning event on 25 October 2011: *"The vaccine business and marketing training received means that we can run the lab as a more effective and sustainable business and also target export markets in neighbouring countries. The vaccine production arm of the LCV is now much better placed to produce the quality vaccines that our livestock-keeping customers need."*

Minister of livestock and fisheries, Bokary Treta at the VACNADA inputs commissioning event at LVC, Mali

Bokary Treta, the Minister of Livestock and Fisheries, said of the project that it: *"...will contribute not only to limit the impact of neglected diseases, including the peste des petits ruminants through increased access to and use of quality vaccines, but also to reduce poverty and the effects of the food crisis among the most vulnerable rural communities by improving the health of livestock."*

CBPP vaccine production resumes and production reaches 15 million doses in Senegal

In Senegal, VACNADA supported two related veterinary vaccine bodies: the vaccine production arm, **ISRA (Institut Sénégalais de Recherché Agronomique)** and the research facility, **LNERV (Laboratoire National d'Elevage et de Recherches Vétérinaires)**.

The upgrade to the ISRA vaccine production labs has resulted in increased efficiency of production processes and reduced risk of contamination.

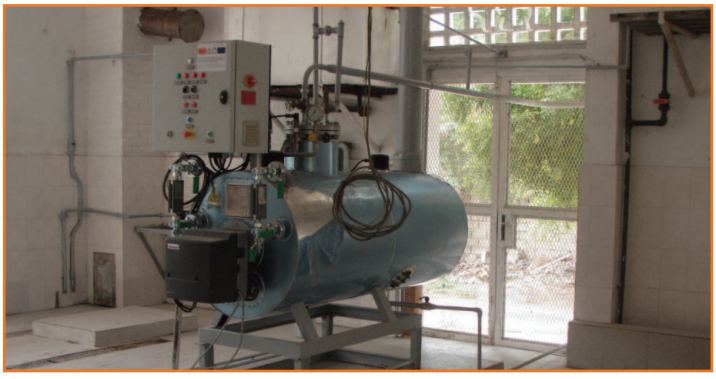
Oliver Clark delivered the training on vaccine operations management and cost of production. The management team found this clarified roles and responsibilities of the staff, which in turn has impacted on performance and productivity.

The new laminar flow equipment installed at ISRA

Staff at ISRA and LNERV received quality assurance training led by Pascale Sierra. This has helped both organisations to increase their knowledge on how to manage quality assured systems. The staff at ISRA noted that this training was very empowering and helped build their confidence in procurement and production. Both organisations are now working together to implement a more systematic approach to quality assurance. A new post of head of quality assurance for ISRA productions has been created. Whilst this post was not funded by VACNADA but by the laboratory itself, it will certainly help to institutionalise the learning within the organisation. One of the key priorities for the ISRA now is to complete the documentation for ISO certification.

El Hadji Traore, chef service alimentation-nutrition directeur de l'unité ISRA-Productions, said: *"The VACNADA investment has had a significant impact on us. We have been able to restart CBPP vaccine production now that we have the equipment in place. This has helped contribute to the 100% increase in vaccine production, to 15 million doses per year with a value of € 1.3 million".*

Before and after the new boiler was installed at ISLA, Senegal



Boiler installed at ISLA, Senegal

And Ndèye Fatou Tall, in-charge of viral vaccine production at ISRA, summed up: *"At ISRA we highly appreciate the VACNADA inputs, which include management and quality assurance training together with equipment and refurbishment done at the ISRA Productions laboratories. These will go a long way in facilitating achieving of the ISRA goals."*

Thermostable PPR vaccine moves closer at BVI

The investment at **Botswana Vaccine Institute (BVI)** is facilitating the production of a thermostable PPR vaccine using state-of-the art freeze drying equipment. The first trial batch has been produced, however the vaccine will not be able to be marketed until further field trials are performed; GALVmed has plans to support the trials.

Microscope with camera installed at BVI, Botswana

The PPR vaccine currently produced needs to be stored in a stringent cold chain, which makes it difficult to store, transport and use: it is anticipated that introduction of production of a thermostable vaccine at BVI will enable wider distribution of the PPR vaccine.

The overall VACNADA project investment into BVI will also enhance the capacity of the laboratory to produce CBPP vaccine. Overall, the support provided through VACNADA will result in production of PPR and CBPP vaccines of a higher quality and at a lower unit cost.

A recent newspaper article from Botswana reported on the commissioning event held on 18 November 2011. It stated that VACNADA was a clear indication of the contribution of development partners towards the fight against neglected animal diseases in Africa. It concluded: *"Utilization of the equipment will without doubt lead to the achievement of the endeavours to improve access to vaccines at an affordable price...by the small livestock keepers."*

The permanent secretary in the Ministry of Agriculture, Micus Chimbombi, said: *"It is urgent to realize sustainable animal health solutions and to address global and local transboundary animal diseases at the same time. It is in this context that vaccination has become one of the most important strategies in the livestock industry for disease control and eradication."*

Training for the freeze drier operators and maintenance staff has increased their confidence and performance.

BVI carried out an exercise to identify the benefits of the new equipment and these included: being user-friendly, improved production and testing efficiency – particularly with respect to automated vaccine vial labelling, and increased production. The new technology was also considered to be in line with the requirement for an OIE reference laboratory. The upgrading of equipment has had positive impact especially during a tough financial period; otherwise BVI could not have upgraded the equipment over this time period.

BVI staff, Jonathan Tamocha – production supervisor, Ben Tikanyane, Rose Kgope and Gaone Mathare being trained on use of the new vial labelling machine

A review of BVI's quality assurance systems was conducted with the support of David and Anne Jones. The quality manual was assessed identifying several differences between the process and documentation. Action plans were drawn up and the improvements are nearly all implemented.

Changes suggested led to the introduction of trend analysis of the quality control tests. Other work undertaken resulted in recommendations for improvement of the quality assurance system at BVI. It facilitated continual improvement to the quality management systems, which has resulted in even more robust traceability of tests results.

Ramogoma Kaisara, projects engineer at BVI commented: *"This project has assisted BVI to assess its performance in vaccine production and identify gaps. Once gaps are closed the institute will be able to provide timely delivery of the product, leading to increased profitability. BVI should ensure that this is a continuous process within the organisation."*

The impact of the investment has been to support quality improvements especially in relation to Good Manufacturing Practice compliance and through improvements to the equipment for production and tests. These improvements need to be seen against a doubling of production capacity for PPR and CBPP vaccines.

BVI participated in the marketing workshop held in Nairobi in June 2011. A specialist sales and marketing post was created in 2008 and a marketing strategy (to 2012) was in place. However, the training introduced new techniques to explore different market segments and defining the different distribution channels for different markets. There were also new management tools that helped to map and model a range of stakeholders' interests. This is complicated by the range of external agencies and factors that shape the market, such as national government and international development partners' responses to disease outbreak situations or changing priorities.

The general manager, George Matlho, noted: "The overall impact of the management training was that a stronger culture of cross departmental working was introduced encompassing production, sales and marketing and finance. This means that costs and margins are easier to accurately determine. The management training was well received and generated enthusiasm amongst the team to try new approaches to enhance productivity levels.

There is an intention to cascade the learning throughout the organisation and especially to include supervisory managers who had not experienced the first round of training. One area where the team identified they would like additional training is in managing contracts with outsourced service providers".

The anticipated impact of VACNADA includes increased productivity, increased efficiency, enhanced system of quality assurance management auditing and improved interaction between departments. Once this is achieved BVI will be in a position to effectively assist in reducing the impact of PPR on Africa's livestock.

World-class vaccine facility moves closer in Ethiopia

VACNADA invested in the **Pan-African Veterinary Vaccine Control Centre (AU-PANVAC)** and the National Veterinary Institute (NVI), both situated on a shared premises in Debre Zeit, Ethiopia, to assist them in their push to become a world-class vaccine facility. The resultant changes are driving up the quality and volume of vaccine production at NVI and supporting the remit of PANVAC.

David Paul Lunn from the College of Veterinary Medicine and Biomedical Sciences, Colorado State University, USA, who attended the VACNADA commissioning event, said: *"I had the chance to visit the NVI and tour the new facilities in November 2011. The transformation from what I had seen 18 months before was astonishing. While previously impressive, the NVI is now clearly a truly world-class production facility with world-class standards. This is something that the Ethiopian people and all the sponsors and developers involved can be truly proud of."*

Yeshambel Petros explains how the water treatment plant works with Steve Sloan, former CEO of GALVmed and Martha Yami, general manager of NVI, Ethiopia

NVI was established in 1964 with technical assistance from the French Veterinary Mission in Ethiopia. The infrastructure of NVI helped to attract AU-PANVAC to the site.

In 1992 NVI was set up as a public enterprise. It is ISO 9001 certified and is working towards the international quality mark for Good Manufacturing Practices. This process will be aided by the new equipment and investment in skills at NVI provided through the VACNADA project.

Martha Yami, general manager of NVI, placed the VACNADA programme in context when she said: *"I would like to emphasize the importance the federal government of the Republic of Ethiopia places on measures to control animal diseases. We are very conscious of the enormous livestock resource with its potential for the people of Ethiopia and the grave threat of animal diseases to the livelihoods of our farming community. The support from VACNADA will contribute to achieving the national 5-year growth and transformation plan in the improvement of livestock production."*

There have been a considerable number of changes made as a result of the investment. Before VACNADA the quality of the water on site was not fit for drinking. Now, with the advent of the reverse osmosis water treatment equipment, pharmaceutical grade water is available on site.

In a country with 42 million sheep and goats, CCCP production at NVI was stuck at 700,000 doses annually. Production is set to double as a result of the VACNADA investment. The VACNADA investment also has the potential to drive considerable efficiency savings through adoption of the improved production process.

Gelagay Aylet, head of vaccine production and sales at NVI, found the VACNADA process a refreshing change from other donor-led *programme. He explains: "The VACNADA process was different from other aid. It started by identifying real problems. It didn't come with its own fixed views or pre-bought equipment. It was an effective approach – problem identification and assessment, gap analysis, solution and investment.*

VACNADA also gave us access to people we couldn't have found ourselves – especially the Pfizer Global Health Fellows Paul Dominowski and Nancy Ng. The approach they took helped us to find the real gaps and to keep pushing back to see how we could creatively solve the problems we faced. Paul, in particular, has become a friend and colleague – I still email him from time to time for advice – so we can keep driving productivity and quality.

The training was very fantastic. It helped us to find the concrete costs, not just the chemicals but also the staff inputs and the utilities. This can make us more profitable – not by passing on the costs, but because we can now work to minimize them.

Because of the VACNADA investment, bulk storage is now possible in purpose-built freezers. This means that we can work more effectively producing larger batches and driving down the contingent costs. This is a clear example of how the different aspects of VACNADA dovetail together to support farmer's access to a timely supply of good quality affordable vaccines."

There have been changes too at PANVAC. Nick Nwankpa, senior veterinary vaccines officer, picked up the story: *"This is just the beginning. Over the next 5–10 years people will be surprised at what this facility will turn out. The process development and biosafety level 3 labs will attract world-class scientists to come and do research."*

For Nick this is important because the labs can now target not only vaccine production but also vaccine improvement. He believes that CBPP vaccines can be improved as experiments can be run and all of the variables monitored. So, way into the future, the VACNADA investment will have impact on livestock.

Nick continued: *"Often international development is money down the drain with ex-pats arriving producing lots of reports but no change. But with VACNADA we got facilities we needed and trained people with real commercial experience – especially our relationship with the Pfizer Global Health Fellows."*

Broader impact

Although the VACNADA project targeted four prioritised diseases, its impact will in many cases extend to the other vaccines the laboratories produce. The business and marketing training and support is one of the inputs which will have impact across all facets of the laboratories, while the quality assurance training will help to elevate quality across the entire product range. Some of the equipment can also be used for other vaccines and the improvements to utilities, including water, electricity and cold storage, will impact on all vaccines produced.

Main challenges and lessons learnt

Meritxell Donadeu, GALVmed director of operations, observed: *"Although the project has been generally successful, it has not been without its challenges and the lessons learnt will be incorporated into future delivery".*

Meritxell went on to detail the main challenges and lessons learnt:

During implementation

Finding the right consultants within the very limited project lifespan: It was difficult to get both Anglophone and Francophone consultants, which meant a delay in the start of those activities. In the end, however, the right consultants were contracted for the work and they made great efforts to successfully deliver on time.

Procurement: Underestimation of engineering and procurement requirements: GALVmed had not done procurement at this scale before, and underestimated the requirements in terms of time and other logistics. Fortunately, GALVmed had the support of Pfizer Fellows with engineering expertise who were able to address this challenge and provide the valuable professional support required. Delays were also due to imports from outside Africa, and the need to bring in suppliers for installation and commissioning.

Lessons learnt: For projects requiring such a level of specialised procurement, in the future a specialised firm in procurement would be sub-contracted.

Customs clearance: Even with the support of AU-IBAR and the EC, in some countries customs clearance was extremely lengthy and complicated.

Lessons learnt: The time for customs clearance should not be underestimated and needs to be built into project delivery schedules.

Training: In some of the laboratories, training was jeopardised due to the lack of staff. It was difficult for the QA consultants to conduct the in-situ training when there was not a person designated for that task. One of the successes of the project has been in Senegal, where lab has committed to recruiting an additional extra person for the QA function.

Time availability: Many of the staff had many chores and duties, and it was not always possible to get all of them together for the various aspects of training.

Lessons learnt: Engage with laboratory management at the onset to ensure the right staff will be available at the time of training, but also try to expand the delivery period with the donors, so there is more time to accommodate the different pressing needs.

Sustainability of the project

Difficulties for government institutions to operate as businesses: The majority of the laboratories are dependent on their governments at different levels. The objective of the management training has been to empower the laboratories, so they can get more self-determination. But:

- It is difficult for the laboratories to deal with the government when it is the employer and the customer at the same time; during management training it was revealed in some laboratories that the final prices of the products could not be adjusted to a commercial reality, because the government does not want to increase the prices, even if that would make the difference between the laboratory being sustainable or not.
- It is difficult to motivate staff when salaries are not performance dependent, which is the case for most civil servants in the target countries, and this is exacerbated when the proceeds of vaccine improvement are not re-invested into the laboratory.
- If the income generated goes back to government and not to the laboratory, it might be difficult to ensure sustainability on equipment maintenance (even if it is factored in the cost of goods).

Some of the laboratories, for example KEVEVAPI, have utilised their management training to discuss some of these issues with their board and the government.

The laboratories have understood better the importance of taking management responsibility, and even if this is a long term goal, the first steps are being taken.

Time pressure due to short project life span: Some of the activities, like management and quality assurance training, need more time to ensure that the staff has had the chance to implement what they were taught and proper follow up was made.

In many cases, the training provided is just the first step, but there is still more work to be done in those areas.

GALVmed procured maintenance contracts of at least one year with the suppliers of major equipment. This ensured that the equipment procured remains functional for many years, build a culture of preventative maintenance in the laboratories and provide some time for the laboratories to generate their own maintenance budget. This is expected to avoid some of the past mistakes of similar projects where equipment were procured but either remained not commissioned or not maintained even after the commissioning.

Unfortunately the regulations applied to this EU-funded project did not permit GALVmed to pay in advance for maintenance contracts unless the payments are covered by bank guarantees. This requirement is expensive to implement and increased the total costs of the equipment. It would be helpful if this regulation is reviewed to support better long term use of equipment procured.

Next steps

The VACNADA project's implementation phase ended in December 2011, but that does not mark the end of efforts to improve the capacity of the eight laboratories to produce affordable vaccines meeting the needs of resource-poor African farmers.

The laboratories themselves have identified specific tasks and through the inputs provided under the VACNADA project they have new opportunities to exploit. And GALVmed remains committed to identifying opportunities to provide on-going support.

Initiatives by the laboratories

To ensure the equipment supplied remains in good condition, the laboratories have been provided with preventive maintenance plans and encouraged to take up annual maintenance contracts funded through the inclusion of this activity in the costing of their vaccines.

The laboratories will continue to consolidate their business management and marketing skills, and implement their knowledge to try to influence policy agendas and improve their operating environment. They can also continue to utilise the links established through the project with the various experts.

AVL, Ghana plan to apply the marketing training to see if there are other vaccines that the laboratory could produce for the sub-region to ensure viability and sustainability of the laboratory.

In Senegal, the ISRA leadership team is keen to visit other vaccine production facilities in order to benchmark their practice and performance. They are also looking to invest in a refrigerated truck to support the transportation of vaccines to neighbouring countries in support of their sales drive.

Joseph O Musaa, chairman of the KEVEVAPI board, explained: *"Our priority is further staff development to ensure that KEVEVAPI can meet the demands on it. We need to keep up our capital programme, staff development investment and market development in balance to build sustainable growth."*

Reports provided to each laboratory map out the long-term plans for the implementation of robust quality assurance systems. KEVEVAPI is committed to attaining the internationally recognised quality standard ISO 9001, and two labs are working towards attaining ISO 17025. GALVmed remain committed to finding ways of supporting further improvements in quality assurance systems beyond the VACNADA project.

The vaccine process development laboratory in Ethiopia will continue to be supported and promoted by GALVmed, and opportunities will be sought to initiate new projects exploiting this facility with partners such as AU-PANVAC.

Further assistance required

Some gaps have been identified in the training provided through VACNADA. Some of them include:

1. Production of diluents, which are used to reconstitute freeze-dried vaccines prior to administration. In many cases they are not supplied with the vaccine, and the farmers struggle to find the right diluents to use in the field thus jeopardizing the efficacy of the vaccine if the right diluent is not used.
2. The broad area of health and safety.
3. Use of tools to enhance digital data capture of information as part of better documentation of processes.
4. Many of the laboratories have requested further support in training, especially management and QA training. They considered VACNADA a very good first step and a start, but they need further development.

GALVmed and the laboratories are exploring ways to address these unmet needs; where appropriate this will include locally sourced training provision.

GALVmed is exploring how it can provide information to advocate for continuing support to upgrade vaccine production laboratories in Africa. The value of enabling increased access to vaccines through delivery mechanisms involving both the public and private sectors and encouraging vaccine producing laboratories to operate as commercial entities while supporting public good requirements is evident. These lessons may also be transferable to other capacity building programmes within development but outside of the vaccine area.

To enhance the learning derived from the project, GALVmed has committed to finding the resources to enable additional monitoring and evaluation of the project in early 2013 when the impact can be realistically assessed.

Wilson Lelei demonstrating the new portable vaporized hydrogen peroxide room sterilizer at KEVEVAPI

Last word

Fred Musisi, who was the GALVmed VACNADA project coordinator, reflects on 2-years of challenging but rewarding work...

When you hear stakeholders as diverse as ministers, board members, managers and staff all acknowledging that a project has made a real difference then you begin to realise that you may have a success on your hands. I was, therefore, delighted that during the series of events held to celebrate the commissioning of the inputs provided through VACNADA this was a consistent theme.

Thanks to the investment of €6.9 million by the EU, the support and encouragement from the GALVmed Edinburgh team, particularly Meritxell Donadeu and Baty Dungu, the concerted efforts of the large, diverse and expert delivery team – many of whom were more than willing to go the extra mile – and the receptivity of the host labs, the vaccine producing labs are now in much better shape than they were two-years ago. Carefully selected new equipment has been installed and is working; refurbished facilities and reliable utilities are operating; better quality assurance systems and manufacturing processes have been developed; managers and staff are putting into practice the technical and business training they have received; and the marketing information and models are being utilised.

I am really proud of the fact that it is widely acknowledged that the VACNADA project has done better than many previous projects. I think that this was largely due to a number of really smart features of the way the project was implemented.

One of GALVmed's acknowledged strengths is its ability to access pharmaceutical company expertise. This was absolutely critical during the VACNADA project, especially at the planning stages: world-class experts in vaccine production were mobilised to work closely with staff from the national labs to undertake joint comprehensive needs assessments and these were followed up by equally thorough specification exercises to ensure that exactly the right equipment was purchased from the right supplier.

Pharmaceutical industry expertise was also apparent in the care taken to ensure staff were trained on site in the use of the new equipment, much of which is expensive, complicated and highly specialist, and in preventive maintenance procedures, and in ensuring that on-going service contracts were in place. And an important element in the training on cost of vaccine production was to ensure that this covered provision of adequate resources for preventive maintenance systems.

A key feature of the training undertaken was that this was delivered at each of the labs, in contrast to the more common model in which a few individuals travel to the training venue, which is often overseas. Our approach of bringing the trainers to the labs was much less disruptive and enabled whole teams to benefit from the training together. Including the UK's Open University as a partner also meant that the managers could obtain certificates acknowledging their achievements. The mode of training was focused on interactive problem solving rather than traditional lecturing, which many trainees found to be highly motivating and empowering, and also refreshingly different. And including board members in the training programme was an unusual approach that appears to have paid real dividends in bringing about organisational change and high-level buy-in.

However, it is also widely acknowledged that this is just the start of the process: more investment and effort is needed to ensure that this increased capacity is translated into sustained production of quality assured vaccines and that these are made available and administered to the cattle, sheep, goats and chickens that poor people rely on for their livelihoods. Encouragingly, a number of labs are taking concrete steps to ensure this does happen and GALVmed is already exploring options to enable it to continue supporting the labs.

So, now the labs have better equipment, facilities, tools, skills and knowledge at their disposal. But during the VACNADA project a number of policy issues were identified that constrain the way the labs are run and the way vaccines are used.

Most of the labs are government owned and for three of the four vaccines targeted by the project – namely CBPP, CCPP and PPR – the government is also the main customer. It became clear during the project that this situation limits the effectiveness and viability of the labs. In most cases they do not have the freedom to price their products or set staff salaries according to market rates, and often are not permitted to retain any profits for reinvestment. This makes it impossible for the labs to function in accordance with sound business principles. It also represents a threat to the progress made during the VACNADA project: if funds are not available to allow the preventive maintenance systems to be continued then the expensive and highly specialised equipment will inevitably breakdown and become unusable; if the highly motivated and well trained staff are not paid market rates then they will leave their jobs. Some of the labs are beginning to embark down a route that may lead to more freedom to operate. Perhaps the time is right for governments to ask themselves questions about what their role should be in vaccine manufacturing.

Another issue is the extent that governments control the use of vaccines. In many cases private animal health service providers and livestock keepers are not currently allowed to handle or administer vaccines against transboundary animal diseases. The number of vaccines needed each year is largely determined by how much the government can afford, with little or no linkages to real demand from livestock keepers or even the prevailing level of disease risk. This means that labs have little or no opportunity to market these vaccines and increase their sales and revenues. One argument advanced to support this situation is that if anyone could use these vaccines it would complicate official surveillance operations by making it difficult to distinguish vaccinated animals from those that had been exposed to disease. One technical solution would be to adopt a DIVA (Differentiating Infected from Vaccinated Animals) strategy and this is perhaps something that GALVmed should consider when developing new and improved vaccines. Enabling private vets and other trained animal health workers to handle and administer these vaccines would reduce the burden on government services, allow livestock keepers to take responsibility for the health of their animals and would open the way for the vaccine labs to actively market their products and grow.

Unless these broader policy issues are also addressed there is a real risk that the VACNADA investment will ultimately make little difference.

In common with many time-limited projects, as the VACNADA project came to an end it was too soon to be able to determine the true extent of its impact. This is one of the main reasons that so little learning emerges from many projects. The result can be that the same mistakes are made over and over again, or that better ways of working are not recognised and promoted. To overcome this problem, GALVmed management has committed to finding the resources to enable an impact assessment to be carried out a year or so after the formal end of the project.

Although VACNADA had a clear focus and objective to increase capacity of national vaccine producing labs, many of the approaches used and lessons learned have value beyond the sector. This is especially relevant as more African government-owned organisations begin to embark on the road to becoming more commercially-oriented operations and perhaps, eventually, fully privatised businesses. An important task still remaining is to package and share the lessons learnt from the VACNADA project. If that is done effectively, the impact of the project could be very considerable indeed.

Peter Wells, acting CEO of GALVmed adds:

Fred is far too modest to admit it, but one of the reasons the VACNADA project succeeded was due to him. His quiet but determined style of leadership and instinctive appreciation of sensitivities and risks, all based on a lifetime of involvement in veterinary research and development in Africa, was exactly what was needed. He provides an excellent model of how effective partnership working can be which we could all learn from. I would also like to acknowledge the immense contribution made by the entire delivery team (see below) – suppliers, consultants and other partners – and the GALVmed staff under the leadership of Meritxell Donadeu and Baptiste Dungu.

Key members of the team were of course the staff, management and board members of the labs. The ball is now firmly in their court and I look forward to seeing how they move forward in the coming months and years. As they do so they can count on GALVmed as a committed partner. In fact my colleagues are already looking to see how we can continue to support the labs in the future, either through new projects or by mainstreaming activities into our core programmes.

Fred Musisi, GALVmed VACNADA project coordinator, Meritxell Donadeu director of operations and Karim Tounkara, director of PANVAC, at the commissioning event at LVC, Mali

The VACNADA team

Project management at GALVmed (Nairobi): **Keziah Kamau and Fred Musisi**

Project management at GALVmed (Edinburgh): **Meritxell Donadeu, Baptiste Dungu, Louise Gordon, Patricia Irving, Thomas McCusker, Hameed Nuru and Sharon Ross**. Support was also provided by all the GALVmed departments

Communication team: **Stuart Brown, Emma Quinn, Duncan Sones and Keith Sones**

Project management for AU-IBAR: **Sam Wakhusama and Mamadou Niang**

Management training team: **Francis Cattermole, Tione Kaonga, Andrew Sergeant, Oliver Clark and Mike Shaw**

Quality assurance teams: **Pascale Sierra, Marie-Laure Mainsant, Stephane Chesneau, David Jones and Anne Jones**

Newcastle disease team: **Mary Young and Zuhara Bensink**

Market assessment and modelling: **Brian Perry, Keith Sones, Timothy Evans (Vetnosis), Berhanu Admassu (Ethiopia), Justin Akakpo (Senegal), William Amanfu (Ghana), Ariel Karugah (Kenya), Eddy Mogoa (Kenya), Aboubakar Njoya (Cameroon), Mary-Lou Penrith (Southern Africa) and Cheick Simbé (Mali)**

Needs assessment: **Stephan Chesneau, Kevin Schultz and others credited in other sections**

Pfizer Global Health Fellows: **Paul Dominowski, Nancy Ng and Seamus Pender**

CCPP and CBPP process improvement team: **Keith Haffer (Advantage Bio Consultants), Nico Oosterhuis and Mustafa Mert (CELLution Biotech BV.)**

PPR vaccine optimization: **Joseph Litamoi (FAO), Francois Thiacourt and Geneviève Libeau (CIRAD-IBET partnership)**

If you would like further information, or you wish to make any comments, please contact us by email on newsletter@galvmed.org

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