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Final evaluation of the project Development of a Framework for the Progressive Control of Foot and Mouth Disease in Pakistan

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Final evaluation of the project Development of a Framework for the Progressive Control of Foot and Mouth Disease in Pakistan
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## Acronyms and abbreviations

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>ECTAD</td>
<td>Emergency Centre for Transboundary Diseases</td>
</tr>
<tr>
<td>ELISA</td>
<td>Enzyme-linked Immunosorbent Assay</td>
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<tr>
<td>ET</td>
<td>Evaluation Team</td>
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<tr>
<td>FAO</td>
<td>Food and Agriculture Organization of the United Nations</td>
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<tr>
<td>FMD</td>
<td>Foot-and-mouth Disease</td>
</tr>
<tr>
<td>LDD</td>
<td>Livestock and Dairy Development</td>
</tr>
<tr>
<td>LIMS</td>
<td>Laboratory Information System</td>
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<tr>
<td>LTU</td>
<td>Lead Technical Unit</td>
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<tr>
<td>NUST</td>
<td>National University of Sciences and Technology</td>
</tr>
<tr>
<td>NVL</td>
<td>National Veterinary Laboratory</td>
</tr>
<tr>
<td>OIE</td>
<td>World Organisation for Animal Health (&quot;Office International des Epizooties&quot;)</td>
</tr>
<tr>
<td>PCP</td>
<td>Progressive Control Pathway</td>
</tr>
<tr>
<td>PCR</td>
<td>Polymerase Chain Reaction</td>
</tr>
<tr>
<td>PKR</td>
<td>Pakistan Rupee</td>
</tr>
<tr>
<td>RAP</td>
<td>Regional Office for Asia and the Pacific (of the FAO)</td>
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<tr>
<td>TAD</td>
<td>Transboundary Animal Disease</td>
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<tr>
<td>UN</td>
<td>United Nations</td>
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<tr>
<td>USD</td>
<td>United States Dollar</td>
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<tr>
<td>USDA</td>
<td>United States Department of Agriculture</td>
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Executive summary

ES1 In September 2015 the four year project named “Development of a Framework for the Progressive Control of Foot-and-Mouth Disease in Pakistan” completed. This is the final evaluation report. Its purpose is to analyse project achievements in their context, draw lessons for planners, and identify good practices.

ES2 The project’s context is a very high occurrence of Foot and Mouth Disease (FMD) in Pakistan, and the adoption of a “Progressive Control Pathway” for this economically very significant disease. The project’s objective was to move from “stage 1” of this pathway to “stage 2” that is, for federal and provincial veterinary services to define FMD risk areas and implement control options. To this purpose the project’s task was to help construct a well-functioning surveillance and response system, a capable diagnostic system and test the effect of preventive vaccination in hotspots of the virus. Evaluation questions zoomed in on these activities: how capable then, is the surveillance system? Has the system responded adequately to outbreaks? Can the practice of preventive vaccination serve as a model to reduce the virus load?

ES3 The evaluation team visited a large number of livestock farms and veterinary units, held interviews with their owners and staff, and cross-checked information requested from the project with observations so sought and received.

ES4 The team found a well-designed and well-managed project. Stakeholders were selected with care and beneficiaries were targeted among farms of various sizes where FMD outbreaks were common. One of the project features much appreciated was the smooth interaction between central and regional veterinary services, geared towards their common aim.

ES5 The capacity of selected laboratories to diagnose FMD serotypes (and at central level, sub-serotypes) has been tried and tuned through outbreaks and sero-surveys, and a proficiency test has shown that the reliability of laboratory test results is of a high standard.

ES6 The project facilitated the effective handling of more than 7 000 outbreaks of FMD by introducing clear standard operating procedures; implementing a practical and efficient mechanism for handling samples; responding quickly; and, most importantly, by defining and using a type-tailored vaccine.

ES7 The project convincingly demonstrated the preventive effect of vaccination with another 20 000 farmers. It has shown the importance of using strain-specific vaccine and of the low cost of the cold chain required for its storage. As a result, the more commercial farmers in the demonstration areas are eager to purchase vaccine themselves.

ES8 The project formulated a risk-based, progressive control plan for FMD that draws insights from the occurrence and characteristics of the disease, and from the experiences gained. Aspects worth mentioning include the piloted vaccine cost-participation scheme and the outbreak surveillance and response mechanism. The project made significant contributions to understanding the epidemiology of the disease by collection and analysis of field data, a function that was slow to be embedded in the office of the Animal Husbandry Commissioner.

ES9 In conclusion, the project has demonstrated that the required vaccine can be identified and purchased only with well-functioning surveillance and diagnostic services. It has combined people and resources from provincial/regional and federal veterinary services with those of FAO, USDA and several other organizations into a network with the clear objective of the progressive control of Foot and Mouth Disease in Pakistan. It has finally shown that the implementation of the Risk-based Progressive Control Plan for FMD requires national leadership in terms of legislative reforms and resource allocations.
Recommendations

1. FAO should support the Livestock and Dairy Development Departments of all provinces and regions in Pakistan in implementing the National FMD Progressive Control Programme as follow-up to the present project.

2. FAO should start a bridging project to maintain the momentum and build on the strategic gains from the current project in anticipation of the approved National FMD Progressive Control Programme.

3. FAO should further expand the awareness activities with better targeting of female field veterinarians and female livestock extension and health workers, in addition to facilitating a regional exchange of experiences. In this context, FAO could adapt its online training course for general risk management of FMD to the specific conditions faced by central and field staff of the veterinary service in Pakistan.
1. Introduction

1.1 Background and purpose of the evaluation

This document presents findings of the final evaluation of the project “Development of a Framework for the Progressive Control of Foot-and-Mouth Disease in Pakistan”. The project ended in September 2015 after a four-year implementation period. The project budget was USD 7.3 million, which was spent by the end of the implementation period. The main donors were the United States Department of Agriculture (USDA) and the Federal and Provincial Governments of the Islamic Republic of Pakistan.

The project was implemented by the Food and Agriculture Organization of the United Nations (FAO), under number GCP/PAK/123/USA. The main project beneficiaries were strategically selected holders of buffaloes and cattle, and the public veterinary services at federal and provincial levels.

The purpose of this final evaluation is to analyse project achievements in their context, draw lessons for planners, and identify good practices. While this report is of interest to all project stakeholders, it is especially useful for those addressing the control of Foot and Mouth Disease (FMD) in Pakistan.

1.2 Evaluation scope and objectives

This evaluation was conducted in September 2015, in the final month of the project’s life cycle. A subsequent project has already been planned by members of the project’s Steering Committee, as a logical sequence of the present one, and will benefit from the experience gained in the present project. Therefore, this evaluation intends to serve planners in the Government of Pakistan, FAO and other stakeholders with information useful for detailed planning.

This evaluation covered all of the project’s interactions at central, provincial, district and farm level. The farm level includes several cattle and buffalo farm categories over a variety of locations in the country. The central level included the office of the Animal Husbandry Commissioner, located in the Ministry of National Food Security and Research. At provincial/regional level the Livestock and Dairy Development Departments are included, with diagnostic laboratories were applicable.

This final evaluation revisits observations and recommendations made during the Mid-term Review of the project, which focused on management and the process of implementation. Beyond implementation, the present evaluation focuses on the project’s outcome level results. Questions posed include:

- To what extent has the project developed a framework for the control of FMD in Pakistan, which serves as the basis for the next stage of control of FMD as described in the FMD Progressive Control Pathway (PCP)? And to this purpose:
- To what extent has the project developed the provincial and regional laboratories’ capacities to diagnose, report, take samples and respond to FMD outbreaks?
- To what extent has the project contributed to strengthening FMD epidemiology, surveillance and rapid response mechanisms?
- To what extent can the practice of vaccination introduced serve as a model for replication?
1.3 Methodology of the evaluation

The evaluation follows the standards described for evaluation in the UN system, with emphasis on the common criteria of relevance, effectiveness, impact and sustainability. It also assesses principles articulated for UN Common Programming which draws attention to human rights-based approaches, right to food, decent work, gender equality, environmental sustainability, capacity development and results-based management.

The evaluation team (ET) collected data and information through the following sources: (i) documents issued by the project or sourced from the internet (listed in Annex 3); (ii) project staff, interviewed formally or invited to present a synopsis of activities and views; (iii) institutions and stakeholders throughout the country were visited on-site and interviewed. Stakeholders were interviewed as single persons, in small groups or as focus groups, allowing for discussion on topics raised by the ET. The stakeholders interviewed included a sample of farmers, veterinary officers and assistants working with these farmers, staff at laboratories upgraded by the project, and several directors of institutions involved or responsible for the control of FMD. A list of interviewees is provided in Annex 4.

Most of the farm visits were conducted as planned; locations included Karachi (Dairy colonies at Lhandi and Nagori and the Eid market), Lahore (dairy colony Gujjar), Jhang, Bahalwarpur, Jogaitpeer, Cholistan, Peshawar and Nowshera. A total of 21 farms were visited and 10 focus group discussions were held, each attended by five to 60 farmers. Two of the planned visits (to Rahim Jahr Khan and to Gilgit) did not materialize due to security reasons, and a visit to Quetta could not be conducted due to time constraints.

The selection of individual farmers interviewed within the areas mentioned was only partly done by project staff; however, the ET influenced which farmers to visit. Farmers visited included those involved in vaccination or outbreaks, as well as those who were not affected but living nearby. Three interviews were done by telephone.

Interviews as well as focus group discussions were conducted in a semi-structured manner, allowing discussion partners ample opportunity to raise issues not brought up by the ET. The ET tried to avoid leading questions and used the tool of triangulation frequently.

After completing all visits, the ET presented tentative findings and further questions to the project team through a formal presentation. The ET’s observations were thoroughly discussed, and feedback received was used to complete and adjust conclusions. The ET also participated, as observers, at the final session of the Steering Committee on the last day of the project’s implementation cycle.

The project’s logical framework matrix (logframe), which describes expected cause-effect relations and the influence of factors beyond the control of the project, was used as a reference against which to measure impact. The logframe used is an adjustment of the original logframe, as recommended during the Mid-Term Review, in order to make the project more evaluable. The logframe is presented in the next chapter.

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1 These are further described in http://www.uneval.org/document/detail/22, accessed October 2015
3 Triangulation: repeating questions in different wording and from different angles and sometimes framed to different interviewees, in order to verify if answers describe the same situation and are well understood.
2. Context of the project/programme

14 FMD is endemic in countries where three-quarters of the world population lives, including in Pakistan. The disease causes enormous economic losses (billions of dollars) world-wide. Losses are both direct (loss of milk production, abortion, reduced fertility, some mortality, loss of bodyweight) and indirect (trade restrictions, choice of breeds of lower productivity, cost of prevention and treatment). A recent study in Faisalabad district of the Punjab ranks FMD as the most damaging disease among dairy cows and buffaloes. The per-animal damage was found to be larger at smaller farms.

15 The FMD virus easily spreads through air and water, and may do so for a few weeks. Where animals of different holdings mix, such as on markets and on communal pasture, and where distances between holdings are small, the chance of infection increases and control is more difficult. Animal movement, including animal trade, is an important factor in further spreading the disease, and this is a reason why the disease is of global concern. Other factors that determine outbreaks in livestock include virus evolution, host immunity and vaccination, wildlife reservoirs, and human conflict resulting in animal displacement.

16 The global distribution of FMD virus is very uneven, reflecting in part the varying national capacities to fund and implement control. It is a complex disease: the virus has multiple serotypes and subtypes, which have absent or incomplete cross-immunity and are constantly evolving. This aspect means that the vaccine suitable for a particular location may change from year to year.

17 Antigenically distinct groups of virus strains tend to occur in defined regions of the world. These groups have been categorized into seven FMD virus pools: the FMD virus strains in Pakistan are part of the west Eurasian pool. Within the context of the west Eurasian FMD virus pool, progressive control of FMD in Pakistan is extremely important for the common goal shared by countries in the region: to reduce the overall FMD burden (FAO, 2013). Pakistan has known hotspots where infection is persistent and virus is endemic, including the huge dairy buffalo colonies in and around Karachi, Sindh. Virus emanating from Pakistan threatens not only local livelihoods, but regional outbreaks (through unregulated trade of live animals through Afghanistan to Iran and Turkey) and may even be a risk for FMD re-introduction to Europe or North America (for example, by people carrying infected meat).

18 FMD control requires both a strong national commitment to disease control and also engagement in regional approaches. A PCP was developed for countries in which FMD is still endemic. In 2008 in Shiraz, 14 countries including Pakistan formulated the FMD PCP regional roadmap leading to “West Eurasia free of clinical FMD by 2020”.

19 Before the project, major challenges to implement the FMD PCP existed in Pakistan, including (i) insufficient FMD vaccine available; (ii) suboptimal laboratory FMD diagnostic capacity; (iii) poor farmer awareness of disease control measures; and (iv) lack of field veterinary personnel motivation to respond to outbreaks. The country also needed an officially-adopted, coherent national FMD control strategy.

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4 See Knight-Jones and Rushton, 2013, The economic impacts of foot and mouth disease – What are they, how big are they and where do they occur? http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3989032/


6 The following paragraphs of this chapter are copied from the Mid-Term Evaluation Report.

7 The seven virus pools are (FMD serotypes shown in square brackets): Pool 1, Asia east [O, A, Asia 1]; Pool 2, Asia south [O, A, Asia 1]; Pool 3, west Eurasia [O, A, Asia 1]; Pool 4, Africa east [A, O, SAT 1, 2, 3]; Pool 5, Africa west [O, A, SAT 1, 2]; Pool 6, Africa south [SAT 1, 2, 3]; Pool 7, America south [O, A].

Thus, the context of this project is global and regional, because of the global need to know about new FMD strains evolving in Pakistan and because a regional approach is needed to control this transboundary animal disease. The context is also local and national, because FMD affects farmer livelihoods and food security and because national veterinary services require support.

In trilateral (USA-Pakistan-Afghanistan) meetings held in Doha and Islamabad in January and February 2010, FMD control was agreed as a priority. In mid-2010 a USDA mission visited Pakistan and developed a concept note with the Federal Livestock and Dairy Development Department. The concept note identified the three key project Intermediate Outcomes at the core of this project.

In September 2010 USDA and FAO signed a Programme Agreement that described FAO’s obligations to implement the progressive control of FMD in Pakistan. FAO prepared the project document which, in March 2011, was signed by the Government of the Islamic Republic of Pakistan and FAO. Project implementation began in August 2011.
3. Evaluation findings

3.1 Analysis of project concept and design

Findings: The project has been designed along a clearly defined pathway of progressive control, with realistic and interdependent activities that contributed to more effective control measures by the veterinary services. Reaching this ‘stage two’ is an intermediate step toward achieving the ultimate goal of full control, or even an intermediate goal of providing livestock producers with access to effective vaccines in targeted areas. The stakeholders were well-selected, and beneficiaries were targeted among farms of various sizes where FMD outbreaks were common.

The project was implemented as a technical, organizational and material support effort to move FMD control along a well-defined pathway of stages of increased control. This Progressive-Control Pathway for Foot and Mouth Disease (PCP) has a horizon of several years beyond the life of the project. It is both a pathway and a yardstick of progress; an instrument of definition and communication. At an annual meeting of 14 countries in the region (Pakistan included), the West-Eurasia FMD Roadmap (which shows the progress of each country along the pathway) was reviewed and discussed; these discussions were facilitated by FAO, World Organisation for Animal Health (OIE) and the European Union. At the beginning of the project, Pakistan was considered to have reached ‘stage one’ in controlling FMD and the project’s main aim was to reach the next stage. The project built on the experience gained in a preceding project on the control of Trans-boundary Animal Diseases which, among others, had identified major hotspots of the FMD virus in Pakistan.

The project’s hierarchy of objectives is defined in four steps (Figure 2). Progressively controlling FMD at this stage of the PCP is expected to reduce the virus load (project’s outcome), so that fewer animals would be affected, and thus economic losses would be reduced (project’s overall objective). The loss of milk production poses a threat to food security for a large number of rural households with cattle or buffaloes, especially in the case of poor households for whom milk constitutes an important source of protein. Therefore a reduction of the number of FMD cases in cattle and buffaloes will improve food security for these households (ultimate project goal).

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11 The FAO and OIE, as well as the EU have developed this guiding tool. An overview with references to more details is provided at http://www.fao.org/ag/againfo/programmes/en/empres/news_110615.html
12 FAO project GTFS/INT/907/ITA, “Controlling Transboundary Animal Diseases in Central Asian Countries”, completed in 2011
13 A discussion on the effect of better control of FMD in endemic areas on the reduced risk of incursions into disease-free regions is, for instance, in http://www.veterinaryresearch.org/content/44/1/116
In order to achieve these objectives, the project has structured its activities toward three intermediate outcomes: (1) Enhanced capacity to diagnose FMD at disease, serotype and genotype level at districts, provincial and federal laboratories in the targeted areas; (2) Surveillance of and response to FMD outbreaks in the country improved; and (3) Preventive, early and consistent immunization practices demonstrated for effective control of FMD. The complete Logical Framework Matrix is provided as Annex 7 and it provides the illustration of the conclusion that individual activities neatly contribute to the respective higher level outcomes. Figure 3 provides a schematic overview of these same activities and instruments developed under each outcome, showing several interdependencies between these, and with some external resources. The three outcomes not only reinforce each other, but also contribute as a system to the reduction of the virus load in Pakistan. Additionally, they have proven to be effective and thus will form the basis for future strategies of progressive FMD control, as shown in later chapters.

The project’s intended ultimate beneficiary groups included a small but strategic selection of private cattle and buffalo holders in the main farming systems (subsistence...
rural, commercial rural (small and large), peri-urban dairy farms (including so-called dairy colonies) and government livestock farms. These groups have been well selected. The process involved provincial and regional Livestock and Dairy Development Departments and several farmer organisations. Some of the major virus hotspots have been included in the project’s focus areas, and these are the areas where outbreak surveillance and response are best put to the test. The number of farmers reached directly is approximately 6 000 trained, 20 000 involved in preventive vaccinations (of which 95 percent smallholders) and at least 7 000 covered in outbreak response. In addition, nearly 2,000 farms were reached through a cost-sharing vaccination facility.

28 Intermediate actors included veterinarians providing public services (and in some cases, individual private veterinarians and animal health workers). Some of the private veterinarians are in the service of a large milk processor (Engro Food Ltd.), connecting the project to small rural commercial dairy farmers. By including these actors, most of the formal service providers have been involved in the project’s activities – more than 2 400 participated in training courses.

29 A third group of project-engaged (but not employed) stakeholders included selected public institutes of veterinary services at seven provinces/regions, including personnel of nine key and 24 smaller laboratories at federal and local government levels. The main departments so engaged are presented in Figure 4. Officers providing an important link between the project and the Government structures are four Transboundary Animal Disease (TAD) officers. Their position has been newly introduced and has proven to be of key importance to effective communication between services.

30 The final group of stakeholders included the Food and Agriculture Organization (FAO) of the United Nations at headquarters, regional and national offices and the main donor, the United States Department of Agriculture (USDA). Through FAO the project has utilized regional resources and networks. Through USDA the project has been able to connect to several services and professionals in the US that further contributed to training, software development and diagnostic services.

31 The project itself consisted of six technical and management staff and a small team of administrative staff and drivers. This team performed and was led well. The office and all staff was based near the Central Veterinary Laboratory and the Animal Husbandry Commissioner (Chief Veterinary Officer), enabling good interaction at the federal level of veterinary services.

![Figure 3. Main project activities and dependencies](image-url)
32 The project has established and maintained three *formal platforms* for planning and communication: (i) A Project Steering Committee (PSC) was tasked to review progress, approve proposed plans and budget changes and, through its members, interact with stakeholders at Government and donor levels; (ii) a Technical Working Group was tasked to discuss and advise on technical and research questions; and (iii) a meeting of TAD officers was tasked to liaise with provincial veterinary services on all project activities. These groups functioned well: they have met frequently and as the minutes show, have guided the project well.

33 The project has addressed only one stage of the overall pathway. Although this stage is likely to be sustainable, it is a *precondition but not in itself enough to ensure an ultimate impact*: the accessibility of effective vaccines by livestock producers. Additional external support was articulated at the design phase of this project, as a requisite for success. One design element that may have cemented the current project’s achievement is vaccine purchase. The project purchased and distributed (carefully specified) vaccines – a function that the provincial/regional public institutes of veterinary services and other parties outside the project’s structure should eventually take over. The project involved the Animal Husbandry Commissioner in the procurement process, but the design could have foreseen a step beyond: toward the end of the project and based on the specifications provided by the Animal Husbandry Commissioner, the provincial/regional authorities should begin to procure vaccines.

34 The project design did not mainstream either a human rights-based approach or a gender approach in its activities.

35 Operational management of the project has been of a high standard. Most activities were *implemented on time*, as planned. The baseline study was an exception. It concluded late (2013) in the project’s life and the final socio-economic study was also not been completed at the end of the project. The results of the latter would have benefitted this evaluation.

36 The project faced several *unexpected challenges* and has been able to deal with these in an effective manner. For example, the fielding of laboratory experts was repeatedly
delayed due to security issues, but not abandoned or neglected: the experts were eventually selected and assigned, and performed beyond their assignment tasks. The project’s implementation period was extended by a year, a logical and practically sound decision that dealt with some of the delays. The appointment by the Federal Government of professionals to establish an Epidemiology Node under the CVO has not materialized, despite several efforts by the project. This was a project risk not sufficiently described in the original logframe. The project compensated by providing its own staff member in a temporary position.

The project has kept a good record of its activities and outputs, allowing it to monitor itself and make strategic decisions. It has been strong in communicating condensed results in the form of minutes, planning and progress reports, and presentations and quarterly bulletins. It has convened regular meetings of the three platforms of communication (Project Steering Committee, Technical Working Group and Meeting of TAD Officers).

The project made very good use of insights gained during implementation and applied these in the form of well-planned and well-implemented activities and instruments. The inclusion of Cholistan in sero-surveillance proved to be very insightful (in this extensive transhumance livestock production system the virus was shown to circulate to a much higher degree than previously thought). The inclusion of high-altitude production systems (with yak herders) proved similarly revealing. The introduction of a cost-sharing model had not been foreseen, but addressed the all-important issue of sustainability by testing farmers’ willingness to pay for vaccination.

Networking by the project team was exceptionally good. Exchanges took place on a regular basis with professional partners both inside Pakistan (see next chapter) as well as abroad (see Figure 3). Though networking was a requirement by project design, the project team’s background and motivation has enabled them to draw on surrounding institutions for solutions and to delegate and support the implementation of project activities to public servants.

3.2.2 Institutional arrangements including government’s participation

The institutional set-up of the project was well planned and has provided the project team with an opportunity to solicit full engagement of the federal and provincial veterinary institutes and services. Its importance is not easily over-estimated, as in 2011, the project’s start-up year, the federal Ministry of Livestock and Dairy Development was transferred to provincial levels and new roles were being defined.

The government showed good commitment at both federal and provincial levels, as well as engagement in project activities. The planning and monitoring meetings (Steering Committee, Technical Working Group and TAD officer’s meeting) were all well attended. TAD officers were fully involved in determining the course of implementing activities, even though most of these had been planned in advance. The commitment was further boosted by allowing provincial governments to select beneficiary farms or villages based on criteria provided by the project. However, the appointment by the Federal Government of professionals of the Epidemiology Node under the CVO has not materialized, despite several efforts by the project.

Technical and operational support by FAO to the project has been effective, even though FAO itself went through a devolvement exercise. Operational and financial decisions were made in cooperation with the FAO representation in Pakistan, and were well documented. The project also engaged outside its planned boundaries as a member of the UN family, by providing vaccination and mitigating services to victims of the flood.

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16 The FAO Representative in Pakistan has become the Budget Holder and a Lead Technical Officer has been appointed from the FAO Regional Office for Asia and the Pacific, RAP. The Lead Technical Unit (LTU) remained with the Emergency Centre for Transboundary Diseases (ECTAD) in FAO HQ.

17 Judging from several Letters of Agreement between implementing parties and the project, and on reviewing the budget. The evaluation did not include a formal audit.
disaster in 2014. The Lead Technical Officer, now operating from the regional FAO office in Bangkok, provided timely feedback on technical content as offered through quarterly progress reports. At FAO headquarters, the Lead Technical Unit (LTU) provided strong strategic guidance both at the planning stage and during implementation. At times of crucial decisions such as procurement of the right type of vaccine, communication between the project and the right expert at the LTU was effective and appreciated.

3.3 Analysis of project’s contribution to results

This chapter starts with an assessment of the project’s three intermediate outcomes, as follows: (i) the capacity to diagnose FMD; (ii) surveillance of and response to outbreaks; and (iii) immunization practices. The project consolidated and expanded its already good achievements as observed in 2014. The last part of this chapter will assess the project’s result and impact.

3.3.1 Intermediate outcome 1 – diagnostic capacity

To what extent has the project developed the provincial/regional laboratories’ capacities to diagnose, report, take samples and respond to FMD outbreaks?

Findings: The capacity of these laboratories to diagnose FMD serotypes (and in the case of the CVL, sub-serotypes) has clearly improved. It has been tested through outbreaks and serosurveys, and a proficiency test has shown that the reliability of test results is of a high standard.

The diagnosis of FMD at disease, serotype and genotype level in provincial and reference laboratories has clearly improved: the capacity of the participating laboratories has expanded to deal with thousands of samples, and the quality of the tests has been checked and found good, as evidenced by the following observations.

Nine provincial/regional laboratories are now able to determine the serotype of the FMD virus, using the enzyme-linked immunosorbent assay (ELISA) tests. This equals the planned number. These labs tested more than 11,000 samples by the end of the project. More importantly, test quality is good: in 2014 the project conducted a proficiency test for serotyping, using the same blank samples sent to all supported laboratories (seven in 2014) to compare test results. The results were very good (5/7 with a 100 percent score, 2/7 with an 83 percent score of determining the correct serotype).

The above proficiency test outcome also shows that the training of lab staff has been effective. More than 20 laboratory staff have attended training courses, both initial training and an annual refresher course. These courses were held at the National Veterinary Laboratory (NVL) and the NVL continues to coach its trainees throughout the year.

The NVL also participates, since 2012, at the international proficiency test, with 50 blind samples received annually from the world reference lab for FMD (the Pirbright Institute, UK).

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19 Those achievements already reported by the Mid-Term Evaluation Mission are summarized.
The NVL was trained in both conventional and real-time polymerase chain reaction tests for molecular diagnostics of the virus, and in its isolation. As a result, it has built a repository of 110 confirmed isolates. Of these, 20 have now been shared with the FMD Research Centre in Lahore, enabling this institute to use the proper sub-types of the virus when manufacturing vaccine. Another result is that the NVL now tests antibodies against structural and non-structural virus proteins (of the FMD virus particle), enabling it to determine the level of virus circulation in different farming systems and areas.

The project introduced a laboratory information system (LIMS) at each of the nine provincial labs and at the NVL. In so doing it sought and received assistance from Texas A&M University for the structure and source code, which was adapted by the National University of Science and Technology (NUST), who introduced it at the laboratories and trained staff. By the end of the project the LIMS has succeeded in centralizing information about FMD sample test results, but functioned well below its potential to be used for tests other than for FMD.

3.3.2 Intermediate outcome 2 – surveillance and response to outbreaks

To what extent has the project contributed to strengthening FMD epidemiology, surveillance and rapid response mechanisms?

Findings: The project facilitated the effective handling of more than 7,000 outbreaks of FMD by introducing clear standard operating procedures; implementing a practical and efficient mechanism for handling samples; responding quickly; and, most importantly, by using a type-tailored vaccine, which was received enthusiastically by farmers and veterinary field staff.

The project introduced several strict procedures and supporting instruments, as well as training for surveillance and response to outbreaks (see Box 1). As a direct result, the provincial veterinary services have performed well; the number of reported outbreaks

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20 It has used this test, for instance, in studying the effect of five common FMD vaccines in buffalo calves; see the publication in the Pakistan Veterinary Journal, 2015 at http://www.pvj.com.pk/pdf-files/35_3/289-292.pdf
21 The robustness of the software still needs to be improved and continued support by NUST is important to maintain the system.
as compared with the situation before the project\textsuperscript{22} has increased rapidly in the first two project years (see Table 1). By the end of the project nearly 7,200 outbreaks had been reported, of which 20 percent could not be confirmed at provincial level.

Table 1. Number of outbreaks reported during the project and serotypes identified

<table>
<thead>
<tr>
<th>Outbreaks reported*</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015**</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>1060</td>
<td>2868</td>
<td>2758</td>
<td>503</td>
<td>7189</td>
</tr>
<tr>
<td>% O</td>
<td>49</td>
<td>41</td>
<td>58</td>
<td>26</td>
<td>47</td>
</tr>
<tr>
<td>% A</td>
<td>9</td>
<td>38</td>
<td>6</td>
<td>46</td>
<td>22</td>
</tr>
<tr>
<td>% Asia-1</td>
<td>4</td>
<td>4</td>
<td>7</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>% mixed</td>
<td>7</td>
<td>2</td>
<td>4</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>% ELISA negative</td>
<td>21</td>
<td>16</td>
<td>24</td>
<td>17</td>
<td>20</td>
</tr>
</tbody>
</table>

*Before the project approximately 500/year  **Data of January-June only
Source: Summarized from project data

51 One factor that surely contributed to the significant increase in outbreak reports is an increased awareness among farmers regarding the effectiveness of the response by veterinarians. During field interviews, farmers close to outbreaks (and those directly affected by an outbreak) praised the alertness and effectiveness of the veterinarians’ response; this reputation spread by word-of-mouth quickly\textsuperscript{23}, especially in the dairy colonies, in which most of the country’s FMD outbreaks occur.

52 The project made a significant effort in the crucial task of further raising awareness among farmers regarding the potential of FMD control. Details are provided in Annex 5. Nearly 6,000 livestock keepers participated in various awareness-raising meetings. Nearly all veterinary institutions have posters inviting farmers to contact the veterinary service in case of suspected FMD. This evaluation did not have enough time to systematically assess awareness levels of farmers in locations further away from recent FMD outbreaks, or where FMD outbreaks remained undetected. The concluding socio-economic study may include some villages in such locations, in order to assess whether farmers have greater awareness of where to report an outbreak and what response to expect.

Box 1. Sample collection and response

Reporting more than 7,000 cases of FMD was a logistical challenge, which the project addressed in an innovative way. Key features of the mechanism introduced are: strict operating procedures, the use of public transport, quick communication using cell phones and reimbursement of real costs.

The moment a field veterinarian determines FMD through differential diagnosis he takes and packs samples following clear procedures and sends these by public transport, often by bus, to the nearest laboratory. For packing he uses a cool-box and containers provided by the project. He phones ahead to inform the lab of arrival time and identification of the bus carrying the well packed sample.

While picking up the sample from the bus station, laboratory personnel sends back to the field veterinarian, in a similar fashion, a replacement cool box containing vaccine and medication for treatment. The value of this is about PKR 1,000.

On its receipt, the field veterinarian starts a ring vaccination (up to 50 animals) and treats infected animals even before the laboratory’s ELISA test results confirm FMD (and its serotype).

After the test results confirm FMD, the field veterinarian receives PKR 1,000 to cover the cost of sampling and transport. However, this reimbursement is made through the TAD officer, who keeps a record of the outbreak and of test results in parallel to the laboratory information system.

\textsuperscript{22} The Chief Veterinary Officer received roughly 500 reports of outbreaks in 2011. The high increase in the number of outbreaks was noted in the press: http://www.dawn.com/news/782244/over-1000-foot-and-mouth-disease-outbreaks-reported-in-pakistan-last-year
\textsuperscript{23} This confirms the importance of the procedure that focuses on quick response and effective response.
As a result of outbreak reporting and sample analysis, the project gained insight into the spatial distribution of the virus' serotypes (see Figure 6 as an example). The project has done a very good job of informing veterinary services and policy makers of the serotypes circulating by publishing bulletins on a quarterly basis.

This information is complementary to the result of sero-surveillance. The project sampled blood of 7,100 animals to determine titres of antibodies against non-structural protein, an indicator of the animal’s exposure to the FMD virus. The outcome of this study (Table 2) confirms that the dairy colonies are the clearest hotspots of FMD virus. This is partly a confirmation of academic studies published earlier but also an expansion of insights, namely, that FMD is endemic also in livestock systems in relatively isolated locations (e.g. in the Cholistan desert and at high altitudes of Gilgit-Baltistan). The data within 18 smallholder production locations further suggest high variation in levels of virus circulation, from 4 percent to 61 percent of individual locations sampled.

Figure 6. Reported outbreaks of FMD in 2014, by district and by serotype
Source: Project

Table 2. Number of sero-samples taken and those positive for non-structural protein

<table>
<thead>
<tr>
<th>Dairy production system</th>
<th>Location</th>
<th>Samples</th>
<th>Positives (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dairy colonies</td>
<td>6</td>
<td>3188</td>
<td>74</td>
</tr>
<tr>
<td>Smallholder rural production system</td>
<td>18</td>
<td>3176</td>
<td>26</td>
</tr>
<tr>
<td>Cholistan desert livestock production system</td>
<td>12</td>
<td>373</td>
<td>62</td>
</tr>
<tr>
<td>High altitude (yak) production system</td>
<td>7</td>
<td>363</td>
<td>38</td>
</tr>
<tr>
<td>Overall</td>
<td>7100</td>
<td>50</td>
<td></td>
</tr>
</tbody>
</table>

Source: Project document

24 See an example at http://www.fao.org/documents/card/en/c/c4d878c4-d48f-4d6d-a8ea-c4fd1a64b270/
25 Antibodies could also indicate a reaction against virus in a non-purified vaccine therefore test results should be interpreted with care. See Jamal and Belsham, 2013, http://www.veterinaryresearch.org/content/44/1/116
Although data on outbreaks and virus was collected and stored through the laboratories and partly through TAD officers, the project was not able to introduce a harmonized National FMD Epidemiology and Information System. In order to collect the data and information needed to make the right decisions, the project kept good records of outbreaks and vaccinations. An epidemiology ‘node’ at the office of the Chief Veterinary Officer had been planned and should have been staffed by a federal officer, but twice a serious effort to attract the right person to this post failed. After the second effort the project compensated by employing an epidemiologist itself, so that data was analysed and interpreted to contribute to planning. As the quarterly information bulletins show, this worked well.

3.3.3 Intermediate outcome 3 – immunization practices

To what extent can the practice of vaccination introduced serve as a model for replication?

Findings: The project convincingly demonstrated, with some 20,000 farmers, the preventive effect of vaccination. It has shown the importance of using strain-specific vaccine and of the low cost of the cold chain required for its storage. As a result, the more commercial farmers in the demonstration areas are eager to purchase vaccine themselves.

Box 2. Cost and benefit of vaccination

<table>
<thead>
<tr>
<th>For a dairy farmer, it makes sense to compare the cost of vaccination with the value of the milk lost if a milking cow or buffalo gets FMD. Reduced milk yield is not the only cost, but a main cost.</th>
</tr>
</thead>
<tbody>
<tr>
<td>The project’s baseline study shows a temporary reduction of 4.5 l/d (an average at rural farms, from a normal yield of 6.5 l/d) during the clinical peak period of, say, two weeks and a till-the-end-of-the-lactation loss of nearly 2 l/d. In the case of peri-urban farms, on average producing more milk per cow, these losses are nearly double that amount.</td>
</tr>
<tr>
<td>The price of a litre of milk varies per season and by distance to urban areas, yet is a locally well-known amount, say PKR 50 or 80.</td>
</tr>
<tr>
<td>The price of one dose of vaccine costs less than two litres of milk in urban areas.</td>
</tr>
<tr>
<td>Peri-urban farmers, for which milk is the predominant source of income, are much more inclined to vaccinate their (higher producing) animals than are rural milk producers. Of the first group, the baseline study suggests that more than half of peri-urban dairy farmers vaccinate their animals (more or less frequently) versus less than a quarter in the second group.</td>
</tr>
<tr>
<td>Please note that the above comparison assumes a 100 percent risk of the animal being infected with FMD.</td>
</tr>
</tbody>
</table>

The effect of preventive vaccination has been convincingly demonstrated. Of the nearly one thousand farms in several dairy colonies that participated in this demonstration, the ET received feedback from approximately 120 farmers (individually or through focus group discussions); with very few exceptions these all stated that the vaccine had prevented their cattle or buffaloes from developing clinical signs of FMD. Respondents compared this absence of FMD to earlier experiences without vaccination and to a few cases of FMD outbreaks in the same or nearby villages. This observation supports the project’s report of no, or insignificant occurrence of clinical FMD in vaccinated animals up to one year after vaccination.

A second strong indicator of the effectiveness of vaccination is the success of the cost-sharing pilot, particularly in the dairy colonies. The pilot was introduced in the last years of the project and 1,835 farms (with more than 110,000 heads of dairy animals) thus purchased the vaccine. In the dairy colonies, for every farmer participating in the free vaccination demonstration, there were four farmers who purchased vaccine subsequently. The cost sharing option was introduced in a few Punjab villages only (570 farmers purchased vaccine there, which is about 3 percent of those who participated in demonstrations). In both areas, the ET was told by a large proportion of farmers (in one focus meeting with rural farmers, about 60 percent), that they would be willing to pay up to the value of two

27 Yet, the recommended frequency of vaccination is every six months.
litres of milk for a single dose of vaccine (see Box 2). The project had sold the vaccine, in this location, for the value of approximately one litre of milk.

The protective effect of vaccination can be attributed to at least two factors: handling of the vaccine and the immune response it triggers. On both factors the project had a strong positive influence. It introduced an effective cold chain (using multiple combinations of a household refrigerator and generator rather than large centralized cool chambers), established clear, detailed vaccine handling and vaccination procedures, and trained veterinary staff accordingly. The ET received several comments from farmers stating that not only the vaccine worked, but also that the vaccination service had been strict, with the booster vaccination administered on time 10 days later.

Vaccination, especially in the dairy colonies, is already being practiced. The immunization effect of project purchased vaccine is best appreciated if compared with reports of vaccine not being effective. The project investigated and published about the influence of vaccine choice on humoral response. This study again underlined the need to collect and analyse samples of FMD tissue during outbreaks, allowing for the identification of (ever mutating) viruses’ sero-sub-types circulating (Figure 6), and thus for the proper definition of criteria for the vaccine to be purchased. The procedure applied to purchase vaccine was transparent, included a thorough analysis of the requirements and involved advice of the Technical Working Group as well as of the Technical Lead Unit of FAO.

<table>
<thead>
<tr>
<th>Genotypes identified</th>
<th>2012</th>
<th>2013-2014</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serotype O</td>
<td>PanAsian-2\textsuperscript{\textregistered} 2\textsuperscript{\textregistered} Unnamed(3)</td>
<td>PanAsian-2\textsuperscript{\textregistered} 2\textsuperscript{\textregistered} Unnamed(1)</td>
<td>PanAsian-2\textsuperscript{\textregistered} 2\textsuperscript{\textregistered} Unnamed(1)</td>
</tr>
<tr>
<td>Serotype A</td>
<td>Iran-05\textsuperscript{\textregistered} 12 Iran-05\textsuperscript{\textregistered} PAK-11</td>
<td>Iran-05\textsuperscript{\textregistered} 12 Iran-05\textsuperscript{\textregistered} FAK-11</td>
<td>Iran-05\textsuperscript{\textregistered} 12 Iran-05\textsuperscript{\textregistered} FAR-09</td>
</tr>
<tr>
<td>Serotype Asia-1</td>
<td>Sindh-08</td>
<td>Sindh-08</td>
<td>Sindh-08</td>
</tr>
<tr>
<td>Vaccine required</td>
<td>2012</td>
<td>2013-2014</td>
<td>2015</td>
</tr>
<tr>
<td>Serotype O: subtype concentration</td>
<td>PanAsian-2 &gt; 6PD\textsubscript{50}</td>
<td>PanAsian-2 &gt; 6PD\textsubscript{50}</td>
<td>PanAsian-2 &gt; 6PD\textsubscript{50}</td>
</tr>
<tr>
<td>Serotype A: subtype concentration</td>
<td>Iran 5 &gt; 6PD\textsubscript{50}</td>
<td>Turkey 06 &gt; 6PD\textsubscript{50}</td>
<td>Kabardino-Balkaria-2013 &gt; 10 PD\textsubscript{50}</td>
</tr>
<tr>
<td>Serotype Asia-1: subtype concentration</td>
<td>Shamir &gt; 6PD\textsubscript{50}</td>
<td>Sind 08 &gt; 6PD\textsubscript{50}</td>
<td>Sind 08 &gt; 6PD\textsubscript{50}</td>
</tr>
</tbody>
</table>

Source: Project document

3.3.4 Overall impact

To what extent has the project developed a framework for the control of FMD in Pakistan, which serves as the basis for the next stage of control of FMD as described in the FMD Progressive Control Pathway (PCP)?

Findings: The project formulated a risk-based, progressive control plan for FMD that draws insights from the occurrence and characteristics of the disease, and from the experiences gained. This provided strong evidence that preventive vaccination with a strain-specific vaccine is effective, and that ring-vaccination in case of an outbreak disrupts the transmission chain.

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28 A discussion is still going on to reduce the size of bottles to less than 50 doses per bottle, which could further reduce the losses of vaccine when vaccinating animals of individual smallholders.

29 As the Baseline Survey shows, see also Box 2.

Other features that this project brought to the plan included vaccine cost-participation and the outbreak surveillance and response mechanism. The project made significant contributions to understanding the epidemiology of the disease by collection and analysis of field data, a function that was slow to be embedded in the office of the Animal Husbandry Commissioner.

The project has achieved its main planned outcome: to move the country’s FMD control status from Stage 1 of the PCP to Stage 2. The new status (of Stage 2 control) was acknowledged provisionally in April 2014 and fully in April 2015 by OIE/FAO and member states at the annual Eurasia FMD Roadmap Meeting. One of the conditions for being awarded this status is the preparation of a risk-based strategy for control of FMD. This strategy was prepared in late 2014 and in the meantime has been endorsed by the Federal Government and the Provincial Governments. The strategy is based on the experiences gained by the current project, and the following would not have been possible without it: a tested mechanism for outbreak response; confidence in the effect of vaccination; and willingness of livestock holders to pay for the vaccine.

Box 3. Risk of FMD outbreaks

| Location: | peri-urban dairy colonies, because of their high animal density and fertility management, which requires a constant movement of animals in and out (at the beginning/end of their lactation) as a collection point and distribution point of the disease. Traditional rural ‘breeding and reproduction areas’ especially for buffaloes are obvious counterparts to these movements. Livestock markets have a similar effect. |
| Season: | near the Eid-ul-Azha celebration, as well as in humid and cold spells. |
| Human error: | insufficient bio-security at infected farms, at laboratories and vaccine producing facilities. Also the use of low-quality or mismatching vaccines. |
| Neglect: | policy makers and veterinary authorities may not be sensitive enough of the potential and significance of controlling FMD. |

Continuous outbreak surveillance, backed up by functional laboratories to determine sero-types (and genotypes, in good cross-checks with two world reference laboratories), has enabled the project to better understand the risk areas and seasons (see Box 3). These contributed to the definition of risk as well as the quality requirements of the vaccine.

It is certain that following project procedures a much higher number of outbreaks has been detected than ever before and, in the absence of radical changes in the livestock environment in Pakistan, that this increased effectiveness can be attributed to the swift and effective response of the veterinary service, including field veterinarians, laboratory personnel, provincial Livestock and Dairy Development Departments, and the project, to which in turn, livestock owners have reacted. Thus the project has developed an effective mechanism for outbreak surveillance and response that is an important element of a framework for progressive control of FMD, as the project title articulates.

The principle effect of ring-vaccination as a response to an outbreak, and on preventing the disease from spreading further, has been demonstrated to be valid in the case of Pakistan. How does the cost of such ring vaccination compare to the benefit of fewer animals getting infected? The project has, in the course of its implementation, reduced the number of animals vaccinated at an outbreak from 100 to 50, and is satisfied that this number is effective in containing the disease for most farm conditions. An estimate of the number of animals infected in an outbreak is 3-10 animals in case of rural farms and 31-30 in case of urban farms. See also http://www.fao.org/pakistan/news/detail-events/en/c/285422/  

32 The Strategy was prepared with in consultation with Director Generals/Directors and senior veterinary officials from all livestock departments. The Chief Veterinary Officer and Ministry of National Food Security have endorsed the Strategy and recommended funding of the program suggested therein by the Federal Government from its Public Sector Development Program.
5-20 animals in case of a farm in a dairy colony\textsuperscript{33}. These infected animals are included in a ring vaccination\textsuperscript{34}; therefore, per outbreak, 30 to 45 uninfected animals may have been prevented from getting serious clinical symptoms of the disease if all were to be so infected. Under these assumptions\textsuperscript{35}, the project has saved the country roughly USD 35 to 55 million. If under more modest assumptions ring vaccination prevented only six animals from getting FMD per outbreak, the amount saved by preventing milk losses would be roughly USD 7.5 million, comparable to the entire project budget.

\textbf{64} Has the project made a significant \textit{contribution towards reducing the (potential) loss of milk} (and thereby to increased food security)? In other words, has a significant proportion of all outbreaks been detected? The answer to this question depends on how many outbreaks have occurred – a number that is not known. The project has strongly improved outbreak reporting (see above), but it would be guesswork to assume that, say, 40 percent of all outbreaks have now been detected and responded to. As the project articulated during its design stage, many an outbreak will not be reported because a farmer may consider the outbreak an inevitable annual event, or because he or she does not sufficiently aware or confident of the effectiveness of prevention or containment, or for other reasons documented in the project’s baseline study. In absolute, rather than relative terms, it is certain that the project has contributed to a reduction of the losses of milk production. The largest effect (that can be calculated with a moderate level of accuracy) has been the result of a ring vaccination after outbreaks, thereby saving the owners of dairy animals more than 20 million litres of milk\textsuperscript{36}. It is important here to realize that the project’s main aim is progressive control of FMD, a progression along the pathway of control. As claimed in the previous paragraph, such a progression clearly is in evidence.

\textbf{65} To what level has \textit{preventive vaccination} further contributed to a reduction of milk losses? For the purpose of getting a rough indication, we consider Landhi Dairy colony and Nagori Cattle Society near Karachi, where through the project 45,000 animals have been vaccinated free of cost and another 74,000 animals under the cost participation scheme. To make a similar calculation as above, an assumption is needed on the frequency of outbreaks in these cattle colonies, as well as of the severity of each outbreak. The former is derived from the project’s baseline study (Table 4). Accordingly, no less than 90 percent of colony farmers in Karachi (Sindh) report an outbreak at least once a year. The latter is derived from the baseline study as well (Table 5), at which farmers reported morbidity rates of 5 percent to as much as 85 percent (which is a high number compared to other sources\textsuperscript{37}). Assuming further that per outbreak in these dairy colonies 6 percent of the animals will develop serious clinical symptoms, we assume that by vaccinating animals in this particular hotspot 5 percent of those animals vaccinated would be saved from showing serious clinical symptoms of the disease. In other words, for each 20 animals vaccinated, one would be saved from developing serious clinical signs. The value of milk saved in these dairy colonies mentioned this calculation is approximately USD 1 million\textsuperscript{38}.

\textsuperscript{33} This number is a very rough estimate taking into consideration average farm size and the % of animals showing serious clinical symptoms of FMD. The estimate is based on data from the project’s baseline study. It suggests that the percentage of females showing severe clinical symptoms is significantly higher in cattle than in buffaloes, and higher in rural areas than in dairy colonies. The reader should be aware that this calculation is a simplification of the complex reality.

\textsuperscript{34} As there is a documented effect of vaccinating animals with clinical symptoms of FMD of reducing the severity of their disease.

\textsuperscript{35} Other assumptions made: the value of milk saved by preventing a lactating animal from attracting FMD is PKR 21,000 as calculated in the baseline study, and an exchange rate of 120 PKR/USD.

\textsuperscript{36} Assumptions, based on baseline survey and on project interventions: 320 litres of milk lost per lactation of infected cow or buffalo, which is a rough average; 7189 outbreaks responded to; 10 heads per outbreak prevented from being seriously affected.

\textsuperscript{37} A study supported by USAID titled “Effects of Livestock Diseases on Dairy Production and In-comes in District Faisalabad, Punjab, Pakistan” reported, for farms near Islamabad, morbidity rates for FMD of 21% in cows and 18% in buffaloes. See http://ebrary.ifpri.org/cdm/ref/collection/p15738coll2/id/128595

\textsuperscript{38} This calculation may be considered as a minimum for this group of farms. In these two colonies buffaloes form an estimated 90% of the herds and reportedly only 5% of these are seriously affected.
Table 4. Responses of 982 dairy farmers on the occurrence of FMD in 2007-2011 (%)

<table>
<thead>
<tr>
<th>Occurrence by farm type</th>
<th>Punjab</th>
<th>Sindh</th>
<th>KPK</th>
<th>Baluchistan</th>
<th>AJK</th>
<th>Federal</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Peri-urban dairy colony</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Once a year</td>
<td>70</td>
<td>77</td>
<td>37</td>
<td>5</td>
<td>35</td>
<td>48</td>
<td></td>
</tr>
<tr>
<td>Twice a year</td>
<td>30</td>
<td>19</td>
<td>50</td>
<td>23</td>
<td>58</td>
<td>33</td>
<td></td>
</tr>
<tr>
<td>Thrice a year</td>
<td>0</td>
<td>2</td>
<td>8</td>
<td>72</td>
<td>0</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Occasionally</td>
<td>0</td>
<td>3</td>
<td>6</td>
<td>0</td>
<td>6</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td><strong>Rural market oriented farms</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Once a year</td>
<td>74</td>
<td>94</td>
<td>61</td>
<td>81</td>
<td>78</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td>Twice a year</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>6</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Thrice a year</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Occasionally</td>
<td>25</td>
<td>5</td>
<td>35</td>
<td>14</td>
<td>19</td>
<td>17</td>
<td></td>
</tr>
</tbody>
</table>

Source: project baseline study, 2014. Rural market oriented farmers: n = 779, peri-urban dairy colonies: n = 203

66 A similar calculation can be made for animals vaccinated at rural commercial farms, at smallholder farms and at a small number of Government breeding farms (under the cost-sharing trial, another 222,600 animals were vaccinated). In these groups not one out of 20 but more likely one out of five would be seriously affected. In this case, the effect of vaccination may have saved milk to the value of an additional USD 8 million.

67 The project did not completed its end-of-project socio-economic study in time. This study is expected to provide further detail and diversity to the rough calculations made by the ET on the positive benefit-cost comparison of outbreak management and immunization.

Table 5. Morbidity rates as reported by farmers interviewed for the baseline study

<table>
<thead>
<tr>
<th>Morbidity rate per outbreak (%)</th>
<th>Punjab</th>
<th>Sindh</th>
<th>KPK</th>
<th>Baluchistan</th>
<th>AJK</th>
<th>Federal</th>
<th>overall</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Peri-urban dairy colony</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cattle</td>
<td>20</td>
<td>19</td>
<td>32</td>
<td>18</td>
<td>25</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>Buffaloes</td>
<td>26</td>
<td>5</td>
<td>28</td>
<td>6</td>
<td>18</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td><strong>Rural market-oriented farms</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cattle</td>
<td>60</td>
<td>70</td>
<td>49</td>
<td>76</td>
<td>60</td>
<td>69</td>
<td></td>
</tr>
<tr>
<td>Buffaloes</td>
<td>56</td>
<td>59</td>
<td>50</td>
<td>85</td>
<td>85</td>
<td>62</td>
<td></td>
</tr>
</tbody>
</table>

Source: Project baseline study, 2014. Rural market oriented farmers: n = 779, peri-urban dairy colonies: n = 203

3.4 Analysis of cross-cutting issues and sustainability

3.4.1 Gender and equity dimensions

68 The project has not considered gender, either in its design or during the first half of its implementation period. It did not specifically record the gender of participants at awareness-raising events and did not organize training courses specifically for women. In the last 20 months or so the project has clearly increased its gender sensitivity when interacting with livestock producers, veterinary workers and veterinary services staff,
including more specifically targeting women in awareness training and engaging female training resource persons. It also trained female extension and animal health workers organized by a dairy production-oriented donor.

69 The contribution of women in keeping dairy animals at small farms is at least as important as that of men, though the type of work is strongly defined by custom. Since women care for their animals (e.g. feeding, milking), they are just as observant and aware of emerging FMD infections. However, custom restricts their role in seeking the advice of trained veterinarians, who are predominantly or exclusively male outside the household. In the case of larger or more commercially oriented dairy farms where labour is hired, the relative involvement of women in dairy farming is much smaller. There are regional differences in the country, but in general the participation of women is low at training courses on veterinary topics, or at awareness-raising events.

70 The project has identified as some of its stakeholders, cattle/buffalo/yak owners, producers and traders who will benefit directly from a reduced impact of FMD and improved ruminants disease prevention and response methods. It has not specifically targeted poor households or economically vulnerable ones, except those vulnerable to FMD. In its pilot for demonstrating the effect of immunization, the project covered several systems for milk production: peri-urban dairy colonies (highly commercial), rural commercial farms, as well as smallholders who normally sell surplus milk only, if any. For immunization pilots, the largest group covered was that of peri-urban dairy colonies (54 percent of all free immunizations), which is well justified considering 55 percent of all outbreaks reported occurred in Landhi Dairy Colony alone. Although the group of peri-urban dairy farmers in ‘colonies’ keeps about 1 percent of the total number of cattle and buffaloes in the country, 55 percent of the recorded outbreaks occurred there. The second group, rural smallholders, made up the balance of free immunizations. As discussed in the previous chapter, these groups derived a large benefit of the project intervention: milk worth USD 8 million through preventive vaccination alone.

3.4.2 Capacity development

71 The project spent considerable effort in capacity development, targeting laboratory personnel, field staff, farmers and veterinary services staff. The purpose and content of the training for implementers largely focused on diagnostic skills and operating procedures, in case of outbreaks. Most new skills and insights were necessary and could be applied on the job immediately, and have been integrated into daily practice. The impact of these trainings was measured based on the changes that occurred after training, as indicated below. The project has not formally assessed and documented the training needs of the persons targeted but claims to have adjusted, where necessary, the content of training courses based on early training experiences and verbal feedback received from participants.

72 The ET considers training of laboratory staff in diagnostic tests to have been very effective, as evidenced by the very good outcome of the so called National Proficiency Testing Scheme for ELISA tests. The majority of laboratories participating had a score of 100 percent correct diagnoses and none scored insufficiently. Not only were the initial training courses appreciated by those laboratory personnel interviewed, but also annual refresher courses. Another indicator of lasting effect is evidence of lively backstopping (mostly by email) by NVL trainers of provincial and regional trainees.

73 The project trained nearly 2 400 field veterinarians and assistants, instead of the targeted 800, and a majority of these were equipped with sample kits (see Box 1) and/or treatment kits. The impact of this training (in combination with the logistics backing outbreak surveillance and response) is evident, as measured by the increase of outbreak reporting and the high percentage of samples subsequently found positive in ELISA diagnostic tests.

39 In the case of training courses for laboratory personnel the project claims to have trained a higher proportion of female personnel than the proportion of women employed in these laboratories.
40 Through the USAID-funded Dairy and Rural Development Foundation.
41 See the project’s baseline study.
42 In case of outbreak response, the project did not target specific producer groups.
The training of these two groups is therefore highly relevant and will have a lasting impact, if equipment and consumables of laboratory tests remain available and outbreak sampling continues to be backed up by the veterinary services.

3.4.3 Partnership and alliances

The Mid-term Evaluation of this project noted and described the constructive professional networks that the project has developed. The evaluation team has made the same positive observations and summarizes these as follows:

- The project maintained good working relationships with provincial and regional senior officers of livestock departments (Secretaries and Director Generals), either through the Steering Committee, exposure trips (also to Turkey to have a common understanding of practices related to FMD control there), or through technical working group meetings. The result is a shared understanding of content and ownership of FMD control;
- Through the FAO representation, the project responded to requests for action after the floods of 2014. Beyond charity and solidarity with flood victims, this has widened the project’s reputation to have the capacity to respond to emergency situations;
- Several dairy farmers’ associations have been involved in defining outbreak response mechanisms, in developing the cost-sharing instrument and in awareness training. Very good connections with the field services of one of the largest milk processors (Engro Foods) has been pivotal in launching the cost sharing mechanism among smallholder farmers;
- Project management has maintained fruitful working relations with several institutes that helped in development, training, and research efforts. These include USDA’s Foreign Agriculture Service which has been of key importance to link up with other US resources such as Texas A&M, Plum Island Animal Disease Centre, The University of California (Davis) and more. Similarly it has involved the National University of Science and Technology to cooperate in adapting the laboratory information software.
- Very importantly, the project has supported the Animal Husbandry Commissioner (Chief Veterinary Officer) in interacting with OIE and in participating at West-Eurasia FMD Roadmap meetings, allowing for important peer review of progress. It has enrolled in the annual proficiency testing scheme of the World Reference Laboratory for PMD (Perbright), thus accessing unique advice and further diagnostic services.

3.4.4 Sustainability and ownership of results

The project was designed to achieve progressive control of FMD in Pakistan, and this evaluation suggests that excellent progress has been achieved; nearly all planned outcomes have been realized. However, total control of FMD has not yet been achieved, and will not be for at least a decade. Therefore, sustained efforts are needed to move to a next level of control. It is significant that the project has not prepared an exit strategy, but a logical next-step strategy. This is the Risk-based National Plan (for the progressive control of FMD), formulated in 2014 and lastly at the project’s final Steering Committee meeting in September 2015. The challenges ahead include further institutionalisation of control efforts, improvement of a regulatory framework, and possibly the production of vaccine locally (to reduce cost). Most, if not all of these challenges would benefit from federal coordination and funding. The project has been successful in keeping FMD control on the agenda through communication, involving decision makers, and demonstrating that strong outbreak management and immunization have a clear effect.
4. Conclusions

**Conclusion 1:** The project has demonstrated that the required vaccine can be identified and purchased only with well-functioning surveillance and diagnostic services.

Immunization against an ever mutating FMD virus with a matching vaccine requires a vaccine to be adapted accordingly, as often as the virus strains change. The choice of vaccine can only be based on knowledge of the virus strains circulating. Although this may sound logical, in reality there are vaccines on the market of insufficient quality to be effective.

**Conclusion 2:** The project has combined people and resources from provincial/regional and federal veterinary services with those of FAO, USDA and several other organizations into a network with the clear objective of the progressive control of Foot and Mouth Disease in Pakistan.

The project used the “Progressive Control Pathway for FMD” as a framework for guiding and for measuring progress. This framework has been adopted by a large number of countries with endemic FMD. The project facilitated Pakistan’s Chief Animal Husbandry Officer to link up with counterparts in 13 other West Eurasia countries which formulated a roadmap towards a free-of-clinical-FMD status by 2020. It facilitated the exchange of information regarding progress along this roadmap with these counterparts at annual meetings. By so doing it has gained appreciation and built trust with counterpart veterinary services about Pakistan’s achievements, as well as planning the next stage of controlling FMD. Such cooperation is invaluable.

**Conclusion 3:** The implementation of the Risk-based Progressive Control Plan for FMD requires national leadership in terms of legislative reforms and resource allocations.

The challenge now is to implement the next stage of the PCP, building on what has been achieved so far without losing momentum or allowing considerable and scarce expertise (technical and managerial) to disperse. The project has formulated a detailed plan for the next stage, with a horizon of three years. This plan has been extensively discussed with provincial, regional and federal livestock and dairy development departments, where it has been approved on its technical and organizational merits; this was a major achievement because of the diversity of the cooperating services. The plan still requires funding of both federal and provincial/regional governments. It foresees activities that require time to implement, such as adaptation of legislation. The challenge therefore is to mobilize external support to bridge the period until such federal, provincial/regional funds can be structurally included in the corresponding budgets.

A particular challenge to be addressed in the follow-on support activities is to ensure that both the public and private veterinary sectors are supported and monitored, in order to purchase and use vaccine that complies with the specifications defined through the process, as demonstrated by the project.
5. Recommendations

Recommendation 1 (to FAO and the Livestock and Dairy Development Departments): The evaluation team recommends that FAO supports the Livestock and Dairy Development Departments of all provinces and regions in Pakistan in implementing the National FMD Progressive Control Programme as follow-up to the present project.

Although the National Programme has already been drafted and approved by these departments, it is not yet funded. It is therefore recommended that each of the Livestock and Dairy Development (LDD) Departments:

- mobilizes funds in their regular budgets proportional to the number of large ruminants in their area of responsibility (or any other objectively verifiable and relevant indicator);
- creates within its department the permanent position of a Transboundary Animal Disease Officer as a full-time post for coordinating FMD control (as well as other transboundary animal diseases);
- participates with the proposed National Programme Coordination Unit (NPCU) or its precursor to exchange outbreak information through the network of TAD officers (proposed name: EPINET), and diagnostic information through a network of laboratories (proposed name: LABNET).

Recommendation 2 (to FAO): The evaluation team recommends that FAO should start a bridging project to maintain the momentum and build on the strategic gains from the current project in anticipation of the approved National FMD Progressive Control Programme.

The evaluation team also recommends that the competent federal authorities seek assistance through FAO to co-finance a bridging project of progressive FMD control in Pakistan (based on the National FMD Progressive Control Programme) until the National Programme is fully operational. Working objectives of such a bridging project should include:

- the continuation and expansion (rather than allowing a disruption) of outbreak surveillance and response, diagnostic capacity, and vaccine profile definition;
- the support of efforts by LDD Departments in defining their budgets in proportion to the number of large ruminants in their area of responsibility;
- the facilitation of external contacts where necessary, including participation at annual Eurasia FMD-PCP roadmap meetings;
- liaison with the Drug Regulation Authority of Pakistan on profile of effective vaccines for FMD;
- the completion of the post-project socio-economic survey and the further stimulation of analysis and publication of survey data already available.

Recommendation 3 (to FAO): The evaluation team recommends that FAO should further expand the awareness activities with better targeting of female field veterinarians and female livestock extension and health workers, in addition to facilitating a regional exchange of experiences. In this context, FAO could adapt its online training course for general risk management of FMD to the specific conditions faced by central and field staff of the veterinary service in Pakistan.

The evaluation team recommends that the team of the bridging project, when implementing awareness activities along the line of the National Programme and specifically its component 6, output 6.1, continue to prepare training events specifically for female field

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43 See document “National FMD Control Program”, a risk-based approach to progressive control of FMD, prepared by the project in 2014.

44 The ET is well aware that a short-term bridging project has already been approved by FAO for this purpose, and is operational at the departure of the ET from Pakistan. Yet, this recommendation is retained here to stress the possibility that this bridging project may have to be extended until all of the LDD Departments have fully assimilated in their budgets the required funds to implement FMD control along the lines of the National Program.
veterinarians and female livestock extension and health workers, encouraging them to participate in risk management, outbreak monitoring and response, and immunization campaigns, thus increasing the outreach and effect of the FMD control programme. To this end, FAO (Animal Health Division, through the EuFMD programme) could adapt its online FMD training course to the findings provided by the current project.

The evaluation team recommends that FAO develop and strengthen a platform for veterinary services of central Asian countries, to exchange experiences and lessons learned in controlling FMD, virus identification, and laboratory diagnostic capacities. The current members of the West-Eurasia FMD Roadmap platform are the countries best targeted.
6. Lessons learned

85 Surveillance and response to outbreaks is one of the pillars of FMD control, because through it the veterinary service can generate information about occurrence and strain of the virus. The project has defined and applied six principles of a good surveillance field system:

- Awareness of field veterinarians and dairy farmers of the disease and control system;
- Training of field veterinarians in clear standard outbreak handling procedures;
- Provision to field vets of treatment kits and sample collection and dispatch material;
- Covering expenditures for treatment of sick animals and dispatch of sample;
- The veterinarian must respond back to the farmer with outbreak handling;
- The laboratory must report back to field staff on laboratory findings.

86 The above points have proven to be both practical and effective. This system also allows both private veterinarians and the public veterinary service to take part in surveillance.

87 A second lesson learned is that the earlier mentioned sample dispatch practice works well. This system uses cool boxes with the necessary materials to safely pack samples; facilitates transport via public bus drivers; provides transport information by cell phone; and similarly organizes cool boxes with vaccine and treatment material by return transport.

88 This project provided an excellent illustration of the roles of stakeholders and the importance of their interaction for progressively controlling FMD. It has also shown the difference in the roles of national and regional services, as well as of public and private veterinary services. The role at the national level has been one of combining insights of provincial and regional veterinary services into a control strategy; standardizing effective procedures; and analysing and communicating the results of surveillance and monitoring data. The role of private veterinarians has been acknowledged as increasingly important in representing the interests of commercial dairy farmers, who in turn demand increasing efforts to control FMD.