

Chapter 4

Lessons learned from H5N1 HPAI and applications of successes to support animal disease control

INTRODUCTION

Despite the significant progress made in controlling HPAI worldwide, the disease continues to be a human pandemic threat and influenza viruses, in particular, require a continued vigilance. It is anticipated that outbreaks will continue to surface in certain endemic areas of the world (Bangladesh, China, Egypt, Indonesia, Viet Nam and parts of India). H5N1 HPAI continues to be a major concern globally, regardless of a slight decrease in the overall number of infected countries/territories in 2011. There is mounting evidence of increasingly active bi-directional swine/human influenza virus genetic exchange in the form of reassortment of H3 and H1 viruses. The genetic diversity of Influenza A viruses in domestic animals and humans is on the increase, posing pandemic threats, particularly in eastern Asia. Meanwhile avian influenza programmes will continue to need to adapt to a world with decreasing donor funding and decreasing political and public interest.

The approach to HPAI response has evolved significantly since 2005. While FAO continues activities at four levels (global, regional, national and local), experience has shown that, especially in areas where the disease has become entrenched, an emphasis on local approaches, placed in a regional context, is more beneficial to a successful HPAI response and to the people whose livelihoods and lives are affected. In fact, FAO's HPAI programme has shown that the success of any global strategy for animal diseases is measured at the local level and that global strategies must take into account local circumstances, livestock production and marketing practices, demographics, customs and traditions, economies and governing structures.

Knowledge gained continues to assist non-infected and at-risk countries to prevent and prepare for HPAI, while allowing targeted approaches for endemic countries and regions where elimination from the poultry sector remains the long-term goal. No single measure can solve or eliminate HPAI. It requires a balanced mix and integration of various tools including, but not limited to, a systems approach and strong underlying coordinated prevention and response framework; strong partnerships at all levels; targeted surveillance; good veterinary capacity; sufficient laboratory and diagnostic capacities; adequate biosecurity; effective vaccination schemes; and successful communication strategies. Adequately addressing HPAI and other diseases is also contingent on a strong political commitment, effective and well-structured veterinary services with adequate, sustainable resources and strong public-private partnerships.

This chapter will discuss some particular areas where FAO's HPAI response has generated lessons learned, tools or approaches that have improved not only the efforts regarding HPAI, but have been applied successfully and progressively to other diseases of significant impact. This chapter will also discuss how the transition is progressing toward promoting and applying the One Health approach to major global health issues. Analysing and addressing such challenges in a holistic manner overcomes barriers, eliminates the division of disciplines into subsectors, provides increased multidisciplinary, multi-sectoral analysis to better inform evidence-based policy and technical responses, maximizes synergies and provides for a more successful and sustainable result for all involved.

A SYSTEMS APPROACH AT THE GLOBAL, REGIONAL, NATIONAL AND LOCAL LEVELS

A major HPAI lesson learned is that a **systems approach**, beginning with a global framework, is needed for TADs to provide the coordinating basis upon which more targeted regional, national and local disease prevention, control, response or eradication plans are efficiently and successfully designed and implemented.

The threat of a global human pandemic, and the ensuing collective response demanded a global, cohesive, collaborative vision and supportive plan that continues to this day. Reactionary and disjointed responses to TADs exist in the absence of concerted, well-thought-out roadmap frameworks that provide the methodical and science-based supportive structure and guidance upon which sustainable and effective local, regional and global responses are based.

HPAI demonstrated conclusively the need for **global coordinated frameworks** that underpin national and regional plans/responses for TADs and zoonotic diseases. From the outset FAO took a lead role in global coordination, working with international partners to address successfully the pandemic threat. FAO continues this leadership today on influenza as well as other TADs. Pathogens and vectors do not recognize political or geographical boundaries and today's globalized world increases that reality. Animal movement, trade and human movement as well as endemic, emerging and re-emerging pests and diseases around the world will demand a continuing and improved level of globally coordinated infrastructure and discussion. This HPAI systems approach was further elucidated by applying a methodical systems framework approach to FMD, which culminated in the development of the FAO/OIE progressive control pathway for FMD (PCP-FMD) in 2011.⁴³ This approach is currently in process for other high-impact diseases such as brucellosis, CBPP, PPR and rabies (see Box 4.1).

FAO's HPAI programme also demonstrated a need for a systems approach at the **regional level** especially in regards to regional plans centring on communication, coordination, surveillance, and data gathering and analysis to better understand risk factors (drivers) of disease and trends.

⁴³ The PCP-FMD has been developed by FAO to assist and facilitate countries where FMD is endemic to progressively reduce the impact of FMD and the load of FMD virus. It is used as a working tool in the design of FMD country, and some regional, control programmes. In 2011, it became a joint FAO/OIE tool and it forms the backbone of the *The global foot and mouth disease control strategy – strengthening animal health systems through improved control of major diseases* published in July. For more information on PCP-FMD see <http://www.fao.org/ag/againfo/commissions/en/eufmd/pcp.html>

Regional laboratory networks are an example of where regional coordination has been applied effectively. These networks were built or supported significantly by HPAI projects and have proven to be the appropriate approach to strengthening the laboratory component for local, national, regional and global responses to HPAI and other TADs. These diseases can quickly overwhelm any local and national laboratory capacities and HPAI demonstrated that successful responses to these diseases require consistency, coordination and collaboration regarding diagnostic assays, quality control of samples and distribution of information. The high level of information and experience sharing, the positive group dynamics for training and meetings, the decision-making process on regional priorities for capacity-building and other developments are elements that keep supporting the pertinence of a regional approach for laboratory strengthening. Regional laboratory networks include annual meetings to discuss outcomes of proficiency testing, constraints and progress made, disease situations, working opportunities and projects. From these discussions collective decisions are made. In 2011, FAO conducted or supported annual regional coordination meetings in all regions⁴⁴ where FAO projects exist (North Africa, West/Central Africa, Eastern Africa, Southeast Asia, and South Asia). Linkages between regional laboratory networks and global specialized networks (e.g. OFFLU, global FMD, WHO's Global Foodborne Infections Network [GFN] and WHO's Emerging and Dangerous Pathogens Laboratory Network [EDPLN]) are often maintained during annual coordination meetings and on specific occasions. Several regional service laboratories that have been designated during the last five years are also supported through these networks and their roles and responsibilities are currently being more clearly defined and harmonized across regions. A good base of expertise now exists at the regional level in most regions at leading laboratories and could be better utilized in collaborations in the future.

Successful HPAI and TADs prevention and response efforts require a **national systems approach** within and between all relevant intergovernmental agencies (e.g. ministries of agriculture, health and environment).

Mirroring global and regional requirements, HPAI also demonstrated the need for broader and improved coordination at the national level. As such, FAO's activities have also centred on facilitating relevant collaborations at the local and national levels. For example, before the pandemic threat, in many countries, ministries dealing with agriculture, human health, wildlife, environment and food safety did not interact or work together. To deal effectively with HPAI at the national level, many countries put interministerial structures of coordination into place to enable a national systems approach to better respond to the threat. And while HPAI and the threat of a pandemic served as the impetus for initial or improved intergovernmental coordination and discussion at the national level, in many countries these alliances have evolved and now provide a lasting structure upon which zoonotic and other animal diseases are better addressed by governments. FAO and WHO simulation exercises in countries in Eastern Europe and Africa have assisted in interagency communication.

Additionally, cross-border collaboration among neighbouring countries has been expanded to include coordinated activities with public health partners, while pilot studies have led to the establishment of more effective, integrated working relationships and

⁴⁴ For more information see http://www.fao-ectad-bamako.org/fr/IMG/pdf/Report_5th_RESOLAB_Dec2011_Engl_F16Jan_GD.pdf

BOX 4.1 PCP-FMD

A stepwise approach is being promoted today for planning and executing control of infectious diseases in animals. This approach applies particularly to those zoonotic and TADs whose control or eradication is deemed to be a global public good or which restrain trade in livestock and livestock products. In this respect, FAO continues to target high-impact diseases and zoonoses, with development of regional roadmaps for progressive disease control. It works directly at the local level with countries and regions with national disease control programmes. A major novel initiative was the design of the PCP-FMD, and the associated regional roadmaps customized to the socio-economic and developmental circumstances in each region. This approach has been given increasing attention from the international community. FMD, because of its significant high impact on trade, is one of the four diseases with OIE disease-recognition status, and causes significant economic losses and inefficiencies in food production.

PCPs enable countries to set disease control objectives and determine the actions needed to meet those objectives. By using a risk-based, strategic framework, the drivers of disease and effective preventive measures can be addressed at a more fundamental level. By working with countries so that they define the actions they need to take, this approach can be tailored to each country's requirements for FMD control (and other diseases in the future), incorporating technical, socio-economic, livelihood and local level priorities. Control of TADs such as FMD requires a truly regional approach, as one country's efforts may be put at risk by the disease situation of a neighbour. For this reason, the regional roadmaps are a key tool to coordinate activities and build confidence. PCPs address control measures in a targeted fashion and improve the ability to measure the efficacy of the strategies adopted, helping to develop sustainable national strategies based on a realistic assessment of disease impact and of the control options available.

Ongoing PCP-FMD country-specific activities are planned to improve FMD disease control in the vulnerable sectors and at the national level by identifying achievable steps in the progression toward increased and sustainable disease control. To date, the FMD PCP approach is being utilized in country and regional progressive approaches in West Eurasia (the West Eurasia regional roadmap includes Afghanistan, Armenia, *(cont.)*

coordination of surveillance strategies among partners. Surveillance efforts in swine, bats and people in Thailand, Viet Nam and the Philippines in 2011 are an example of integrated coordination. A cross-border collaboration example is the Mediterranean Animal Health Network (*Reseau Méditerranéen de Santé Animale*; REMESA). Set up in 2009 in the western part of the Mediterranean, REMESA includes the chief veterinary officers (CVOs) of ten countries representing the African and European shores (Algeria, Egypt, France, Italy, Libya, Morocco, Mauritania, Portugal, Spain and Tunisia) and creates a common framework

Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Islamic Republic of Iran, Pakistan, Tajikistan, Turkey, Turkmenistan and Uzbekistan), Africa (the East African regional roadmap includes Burundi, Djibouti, the Democratic Republic of the Congo, Eritrea, Ethiopia, Kenya, Rwanda, the Sudan, South Sudan, Somalia, the United Republic of Tanzania and Uganda) and the Andean region of South America. Additionally, project activities allow for further capacity to address those TADs which are the most challenging diseases for national veterinary services and those that need to be addressed on a regional basis. For example, the PCP-FMD approach in Afghanistan, Pakistan, Tajikistan, Turkmenistan, and Uzbekistan includes FMD and PPR. The PCP approach is being developed or explored for other diseases of global concern such as brucellosis, CBPP and rabies.

For more information on PCP-FMD see <http://www.fao.org/ag/againfo/commissions/en/eufmd/pcp.html>.



for work and cooperation. REMESA coordinates the development and implementation of animal health regional projects and programmes under four thematic subnetworks for: laboratories (RELABSA), epidemiology (REPIVET), communication (RECOMSA) and socio-economics (RESEPSA).⁴⁵ A FAO/OIE regional coordination unit in Tunis supports and assists the network through a technical and a secretarial role with FAO providing the REMESA

⁴⁵ For more information see <http://www.remesanetwork.org/remesa/en/>

secretariat in 2010 and 2011. In 2011, activities included technical assistance and support in emergency situations (e.g. RVF in Mauritania, needs assessment in Libya) and TADs and zoonoses capacity-building and harmonization (e.g. RVF, PPR, WNV).

APPLYING AND CAPITALIZING ON HPAI LESSONS FOR SUCCESS

The HPAI investments in frameworks and coordination at global, regional and national levels have had and will continue to have residual positive effects that transcend a particular disease threat and go beyond the interministerial collaboration in other areas. The following discussion will demonstrate how these efforts have paid off. Long-lasting dividends have been provided by the foundations built by HPAI efforts in areas such as national and regional laboratory capacity, veterinary infrastructure, surveillance, involvement of stakeholders and compensation, to name a few. For many, HPAI efforts also brought about the acknowledgment that part of a long-term successful disease prevention and response is the understanding of the drivers of disease, a better understanding of market forces and active involvement of all stakeholders throughout the process.

INVESTING IN ANIMAL HEALTH SERVICES

HPAI demonstrated conclusively that countries require sufficient and sustained investment regarding capacity and capability in veterinary personnel, infrastructure, tools and knowledge in order to respond effectively to and to prevent the endemic, emerging and re-emerging high-impact diseases in today's world.

The global efforts on HPAI brought to the forefront what many involved in the efforts on transboundary animal disease efforts had grappled with in the past. Animal health veterinary and laboratory diagnostic services, for various reasons in many countries, are not consistently well-resourced financially or otherwise, and they often lack sufficient personnel and adequate infrastructure. Additionally, the technical capacity of both government and private veterinary services is sometimes limited in key areas for disease prevention and control, such as epidemiological skills (investigation, surveillance and analysis) and laboratory diagnosis.

To that end, since the beginning of the HPAI threat, FAO and its partners have focused on providing resources and technical advice to increase and improve countries' veterinary infrastructure and capacity. These efforts benefitted participants/countries, by enabling them to share ideas, compare experiences and discuss solutions and response options so as to provide them with take-home messages, lessons learned and benefits. Specific examples of benefits include participation in international scientific standard setting, provision of continuing professional development and veterinary governance and assistance to countries in OIE's tool for the evaluation of performance of veterinary services (OIE PVS Tool). Countries have taken different approaches to disease control and prevention. Successful plans have been those with strong political commitment from the highest level of government and a superior level of professionalism throughout the integrated animal health systems.

It is clear that a country's investment in its animal health programmes/services must take place in a structured approach that is relevant to the needs of the stakeholders in animal production systems. It must have clear goals to provide defined public good outcomes and must report progress about them. While HPAI demonstrated that it is necessary to develop more holistic health services for smallholder poultry owners, covering entire communities

and going beyond avian influenza, this lesson applies to other animal production sectors as well. Therefore, it is vital that countries include stakeholders in the process as they develop veterinary services and animal health programmes.

PREPAREDNESS AND CAPACITY FOR EMERGENCY RESPONSE

H5N1 HPAI re-emphasized the need for robust rapid emergency assessment and response in the event of high impact animal, plant and zoonotic diseases.

The CMC-AH has directly and indirectly contributed to improving countries' veterinary services capacity. The CMC-AH's **emergency assessment and response** has been a major component of FAO's HPAI global programme and has been expanded to assist countries with other emerging and re-emerging pathogens. In this respect, FAO has been able to provide immediate support to countries, enabling them to address HPAI outbreaks and contributing to successful elimination. Responding to country requests since 2008, the CMC-AH has deployed missions to address other disease events as well.⁴⁶ In 2011, key missions included a response to RVF in Mauritania, FMD in the Republic of Korea, ERV in Uganda and an investigation into white spot syndrome, a disease of farmed shrimp in Southeast Asia (see Box 4.2). In early 2012, the CMC-AH had undertaken missions in Libya and Palestine to assist investigations regarding the introduction of an exotic FMD virus. A major lesson learned from the CMC-AH efforts is that few of the countries requesting assistance with major high-impact diseases have advanced preparedness and contingency plans. Even when they have developed diagnostic capacities, and/or existing field services, they have difficulty in harnessing their own resources.

To assist countries, a guide entitled *Good emergency management practice: the essentials* (GEMP)⁴⁷ has been produced and updated in 2011. As the global animal and human health challenges continue, the need remains for FAO to continue coordinating and supplying emergency assessment and response teams at country requests. The CMC-AH has evolved and is looking to better integrate its activities as well as to consider prevention and the development of preparedness planning as part of the continuum of services provided to countries. The CMC-AH can provide both immediate and longer-term development assistance to countries to better meet the needs of today and the future. Additional benefit would also be provided as the CMC-AH further progresses, working across agencies and disciplines to develop its client countries' resilience.

NATIONAL LABORATORY CAPACITIES

Part of an effective response to high-impact diseases is the ability of the national laboratory system to accurately and quickly diagnosis disease under a quality management system.

In addition to the regional laboratory efforts previously discussed, a great amount of progress has been accomplished in 2011 in terms of enhancing **national laboratory capacities**. This progress can best be elucidated by the following comparison in endemic hotspot areas. In 2005, the majority of the other laboratories in Southeast Asia region

⁴⁶ For more information see <http://www.fao.org/docrep/013/i1874e/i1874e.pdf> and <http://www.fao.org/docrep/014/al894e/al894e00.pdf>

⁴⁷ Available at <http://www.fao.org/docrep/014/ba0137e/ba0137e00.pdf>. Related links to GEMP workshops and documents are available at http://www.fao.org/ag/againfo/programmes/en/empres/news_120112.html

BOX 4.2

**Emergency response assistance to countries:
RVF mission in Mauritania**

From 7 to 17 January 2011, the CMC-AH deployed an emergency mission to Mauritania following an official request by the government for assistance to control an unexpected epidemic of RVF in the northern Adrar region. Never before observed in this type of Saharan ecosystem, the RVF epidemic caused the death of camels, small ruminants and humans.

The CMC-AH dispatched a team composed of experts in VBD epidemiology, diagnostic techniques, risk management, and laboratory networks. The mission was funded by USAID, the French Government and the Spanish Agency for International Cooperation for Development (AECID).

Through field work and collaboration with stakeholders, including national and regional human and animal health authorities, international organizations, NGOs and farmers' organizations, the team was able to identify the key epidemiological features of the epidemic, its instigating factors and evolution, and to propose an effective plan of action to eliminate it and prevent recurrences.

After analysis, the team formed the hypothesis that the virus had been introduced to the area through the movement of infected animals, most likely camels, from adjoining regions where the virus is endemic. Exceptionally heavy rainfalls in the northern region of Adrar from late September to early October 2010 impacted low-lying areas, leading to the explosion of the mosquito population and creating favourable conditions for the amplification of the virus in human and animal populations.

The team provided direct technical support including laboratory work and, after commending the government for its efficient response in the face of this difficult and unexpected situation, elaborated a number of recommendations to consolidate the management of the epidemic in the areas of organization, surveillance, methods of treatment and laboratory work.

Recommendations included: the elaboration of a short-term contingency plan by the government at the national, regional and local levels to fight RVF, followed by the creation of a committee, under the joint direction of the ministries of health and rural development, to manage zoonoses over the medium term; the ongoing observation of the dynamics of populations of mosquitoes; the creation of a system of sero-surveillance in major slaughterhouses; communications campaigns to inform the population about the modes of transmission of the virus; and the design of more efficient transport systems for laboratory samples.

The team also worked with the United Nations Central Emergency Response Fund (CERF), WHO and UNICEF to draft a programme providing the Government of Mauritania with additional financing.

had very low capacity for diagnosing H5N1 HPAI. Since January 2011, HPAI diagnosis and confirmation have been carried out by all national laboratories in endemic areas. Samples and testing are now handled in a biosecure environment and under a quality management system. Additionally, the laboratories' capacities for the differential diagnosis for other avian diseases such as Newcastle disease virus have been expanded.

Meeting the multiple animal health and zoonotic disease challenges of today and the future will require FAO to expand laboratory support to a broader range of priority diseases so that the capacity of animal health laboratories to detect and diagnose diseases under a quality management system is enhanced for all diseases of national, regional and global significance. Specific areas requiring future focus are biosafety training and standard operating procedures (SOPs), establishing guiding principles for other national and regional priority diseases and developing creative and strategic approaches to expand utilization of molecular methods through routine application to pathogens in addition to AI. Hurdles also remain for improving laboratory biosafety for facility management and engineering aspects due to budget constraints for maintenance and equipment, personnel and technical expertise.

The major investment made in national laboratories has been in terms of laboratory supplies and training. However, investments have also been made in laboratory networking, through the establishment of regional laboratory networks in several regions, especially in Africa and Asia. This investment will be lost in many places if efforts are not sustained to support laboratories in the many components that extend beyond supplies and training in diagnostics. Deficiencies in the capacities and capabilities of laboratories may lead to inadequate responses to disease management at the animal-human interface and in animals. As part of efforts to address these deficiencies, FAO developed a tool to aid in laboratory assessment: the FAO laboratory mapping tool. In collaboration with national partners, this tool aims to determine the status, gaps and progress made in laboratory functionality so as to facilitate the definition of mechanisms and targets for capacity-building to fill these gaps. The tool assists laboratories to ascertain their ability to receive and appropriately handle sample submissions, to correctly diagnose, maintain records and report on animal diseases; hence, to detect existing or emerging disease threats. Laboratory external and/or self-assessments were conducted with the laboratory mapping tool in 2011⁴⁸ and initial data analysis and reviews were conducted in each region in Africa and Asia (see Box 4.3). This tool was part of the tripartite (FAO, OIE, WHO) IDENTIFY component of the USAID-funded EPT Program initiated at the end of 2009. It seeks to strengthen national laboratory capacity for rapid, accurate and sustainable detection of targeted diseases in hotspot regions defined as those where the risk of emerging human and/or animal diseases is highest. These regions have been identified as the Congo Basin in Central Africa and countries in South and Southeast Asia, where, respectively, 12, 11 and 3 laboratories are partially supported by FAO. This project not only provides the opportunity to keep momentum in the support provided to laboratories in previous AI projects, but also has enabled the development of an advanced framework for veterinary laboratory strengthening. The two outputs of this laboratory strengthening framework, consolidated in 2011, are: (1) to improve the ability of beneficiary laboratories to diagnose priority diseases; and (2) to involve laboratories in

⁴⁸ EMPRES Transboundary Animal Disease Bulletin No. 40 (available at <http://www.fao.org/docrep/015/i2811e/i2811e.pdf>).

BOX 4.3

**Profiling laboratory capacity in the context of emerging pandemic threats:
The FAO laboratory mapping tool****Description of the FAO laboratory mapping tool**

The FAO laboratory mapping tool is based on a standardized format that allows data to be captured by either external evaluators or through self-assessment. In general, the tool is designed to facilitate the assessment of laboratory functionality in a systematic and semi-quantitative manner (with particular focus on capacity and capability to respond to regional priority diseases determined under the IDENTIFY project). Initially, two slightly different versions of the tool were developed and piloted in three regions (South and Southeast Asia and the Congo Basin in Africa), and feedback was collected for continued improvement of the tool. Efforts have since been made to harmonize the two versions into a single tool that can be used in any region. Thus, it can be useful for generating knowledge of laboratory functionality across regions, in particular, from the perspective of investment needs, risk modelling of disease emergence and spread.

The most recent and harmonized version of the FAO laboratory mapping tool comprises five modules: (i) general laboratory profile; (ii) infrastructure, equipment and supplies; (iii) laboratory performance; (iv) quality assurance and biosafety/biosecurity; and (v) laboratory collaboration and networking. A total of 18 categories and 94 subcategories have been selected for all of these five modules. These elements are thought to be fundamental for optimal description of laboratory functionality. Each of the 94 subcategories includes four clearly defined options, which correspond to scores from zero to three. An explicit questionnaire is used to collect data (94 scores from zero to three obtained), and an overall as well as a summary score per category is generated for each laboratory. The score is used to assign a given laboratory into one of three levels of functionality: basic, moderate and advanced.

Flexibility

This tool can be used as a whole, or in parts by focusing on just one or more of the modules (e.g. during on-site expert missions on quality assurance and biosafety).

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networks and networking. In 2011, FAO trained 44 people in Africa and 52 people in South and Southeast Asia under the IDENTIFY project. Also, a few innovative approaches have been initiated, such as a) allowing laboratory directors to visit each other's facilities through a study tours programme; b) developing partnerships between national laboratories and the private animal production sector; c) providing access to African laboratories for sequencing services and proposing multi-diseases molecular kits and protocols; d) establishing a four-way linking framework (see Box 4.4); and e) developing the EMPRES-i genetic module (see Box 4.5).

Furthermore, external and/or internal assessors can apply the tool and findings can be compared over time. The tool also helps regional service laboratories to devise strategies to contribute to the improvement of other laboratories within the network.

Pilot use of the laboratory mapping tool

The tool was applied in 2010/11 (under the IDENTIFY project) in three areas (South Asia, Southeast Asia, Congo Basin), where 12, 11 and 3 laboratories from 11, 9 and 2 countries were analysed, respectively. The initial application of the tool made by external assessors (Asia) and internal assessors (Africa) provided the baseline information to categorize the laboratories in the project and map the national and regional strengths and weaknesses. Functionality of the laboratories was categorized as basic (n=5), moderate (n=15) and advanced (n=6) across the three areas. The main constraints for the majority of laboratories assessed could be summarized as follows: (i) low operating budget of the laboratory from the national government; (ii) prohibitive costs for equipment, maintenance and reagents; (iii) difficulties to ensure biosafety and biosecurity; (iv) inadequacy of human resources both in skills and number; (v) insufficient sample flow to the laboratory to justify maintenance and operating costs; and (vi) limited access to up-to-date information through scientific publications. Linkages between the tool and the USAID/FAO monitoring and evaluation (M&E) have been established in order to give a clear picture of the project's progress and impact on laboratory functionality.

Next Steps

Further assessments by internal or external experts will be carried out with the same mapping tool in the same laboratories. The application of the tool in three areas enables assessment of a large number of laboratories on a standard basis, and evaluation of the strengths and weaknesses over time at national and regional levels. Results will serve to measure progress and target needs for improvement. They may also serve as advocacy material, and will be useful for decision-makers, donors and national bodies. It is proposed to apply this tool wherever possible and to scale-up its use to other regions, as has already been the case in North Africa and South America. The countries themselves may also use it to assess their status. The FAO laboratory mapping tool will be developed to allow independent application of specific modules that are directed to assess capacity for a particular disease or to specifically measure the project's impact on laboratory functionality.

SURVEILLANCE CAPACITY

Risk-based surveillance

A strategic, targeted and more comprehensive approach to surveillance is used to inform decisions which, in turn, lead to improved results.

Surveillance of HPAI and other diseases has progressed from reactive, general surveillance to a risk-based, targeted approach. This approach looks beyond the silos of a specific animal disease to include other data in a country or region in order to forecast and mitigate

BOX 4.4

Four-way linking of epidemiological and virological information on human and animal influenza: a tripartite initiative

Successful management and containment of HPAI depends on the ability of the animal and human health sectors to work together before, during and after the outbreaks, by efficiently managing epidemiological and virological information. Although the coordination between public and animal health sectors, as well as the awareness of the need for good coordination, has improved in recent years in many countries, major efforts are still required by the different actors at the human-animal interface (HAI).

Collaborating Towards One Health

The four-way linking framework is a collaborative effort among WHO, FAO, OIE, OFFLU and GLEWS to improve national, regional, and global qualitative risk assessments for animal and zoonotic influenza. This framework seeks to establish a mechanism at the national level for routine integrated qualitative assessment of virological and epidemiological influenza data from humans and animals (i.e. from four different national sectors). This framework involves collecting and sharing relevant epidemiological and virological information between the sectors and linking information for joint assessment by experts of the four national sectors. It would allow improved understanding of the overall situation, including animal and public health risks from influenza, to identify gaps in the available information or national systems. Once in place, the four-way linking framework could act as a supportive national platform upon which internationally mandated capacity-building and other national-level projects and activities designed to improve the systems, could be aligned. In addition, information from risk assessments generated by this framework can be used by decision-makers to develop and implement new scientifically-based measures to prioritize, manage or control the risks identified, as well as to evaluate the effects of those measures already in place.

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diseases before they spread beyond a local occurrence. Intensive and focused HPAI surveillance is particularly essential in high-risk areas such as those with a high poultry density (especially those with a large free-grazing domestic duck populations), in situations where wild waterfowl and poultry frequently come into contact and in wet markets or along market chains where HPAI has been previously detected.

FAO disease surveillance is also supported by a newly adapted programme that falls under the USAID-funded EPT Program, established in 2009 to expand upon the lessons learned in combating the global H5N1 HPAI pandemic. The new EPT Plus Program will reflect the honing of FAO's surveillance of influenza viruses over the years, which now increasingly focuses on monitoring for pathogens with pandemic potential in the mixing of crowded human populations with domestic pigs, domestic poultry, wild waterfowl and farmed ducks. The programme will also monitor major hubs of contact where, if people

Process

This tripartite initiative implies three main steps: (1) an expert mission to identify key partners, national initiatives, efforts, and operational tools and systems in place for epidemiological and virological surveillance for influenza in both the public and animal health sectors, and to assess the gaps in the available information and areas for relevant national risk assessments; (2) a national workshop to describe the gaps and define a plan of action for the establishment of the four-way linking platform; and (3) the monitoring of follow-up activities conducted by national stakeholders and provision of assistance for the establishment of a national multisectoral, integrated risk assessment mechanism for influenza, if requested by the country.

Implementation at the national level: pilot countries

This framework is to be tested in three pilot countries. Joint WHO/FAO/OIE review missions took place in the first two pilot countries – Egypt and Viet Nam – in December 2010 and June 2011, respectively. Subsequently, the two national workshops were conducted in September 2011 and February 2012. These scenario-based workshops addressed principles of joint risk assessment and risk communication, and showed the need for joint outbreak investigations and joint risk assessment; they generated discussions on required mechanisms for joint reporting and assessment of outbreak findings, for policy and decision-makers. Egypt held the first four-way linking meeting with the designated focal points of the four sectors, in February 2012. It is hoped that countries will develop formal agreements between public and animal health sectors to improve cooperation and data sharing. The third pilot country is Bangladesh; the review mission is planned in July 2012 and the workshop, in October 2012. Discussions are ongoing for implementation of this framework in other countries that face endemic H5N1 HPAI. Interest has already been expressed by India and Indonesia. Suggestions have also been made to expand this initiative to other zoonoses.

repeatedly come into contact over time with swine and poultry species, new viruses could emerge or be transmitted into the human population. The aim is to overlay various agro-ecological and virological data to gain a deeper understanding of what drives the emergence of new, potentially pandemic influenza viruses.

As previously mentioned, greater interaction between epidemiology, surveillance and communications is developing at the regional and country level, including interagency coordination. Also, while further study and integration of surveillance and socio-economic disciplines is needed, coupling cross-border risk assessments with socio-economic market chain studies has improved understanding of trade, risk factors and regulatory compliance. As a result, all efforts to find locally relevant models and approaches to disease prevention and response are better informed. A recent example of applying this experience to other challenges besides HPAI is an integrated regional public health-animal health surveillance

BOX 4.5

The EMPRES-i genetic module: a new tool to link epidemiological and genetic influenza information

Combining surveillance, genetic characterization and geomapping for animal influenza viruses can contribute to a better understanding of the epidemiology of influenza as well as virus evolution. Adding information such as agro-ecological farming system characteristics, can also support risk modelling of influenza emergence and spread in animal populations and possible transmission to humans, by refining influenza high-risk areas and risk factors. Integration of viral characteristics into an animal disease database, EMPRES-i, therefore, provides a unique tool to improve knowledge in disease epidemiology and ecology. More broadly, this tool can constitute an influenza gene observatory and has already been proposed to support risk assessment of human-animal influenza threats. Scientists in the human and animal health sectors have confirmed interest in such a tool and OFFLU endorsed it in 2011.

History and progress

A web service was developed in 2010 between EMPRES-i and OpenFluDB that enabled these databases to compare their respective information, such as host species or geographical location. In 2011, an algorithm was developed as the interface between EMPRES-i outbreak data and influenza virus sequences present in OpenFluDB. This interface ranks all suitable isolates against all outbreaks according to the best combination of three criteria (geolocation, host species, time of sampling/event) and provides an automatic score from 0 to 100 percent indicating the confidence of each most possible proposed linkage. When possible, the manual validation of the linkage between sequences and outbreaks is carried out on this interface.

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programme in Southeast Asia. This programme addresses important zoonotic diseases for which flying foxes (bats; *Chiroptera spp.*) are reservoirs that can infect people either by direct contact or through livestock species such as pigs.

Participatory approaches, such as PDSR in Indonesia, for example, have demonstrated that contact through active surveillance may have stimulated greater passive reporting due to the establishment of relationships with communities, especially when strong links between livestock holders and the animal health service are formed (see Chapter 4 for more information on PDSR in Indonesia). Similar examples of surveillance at the community level include CAHO in Egypt and the SMS gateway in Viet Nam and Bangladesh. These surveillance systems have improved the quality and numbers of disease information reported in HPAI endemic countries. However, factors influencing reporting include turnover of local veterinary staff in developing countries and HPAI fatigue, compounded by unsound culling policies and insufficient compensation.

Development of applications

The genetic module benefits from existing tools within EMPRES-i (for spatial mapping, export of information and interfaces with other databases, such as the Global Livestock Production and Health Atlas [GLiPHA]) and from the phylogenetic tools already developed by SIB. In particular, the sequence similarities maps (SSM) enable identification of relative genetic distances for a high number of viruses which is then used to study virus evolution and clusters, in combination with epidemiological information (e.g. date, species, location). FAO and SIB have been working on these possible applications of the tool including spatiotemporal mapping of virus clades and clusters (that can be overlaid by other layers such as animal densities maps); screening for distribution of viruses (according to geographical location, host, time) with molecular markers of interest; identification of potential drivers of virus evolution and the occurrence of reassortment events and knowledge gap analysis of virus sequences.

Expansion and Future

FAO is currently applying this module to analyse data from FAO and national surveillance projects in various countries. It will make this tool available in 2012 for scientists who wish to use it or propose further developments of it. The scientists will also be invited to propose linkages between known sequences and outbreaks. The ability to link to other influenza databases such as GenBank/Influenza Virus Research, Global Initiative on Sharing Avian Influenza Data (GISAID)/EPIFLU, and Influenza Research Database (IRD) are also being explored. In parallel, efforts have been initiated by FAO at the country level, so that the linkage between sequences and outbreaks is preserved. Development of this module for other diseases is being considered and has been initiated for FMD.

Other lessons include the fact that global surveillance is improved only if networks are active and strong at the national and regional levels. For any programme to be successful, incentives for disease reporting need to be identified and discussed with all stakeholders in the different livestock (mammalian and avian) value chains from the beginning.

FAO's HPAI response efforts in epidemiology and surveillance have led to increased coordination, awareness and timely response to disease trends, potential disease emergencies and new HPAI/other disease events. However, much work remains to address ongoing influenza threats as well as other high-impact diseases.

The continued need for increasing emphasis on risk-based and systems-based approaches for disease detection, prevention and control will lead to cross-sectoral benefits. To prevent disease events and to be better prepared in places where they are most likely to arise, future efforts will rely on predictive risk profiling and modelling for endemic, emerging or re-emerging infectious diseases. Risk-based, cost-effective surveillance guide-

lines are needed at a regional level with implementation mechanisms outlined at the national level, requiring national investments for the public good.

SURVEILLANCE TRAINING

Staff turnover and ongoing HPAI and other disease threats make continued training in surveillance very important.

To date, FAO's activities have included significant efforts to develop integrated surveillance training of field epidemiologists and laboratory personnel in order to improve the response and coordination to disease outbreaks at country and regional levels, such as FETPV. A hands-on training and mentoring approach, FETPV builds the capacity of the individual veterinarian as well as the institution. It promotes the establishment of formal and informal networks of veterinary epidemiologists who apply their skills in field epidemiology. Through systematic training according to identified national needs, FETPV helps develop national and regional strategies for developing capacity in veterinary epidemiology, particularly human resources.

As part of the FETPV programme, FAO developed a human-wildlife-environment interface module entitled, Wildlife Investigation in Livestock Disease and Public Health (WILD) which has been delivered to more than 30 countries in Africa, and 14 countries in Southeast and South Asia, including the specific national FETPV programmes in Thailand and China. Further courses are planned for Thailand, Bangladesh and Ghana in mid-2012.

Additional epidemiological training and technical assistance in data collection, analyses and management have occurred in Africa and Asia. Two examples include a training workshop held in July 2011 in the United Republic of Tanzania on risk analysis and mapping in reference to HPAI and other TADs, and a HPAI simulation exercise trainers' training session in Togo in August 2011. Training has enabled local staff to have transferable skills in surveillance. An example includes enabling staff in Southeast Asia to be able to respond to the increasing challenge of hvPRRS in the region. Local staff from countries in Asia have been trained to conduct surveillance for H1N1 influenza in pigs. H1N1 surveillance reporting has demonstrated the level of interactions between swine and poultry and a broader approach is expanding to include contact populations of bats and humans. Further capacity development for local veterinarians is needed to sustain this effort along with the benefits derived from such cross-sectoral exchanges with wildlife and public health entities. Meetings with the FAO, OIE, WHO Tripartite⁴⁹ and national partners have promoted joint and coordinated surveillance pilot studies for rabies, ERV, H1N1 and HPAI.

APPLYING SURVEILLANCE INFORMATION FOR GLOBAL EARLY WARNING

While risk-based, targeted surveillance has brought better information to light regarding influenza A viruses, a next step in successful prevention, detection and response is the use of surveillance results to better understand disease and inform actions and mitigations. This step requires collection, analysis and real-time distribution of information gained through all forms of surveillance around the world so that countries and entities can then apply the

⁴⁹ <http://www.fao.org/docrep/012/ak736e/ak736e00.pdf>

knowledge gleaned. The joint FAO/OIE/WHO GLEWS⁵⁰ has been providing this service since 2004. It is currently at the forefront of capturing disease events to provide a global disease situation baseline, expanding types of data gathered, increasing the collaborations for data sharing, strengthening countries' disease information management, improving the quality of disease information reporting, and providing enhanced disease intelligence analyses capability and early warning information to countries. For examples, please see the GLEWS website: <http://www.glews.net/>

EMPRES-i is a web-based platform conceived within GLEWS to collect reliable information on animal disease outbreaks and surveillance activities of select priority diseases.⁵¹ Combining surveillance, genetic characterization and geomapping for animal influenza viruses can contribute to a better understanding of the epidemiology of influenza as well as virus evolution. Integration of viral characteristics into an animal disease database (EMPRES-i genetic module) provides a unique tool to improve knowledge in disease epidemiology and ecology. In 2011, an algorithm was developed as the interface between EMPRES-i outbreak data and influenza virus sequences present in OpenFluDB, a specialized human and animal influenza database developed by the Swiss Institute of Bioinformatics (SIB),⁵² that enabled both databases to integrate respective information for the benefit of the user, such as host species, geographical location and genetic sequences.

WILDLIFE SURVEILLANCE

Surveillance for zoonotic diseases such as HPAI, severe acute respiratory syndrome (SARS) and ERV in wildlife populations is an important way to assess specific health risks at the human-animal-ecosystem interface.

FAO wildlife surveillance and telemetry information has contributed significantly to the global knowledge base that exists about the role of wild birds in H5N1 HPAI. The data collected by FAO has also been utilized to inform and advance the science related to global avian influenza risk modelling, and to define additional important wetland and migratory waterfowl conservation needs. Overall, because of training and coordination, surveillance is increasingly conducted using a One Health approach to address diseases transmitted among people, livestock and wildlife (see Box 4.6).

ENHANCING COMMUNICATION AT THE COMMUNITY LEVEL

With the understanding that awareness-raising activities by themselves were not leading to changes in behaviour and improved farming biosecurity practices, FAO has been emphasizing the need to shift away from didactic, top-down communication towards processes and tools that are driven by deeper community participation and voluntarism.

⁵⁰ FAO, OIE, and WHO have each developed systems that collect, analyse and respond to information on outbreaks from a variety of sources, including unofficial media reports and informal networks. The joint FAO/WHO/OIE GLEWS for major animal diseases, including zoonoses, was created in 2006 to act as a joint system that builds on the added value of combining and coordinating the early warning capacities of OIE, FAO and WHO for the benefit of the international community.

⁵¹ EMPRES-i is a web-based application that has been designed to support veterinary services and organizations by facilitating the collation, analysis of and access to animal disease information. More information can be found at <http://empres-i.fao.org>

⁵² More information is available at <http://www.isb-sib.ch>

BOX 4.6

Increasing wildlife knowledge at the animal-human-ecosystem interface

Approximately sixty percent of emerging infectious diseases of humans are zoonotic. Of these, 70 percent originate in wildlife. These pathogens and diseases include HIV/AIDS, Nipah, Hendra and WNV, as well as ERV, rabies, SARS and monkey pox. It is clear that preventing further transmission of emerging infectious diseases among species and minimizing impacts if they do jump species relies on collaboration and integration of multiple disciplines and partners including ministries of agriculture, health and forestry and environment. Working with ministries of forestry and agriculture, FAO's Wildlife Health and Ecology Unit is conducting wildlife disease surveillance in a variety of species including waterfowl, waders, shorebirds, flying foxes, insectivorous bats, wild boar, gazelle and buffalo in more than forty countries. Additionally, FAO has marked more than 650 wild animals in more than 25 countries including buffalo, flying foxes, migratory waterfowl and wild boar to better understand their habitat use, migration patterns, and their interactions with livestock, people and other wildlife species. The information gleaned from these efforts contributed to disease ecology studies that determine the role of wildlife in outbreak events, and also provides valuable information to resource managers to enable them to protect species and sensitive habitats. Below are just a few examples of specific projects in a One Health approach.

The Role of Bats in Emerging Zoonoses

Bats (order *Chiroptera*) are the second most diverse mammal group in the world. Despite their importance in maintaining the health of plants and animals via the ecosystem services they provide, bats are disliked in many regions of the world due to cultural myths and lack of knowledge. The emergence of the novel Nipah Virus, between 1998 and 1999 in Malaysia resulted in over one million pigs culled, 257 human cases reported of which 105 were fatal, and numerous surviving persons who continue to suffer neurologic signs (more information available at <http://www.ncbi.nlm.nih.gov/pubmed/10823779>). Since 1999, additional outbreaks have occurred in Malaysia, Singapore, Bangladesh and India affecting both pigs and humans. The natural reservoir host for this virus has been identified as fruit bats from the genus *Pteropus*. In Bangladesh, the virus made the jump directly from bats to humans, while outbreaks in Malaysia were caused by virus transmission from bats to pigs, and then from pigs to people. With the variety of transmission pathways, Nipah virus is one of the most concerning emerging diseases in recent times.

Managing zoonotic diseases for which bats are natural reservoirs requires multidisciplinary collaboration. Ministries of health, agriculture, forestry and the environment must work together to ensure that human, livestock, wildlife and ecosystem health are taken into account. In order to address these multidisciplinary concerns associated with management of bats, FAO published a manual in November

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2011 entitled *Investigating the role of bats in emerging zoonoses: balancing ecology, conservation and public health interest* (available at <http://www.fao.org/docrep/014/i2407e/i2407e00.pdf>). This manual explores bat ecology and the role that these mammals play in emerging infectious diseases while highlighting the important role they play in maintaining ecosystems that support human, plant and animal life. The manual targets epidemiologists, natural resource professionals, and veterinarians, among others, who interact with bats.

For more on the role of bats in emerging zoonoses see <http://www.fao.org/docrep/015/i2811e/i2811e.pdf>

Bats-Pigs-People: One Health surveillance in Thailand, Viet Nam and the Philippines

This regional FAO approach to understanding disease dynamics among bats, livestock and people was launched in late 2011 in Thailand, Viet Nam and the Philippines. The project builds upon the successful One Health collaboration implemented in the Philippines as a response to the detection of ERV in domestic swine. In the Philippines, the authorities collaborated and implemented surveillance in pigs, bats and people. In the new project, funded by the Australian Department of Agriculture, Fisheries and Forestry (DAFF), surveillance and radio-marking on flying foxes is continuing, with the aim to characterize better the interface between bat habitat use and movements, livestock



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farms and large densities of people. Development, deforestation, urban encroachment and expansion of farming are also contributing to decreased habitat for wildlife, including bats, which is not only a conservation issue, but leads to higher contact rates between bats, livestock and people. As the diseases of concern include rabies and other lyssaviruses, Hendra and Nipah viruses, Japanese encephalitis and other flaviviruses, Ebola viruses, SARS coronavirus, Menagla virus and Melaka virus, it is important to consider where risk may exist for direct bat to human transmission, or indirect human infection from bats to pigs to people. Furthermore, it has been recognized from the Philippine experience with ERV, that even if viruses do not cause disease in livestock, they can have significant implications on trade

and the perceived risk to the public. For these reasons, a One Health approach that protects the interests of livestock producers, conservationists and public health is required.

As of 5 May 2012, ten flying foxes (*Pteropus lylei*) have been marked in Thailand with samples collected for disease analyses.

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Mongolian gazelle – cattle interface and FMD

The pathways for entry of FMD virus into Mongolia and then subsequent exposure of susceptible animals can occur through movements of fomites (vehicles and goods), livestock or wildlife. Of these, wildlife and, specifically, Mongolian gazelle, has been implicated in the spread of FMD throughout much of the eastern three Aimags during the 2010 epidemic affecting pastoralist cattle herds. Reactive measures included large-scale culling, blockading of underpasses along a railway, and hazing herds to reverse their direction of travel. However, there has been no scientific study to date linking gazelles as the cause of FMD outbreaks and some supporting evidence exists demonstrating that gazelle may be passive recipients of the disease once an outbreak is already occurring. The project currently underway with the Mongolian authorities and several other partners involves surveillance in both cattle and gazelle, analysing movements of gazelle and cattle using radio-telemetry, and evaluating the interface between pastoralist herds and gazelle. In addition, a retrospective analysis is being conducted to determine whether there are spatial or temporal relationships between 2010 FMD outbreak foci in domestic livestock in Mongolia with livestock density, preferred gazelle habitat, and gazelle location as determined from satellite telemetry data. In conjunction with these activities, there is a significant capacity-development dimension to this project. That will prepare national authorities to prevent future FMD outbreaks and to mitigate the impact of future FMD events on livestock and Mongolian gazelle, thereby supporting livelihoods, food security, and the conservation of this near-threatened species.

Wildlife farming and bushmeat consumption:**One Health implications for resource management, livestock and public health**

The use of wildlife and its products, in particular wild meat, traditionally contributes to food and nutrition security, provides protein intake and generates revenues for the livelihoods of communities. It is deeply rooted in their cultures. However, this subsistence activity is rapidly moving towards large-scale business enterprises. Such an evolution in consumption and more systematic trading is driven by population growth, urbanization and globalization. This increase in the exploitation of the resource and the development of informal trade practices, often against the interests of local people, raises new health, environmental and socio-economic issues and can undermine the livelihoods of local communities. In order to acquire a deeper understand-

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FAO has responded quickly to lessons learned about the need for **greater community engagement**. Participatory communication interventions have been developed and are being carried out in Bangladesh, Indonesia and Egypt. These activities range from the training of village animal health workers as community level communicators, to local forums enabling communities to increase their capacity for decision-making to combat HPAI and other diseases, to devising grassroots sustainable biosecurity measures for resource-poor settings through the use of participatory communication methodologies.

ing of the new challenges related to wild meat use, social, ecological, and economic viewpoints should simultaneously be taken into consideration. Approaches aimed at addressing this issue require an intersectoral and multidisciplinary One Health effort to provide concrete strategies and to reduce undesirable economic, social and environmental impacts. To take up these new challenges and to design tomorrow's wild meat-use policies, international organizations such as FAO have to define policies and options to help public policy-makers choose their priorities from now on, adapted to their own situation. Through multiple partnerships including the Scientific Task Force on Wildlife and Ecosystem Health, and the Convention on Biological Diversity's Liaison Group Meeting on Bushmeat, FAO is making contributions that help address this important topic, which has implications for food security, international trade, disease transmission and conservation. FAO's Wildlife Health and Ecology Unit : 1) supported the 2010 Conference of Forests Side Event, Hunting Trade and Management of Wildlife in Tropical Forests, by making a presentation entitled Wildlife Farming and Bushmeat Consumption: One Health Implications for Resource Management, Livestock and Public Health; 2) encouraged capacity development related to wild meat and bushmeat issues in the Congo Basin and West Africa; 3) supported the FAO Forestry Global Environment Facility (GEF) project; and 4) sponsored an interdepartmental workshop on 26 October 2011 entitled, Wild meat, Bushmeat, Livelihoods and Sustainability: Implications for Food Security, Zoonoses, Food Safety and Biodiversity Conservation which aimed to enable sharing of information, but, more importantly, started the preparation of a Draft Position Paper on wild meat and bushmeat including perspectives across FAO departments. For more information see http://www.fao.org/ag/againfo/programmes/en/empres/bushmeat_meeting_2011.html.

Disease investigation on the interactions between domestic cattle and wild bovids in Botswana

Many diseases can be shared and transmitted between cattle and African buffaloes. Evaluating the animal health status and understanding the transfer and dissemination of pathogens at this interface is a high priority for veterinarians and wildlife managers in the Transfrontier Conservation Areas (TFCA). Diseases targeted included bovine tuberculosis, brucellosis, RVF, theileriosis, FMD and lumpy skin disease. This study provided the first baseline data on the circulation of these infectious diseases in two of the most representative areas for wildlife within the Botswanan part of the Kavango Zambezi TFCA.

FAO has also developed and successfully field-tested dialogue-based tools and innovative processes to engage non-technical audiences in a deeper understanding of and involvement with transmission, prevention and control of not just HPAI but, increasingly, other zoonotic endemic, emerging and re-emerging infectious disease threats. The method, which works by stimulating and harnessing curiosity, and finding socio-culturally acceptable descriptions of technical topics, has yielded significant changes in individuals in terms of their understanding and interest about biosecurity, and their ability to act upon the knowledge acquired.

FAO has also been active in providing technical assistance and in building capacities for communication planning with an emphasis on strengthening the technical capabilities and competencies of ministries of agriculture or livestock in a number of at-risk countries in outbreak, risk and behaviour-change communication. It has taken a multidisciplinary approach, collaborating closely with epidemiology, biosecurity and socio-economics experts. Regional multidisciplinary workshops in communication planning and skill-building for HPAI prevention and control have been held for North Africa, West and Central Africa, East Africa and Central Asia, involving over 40 countries. One such example is the April 2011 regional workshop involving ministries of agriculture and health, journalists and other stakeholders on HPAI preparedness held in Kenya (i) to review the current status of communication in the prevention and control of HPAI and other TADs in the region, particularly with regard to communication strategies in place; (ii) to consider the role of the media in the fight against HPAI and other TADs including zoonoses as bridges between experts and the general public; and (iii) to strengthen intersectoral collaboration on animal and public health communication.

SOCIO-ECONOMICS, STAKEHOLDERS AND DISEASE MANAGEMENT

HPAI highlighted the importance of understanding stakeholder behaviour and how it can affect disease spread and also management and control. In short, socio-economics must be an integrated part of any effort to achieve effective disease control that takes into account peoples' incentives and disincentives for compliance. For success, required economic data must be integrated, accurate and up-to-date.

Understanding the social and economic context of people provides an entry point to improved disease control and management. Markets, producer and smallholder sectors, incentives, partnerships across productions and food chains and between public and private sectors, communities, and factors at the local level, all play important roles (see Box 4.7). HPAI elucidated the importance of going beyond scientific and veterinary disease basics to include understanding of the human, livelihood, and socio-economic factors affecting disease dynamics and control, beginning at the local level. Specific to HPAI lessons learned, there is now a greater appreciation of the importance of poultry owners and value chain stakeholders when addressing disease surveillance, reporting, containment and control. As a result, there is enhanced collaboration with the private sector, searching for options for demand-driven HPAI control and considering compliance incentives when developing HPAI control programmes. Also, capacity-building is ongoing to better integrate socio-economics into field epidemiology (i.e. social networks and disease dynamics).

In 2011, specific activities conducted in Asia to better understand the poultry trading routes and value chains have directed the formulation and re-formulation of control and surveillance guidelines with respect to the designation of high-risk districts and high-risk nodules along the poultry market chain for active surveillance sites. In 2011, in Africa, mapping of national trade flows in poultry and poultry products through value chains and trade flow analysis in Rwanda, Kenya, Uganda and the United Republic of Tanzania was performed. Participatory interactions with stakeholders throughout the chains will lead to solutions relevant to their interests. It will also increase the potential of their engagement in the disease control programme and ownership of the outcomes.

BOX 4.7

**Redefining engagement with stakeholders:
PPR and the livelihood-centred animal health protection approaches**

One of the many lessons from HPAI has been the need to engage all stakeholders from the onset in disease management and control. ECTAD's socio-economic unit has been helping veterinary services understand and identify the different actors and value chains within which disease occurs. This information is now helping to develop and implement a livelihood-centred animal health protection approach for diseases such as PPR.

A livelihood-centred animal health protection approach is premised on understanding the livelihoods of livestock producers better, and building upon their requirements for a more effective and efficient animal health care. This goal involves reducing the animal disease burden at household level; increasing production, and thereby ensuring investment into animal health; engaging the community to allow for appropriate strategies and animal health delivery mechanisms; and soliciting national and international support to provide policy support and appropriate initial investments in technology development.

Initial socio-economic work is concentrating on improving the understanding of the livelihoods, demands and decisions made by livestock producers, on the economics and relationships they have across the value chains, and on identifying gaps in technologies within this context. This work will allow for an improved engagement of all stakeholders as it will build upon identified win-win situations for all involved.

Work continues on understanding decision-making of livestock keepers and other stakeholders, to enhance compliance through creating better incentives and limiting disincentives. It is also acknowledged that the disease-management programmes need to know how best to reduce disease risk while not interfering with trade or having control programmes drive price differentials in the products of affected sectors.

Examples of activities related to this work were conducted in 2011 in East Africa, where FAO supported development of a draft regional livestock policy for the region in order to contribute to the harmonization of livestock policies and plans in the EAC members (Burundi, Kenya, Rwanda, the United Republic of Tanzania and Uganda). The harmonized policies are intended to provide a framework for improved livestock sector development through better coordination and management of HPAI and other TADs, in response to regional market demands. Efforts such as these are important because unenforceable legislation that attempts to contradict economically successful and well-established trading practices is counterproductive. Most communities and stakeholders will continue to trade in a manner that precludes health inspection, good biosecurity or other assurances of disease-free status.

Similar observations can be made about socio-economics, marketing chains and drivers with regard to lessons learned on vaccination policy/implementation and biosecurity issues.

MANAGING VACCINATION SCHEMES

Vaccination is one of several tools in a pallet of disease control methods which includes surveillance, market and movement control, humane culling, enhanced biosecurity and vaccination, all of which should be discussed among all stakeholders when developing a targeted, comprehensive strategy that allows countries and regions the flexibility to adapt to their needs over time.

Initial triggers for vaccination included industry demand, economic loss and the protection of public health. Reactive decisions were made to meet immediate needs and there were limited technical resources and information to develop an exit policy. There was limited public sector experience with animal mass vaccination against avian influenza and in some countries industry demand for vaccine programmes drove programmes that were far from comprehensive in nature. Vaccination decisions should also reflect differences and incentives needed in the commercial and backyard poultry sectors. Both of these sectors require greater interaction between industry, stakeholders and government disease managers and politicians.

From 2005, numbers of reported human cases in China, Viet Nam and Indonesia have been declining. This result can be attributed partially to poultry vaccination. Currently, a targeted approach is being used to control HPAI in Indonesia and Viet Nam and an HPAI policy is evolving from control to elimination in China. A phased approach for an exit strategy is now being planned in Vietnam and China. Vaccination continues to be a challenge in Egypt (see Chapter 3).

Vaccines are now being assessed at least twice annually as recommended in Asia and OFFLU, and national laboratories have collaborated to play a key role in conducting antigenic and molecular analysis of field isolates necessary to adjust vaccine strains. This collaboration is especially important as, in the past few years, a newer variant of the H5N1 virus, referred to as clade 2.3.2.1, has emerged and expanded its geographic range from Southeast Asia to Eastern Europe, East Asia, and South Asia. Some variants of clade 2.3.2.1 are different enough from other H5N1 HPAI clades so that available poultry vaccines are ineffective in some countries.

Scientific and technical vaccine and vaccination-related specific lessons include:

- Inactivated vaccines remain the most effective method of immunizing poultry against H5N1 and this may likely be the best option for the next decade.
- Regular semi-annual vaccination quality checks should be conducted to assure that vaccine master seed strain matches the field strains. In addition, cross-sectional studies are needed as part of a vaccination programme in order to measure real vaccine coverage in the field.
- Knowledge of agent-host (i.e. virus-birds) interactions has increased though many questions remain.
- Specifically for domestic ducks, further field trials may be required for improved vaccination schedules, to assess more recent experimental challenge results for optimal efficacy at 7 and 21 days.

ENHANCING BIOSECURITY PRACTICES

Successful biosecurity programmes require a detailed knowledge of the production systems and practices and early engagement of producers in developing appropriate solutions through a participatory process.

Biosecurity has been recognized as the main tool for the prevention and control of HPAI and other poultry diseases, especially in countries where HPAI vaccination has proven to be non-effective. While over the last few years there has not been any significant improvement regarding awareness, knowledge or implementation of biosecurity measures among backyard poultry holders and duck producers (mainly due to lack of incentives), there has been improvement in the understanding of biosecurity in the role of HPAI and the challenges and opportunities of biosecurity issues with the private sector. In HPAI-infected countries, there is a growing interest, by both the poultry producers and veterinary services, in biosecurity as a tool for the prevention and control of multiple diseases.

Currently, the HPAI-infected countries in the Asian region and Egypt are at different stages of development and implementation of biosecurity programmes (see more specific information in Chapter 4). Adaptation of standardized biosecurity approaches has advanced and a second generation of more realistic and appropriate measures and approaches are now emerging. For example, research is currently underway in Indonesia to identify the most cost-effective biosecurity practices for layer farmers. In Vietnam, several pilot approaches to biosecurity improvements have also been completed. The sustainability of training programmes is largely in the hands of the private sector, but, in most countries, the support of veterinary services will be required. Continuation of biosecurity training programmes in HPAI-infected countries is needed for better knowledge and awareness of producers and other partners. It is of note that a more holistic approach to disease prevention with regard to biosecurity measures would be to move away from a specific single disease initiative and, instead, focus on multi-disease control programmes, good production practices and overall herd/flock/animal health management. This approach would better reflect real world disease pressure conditions, provide more efficiencies, be more cost-effective, improve farm profitability, increase incentives and gain increased application by livestock holders.

Improved collaborations and partnerships between the public and private sectors are essential for effective implementation of biosecurity programmes in poultry production and along the entire marketing chain.

An excellent example can be seen in Bangladesh,⁵³ where the country has developed and approved national biosecurity guidelines for the commercial sector, and has developed biosecurity SOP's and training programmes. Additionally, government veterinarians have been trained as biosecurity auditors to assess proper plan implementation. The programme has mechanisms of public and private partnerships and is fully supported by the industry and the Department of Livestock (DLS). Only minor adjustments would be required for the establishment of similar biosecurity programmes to support other livestock industries and the model adapted in other countries.

PARTNERSHIPS

Coordination and partnerships at the local, national, regional and global levels have been essential in the eight-year HPAI effort in all countries. Coordination and a concerted, sustained effort are vital in endemic hotspot areas. FAO has played a central role in forging

⁵³ Available at <http://www.fao.org/asiapacific/bangladesh/en/>

and coordinating partnerships among a number of players and stakeholders involved in the control of HPAI and other high-impact emerging and re-emerging infectious diseases. These have included partnerships with national governments, NGOs, donors, national and international research institutes, regional organizations and other international developmental and technical agencies.

Global and regional partnership efforts to address the problem of H5N1 HPAI have clearly yielded significant results. The understanding that a pathogen that predominantly causes losses in livestock can cross species barriers to affect humans and result in epidemics and pandemics has spurred politicians and decision-makers to invest in the challenge of preventing and countering emerging infectious diseases. Much work remains to further address ongoing influenza threats as well as other zoonotics and TADs. The complexity of the drivers of these zoonotic infectious diseases that have such widespread impact has stimulated a One Health movement that promotes multidisciplinary and multisectoral approaches to addressing the complexity of the problem.

TOWARDS A ONE HEALTH APPROACH

The framework to manage diseases effectively at the human-animal-ecosystem interface is known as the One Health approach. One Health addresses threats and reduces risks of emerging and re-emerging infectious disease through a collaborative, international, cross-sectoral, multidisciplinary approach. To date, the One Health approach has been used to address infectious diseases, but this framework can be used across disciplines to address a wider range of issues across the three health domains. More specifically, One Health acknowledges the animal-human-ecosystem interface, and places disease dynamics into the broader context of agriculture and socio-economic development and environmental sustainability.

FAO developed a strategic AP entitled, Sustainable animal health and contained animal-related human health risks – in support of the emerging One-Health agenda.⁵⁴ This plan has taken the lessons learned from the avian influenza response since 2006 and applies this knowledge in approaches to the control of other emerging infectious diseases and global TADs. The AP promotes a proactive approach to disease risk management. The actions recommended are risk-based and tailored to the local context engaging the people involved through participatory processes. All actions of the plan aim at sustainability and ownership by countries and regions. They range from immediate to long-term actions with a developmental perspective (see Box 4.8).

FAO's Animal Production and Health Division (AGA) has been leading One Health discussions within FAO as well as at the global level with international partners (see Box 4.9). The tripartite mechanism under which FAO, OIE and WHO share plans and identify opportunities for collaboration, is leading to a deeper appreciation of shared perspectives, issues and goals. One collaboration example is the FAO/OIE OFFLU, a global disease specialized network that works at the human-animal interface. In February and September 2011, OFFLU contributed to two Vaccine Composition Meetings held by WHO in Geneva to help determine strains to be included in human vaccines for the upcoming influenza season (see Box 4.10).

⁵⁴ See Chapter 6 of the Fourth Report January–December 2010 Global Programme for the Prevention and Control of Highly Pathogenic Avian Influenza for further history and background (available at <http://www.fao.org/docrep/014/i2252e/i2252e00.pdf>).

BOX 4.8

**FAO's One Health strategic action plan:
promoting One Health at the animal production and health division**

During 2010, FAO worked on a corporate strategy and an AP for the period 2011 to 2015, setting out the priorities and the organization's contribution to the One Health framework. Since the AP's approval in March 2011, efforts have been underway to implement it at the global, regional, national and local levels. Overall, the AP is creating a more robust global animal health system that effectively manages major animal health risks, paying particular attention to the animal-human-ecosystem interface, and placing disease dynamics into the broader context of agriculture and socio-economic development and environmental sustainability.

The AP emphasizes the following six broad priority actions for the first phase (2011–2013). Identification of these priority areas takes into account the immediate capacity requirements and needs for better management of animal associated health threats at global, regional and country levels. As the AP progresses and more funding becomes available, other services and products will be undertaken to complement the ongoing activities in order to achieve the goals and the objectives of the AP by 2015.

The FAO One Health AP priority areas

- continue the campaign against H5N1 HPAI with greater emphasis on a long-term approach to disease control in endemic countries;
- develop the progressive control pathway approach for priority diseases;
- strengthen the international capacity for emergency response support;
- develop an upstream approach to disease prevention and control through better understanding disease drivers and risk factors for disease emergence, persistence and spread;
- support disease intelligence and global early warning; and
- provide support to disease impact and socio-economic analyses.

In support of the One Health approach, advocacy initiatives at the country and regional levels have been developed to provide a wider focus on infectious diseases of high impact to facilitate information sharing and improved evidence-based decision-making along with a more strategic and effective long-term prevention and response capacity for animal, human and zoonotic pathogens.

For example, in addition to providing country personnel with training in an holistic approach to wildlife and livestock epidemiology and surveillance methods, surveillance data collection of animal diseases is being enhanced and integrated with environmental and food safety data in pilot countries. This data will be utilized to provide more comprehensive data for risk analysis. It will allow improved risk modelling (based on more layers of data) that will support early warning on animal diseases at regional levels for the international community. It will also enable improved predictive and response information for countries.

BOX 4.9

2011 FAO and global One Health efforts

In May 2011, FAO's Agriculture and Consumer Protection Department hosted an inter-departmental FAO Corporate One Health Workshop at FAO headquarters to bring together experts and leaders from across FAO's diverse disciplines and departments. The aim of the Workshop was to identify areas for improved collaboration within FAO and to explore a possible organization-wide One Health strategy. The two-day Workshop was attended by 44 people from more than 20 different backgrounds within FAO as well as observers from OIE and WHO. Throughout the Workshop, participants were invited to reflect on ways One Health is implemented in their discipline and to consider how it could be improved. Defining the FAO corporate One Health strategy, encouraging close collaboration between organizations, and supporting interdisciplinary thinking, were all highlighted as major areas of synergy throughout FAO.

Since that Workshop in 2011, significant changes, both internal and external, have taken place within FAO which strongly signal that the time is right to reconvene to pursue the One Health approach at an international organizational level. Leading by example would entail further reform and mainstreaming of the One Health approach at FAO. Some highlights demonstrating the momentum the One Health approach has gained externally, and with FAO partners, since the Workshop include, but are not limited to: 1) the High Level Technical Meeting to Address Health Risks at the Human-Animal-Ecosystems Interfaces 15-17 November 2011 in Mexico City (available at <http://www.hltm.org/index.php>); 2) the USAID-funded RESPOND project setting One Health networks in Africa and Asia between veterinary and public health faculties; 3) the Global Risk Forum One Health Summit 2012: One Health - One Planet - One Future Risks and Opportunities 19-22 February 2012 in Davos, Switzerland (available at http://www.grforum.org/pages_new.php/one-health/1013/1/938/); and 4) the development of courses and degrees in One Health at a number of universities.

Through workshops and national consultations, countries are assisted in formulating their own One Health frameworks. Collaborative working relationships to provide regular communication and coordination between various ministries of agriculture, public health, environment and forestry are a more routine occurrence. For example, FAO facilitated the One Health consultation to establish a One Health framework and roadmap in Bangladesh. This led to the region's first national One Health strategy. In Asia, FAO worked collaboratively with UNICEF, AED, World Health Organization–South-East Asia Regional Office (WHO-SEARO) and others to develop *One Health: seeing around corners*,⁵⁵ the first One Health-driven communication strategy framework. Based on this framework, several countries, including Bangladesh and Viet Nam, are developing country-specific One Health communication strategies relevant to HPAI and a range of other diseases.

⁵⁵ Available at <http://www.fao.org/docrep/014/al911e/al911e00.pdf>

Veterinary public health has seen increased emphasis in 2011 with country-level activities on rabies, zoonotic parasitic diseases, anthrax, food safety and antimicrobial resistance data gathering efforts, to name a few. For livestock, well-understood interventions can be applied in the context of the One Health approach and integrated control of zoonotic diseases provides an ideal platform for One Health at the community level. In addition to its commitment to global initiatives to develop and institutionalize the One Health agenda, FAO has been working actively at the country level to operationalize One Health through locally adapted approaches for improved surveillance, joint outbreak investigations, increased community awareness, establishment of policy platforms, effective delivery of control measures, joint simulation exercises and increased and synergetic intersectoral collaboration.

In many instances, zoonotic diseases have their roots in controllable disease in animals, especially in domesticated species. There are a number of endemic zoonotic diseases such as anthrax, brucellosis, tuberculosis and rabies for which successful control can only be achieved if the attitudes of communities are fully understood and taken into account in developing control policies and strategies. Brucellosis, bovine tuberculosis and rabies are diseases of increased concern as they emerge and re-emerge in many developing countries where control programmes are not adequately implemented and habits such as pasteurization of dairy products, proper handling of infected meat products and vaccinations are not commonly practised in rural communities. There are very significant benefits to human health, household food security and poverty alleviation from control and elimination of these diseases. FAO has been working in this direction by developing integrated control approaches with effective implementation at national and community levels (see Box 4.11). In many developing countries, especially rural areas, international interventions to reduce disease burden is hampered by inadequate technologies not adapted to the local prevailing production systems, agro-ecological conditions, reduced capacity of veterinary services and lack of coordination. Under a One Health approach, FAO is working to develop holistic community-based animal health packages for the management and control of animal and zoonotic disease constraints/risks. These are designed to alleviate poverty and to improve animal and human health, livestock opportunities for rural development and food security. These efforts are site-specific, developed in direct partnership with the livestock holders and keepers, farmers, farmers' associations, communities and local governments. These can be delivered through a variety of ways depending on the local context: livestock holder/keeper field schools, CAHWs and community Animal Health Clubs (AHCs).

The aim is to provide technical information and guidance and to foster interaction between the stakeholders of a specific livestock production chain in order for them to identify collectively options for sustainable development, and animal and zoonotic disease intervention strategies. Stakeholders' concerns, priorities and constraints are identified and discussed, including potential roles to eliminate constraints. FAO's AHCs and livestock holder/keeper field schools could take the dialogue, knowledge and AP resulting from the national diseases policy platform and apply it at the community level in a collaborative, locally customized and sustainable manner. AHCs provide basic training for teachers and school children on prevention and control of zoonotic disease, animal husbandry practices and general health education including nutrition, sanitation and environmental hygiene.

BOX 4.10

OFFLU laboratory network contribution to the WHO biannual consultation on the composition of influenza vaccines – One Health in action

Every six months, a global team of specialists reviews all human influenza virus activity and virus characterization. The review includes human seasonal influenza and zoonotic influenza, that is A(H5N1), A(H9N2), A(H1N1) or any other relevant subtype. The team also examines the status of development of new candidate vaccine viruses. This process is meant to provide guidance for national authorities and vaccine companies on the selection of candidate viruses for use in vaccine development. In January 2010, an agreement was signed between OFFLU and the WHO network, making official OFFLU's involvement in this consultation process for an initial period of three years.

Contributing Data for Analysis

Data sources of the OFFLU contribution include the OFFLU network laboratories (OIE/FAO Reference Centres in animal influenza, national laboratories of heavily infected countries) for molecular and antigenic data, animal health databases EMPRES-i (FAO) and World Animal Health Information Database (WAHID) (OIE) for epidemiological data; IVR-GenBank, SIB-OpenFludB, and GISAID-Epiflu for genetic sequence data. OFFLU experts (OIE/FAO Reference Centres and national veterinary laboratories) are contacted by the OFFLU secretariat for sharing of their published and unpublished data with OFFLU for the six-month period (February to September or September to February). Animal health genetic, antigenic data and epidemiological data are analysed and displayed by FAO. As with every WHO collaborating centre for influenza, OFFLU provides a report to WHO and the panel of available epidemiological and molecular data for animal influenza that require full attention. OFFLU also delivers a presentation giving an overview on the compiled and analysed data. Two OFFLU representatives participate in the consultation: an expert from an OIE/FAO Reference Centre (rotating attendance) and an OFFLU/FAO scientist.

(cont.)

The information is imparted to school pupils and university students, along with training and mentoring by university staff and veterinary staff. The pupils and students then share the information with their friends, families and neighbours mobilizing them to take action to prevent diseases in their communities. AHCs have been well-utilized in addressing rabies outbreaks in several countries (see Box 4.12). Often the solutions to local animal and zoonotic disease can be found in small, practical things that stakeholders can do in husbandry, hygiene or animal management that will prevent or eliminate the pathogen. These community-based efforts provide education, extension and improved service delivery beyond specific disease issues. Local community education, active participation and leadership underpin a lasting capacity within the community to prevent and control diseases at the source.

Real World Results

In February 2011, OFFLU shared information related to 123 H5N1 HPAI viruses from Nepal, Viet Nam, Bulgaria, Romania, Myanmar and the Lao People's Democratic Republic, 76 of which were not yet publicly available while 47 were already publicly available. In September 2011, OFFLU shared new and previously unreported sequences from Bangladesh, Egypt, India, Indonesia, Israel, the Lao People's Democratic Republic, Myanmar and Viet Nam, representing clades 1, 2.1.3, 2.2, 2.2.1, 2.3.2, 2.3.4. The report included 245 H5 sequences (120 non-public and 12 public domain sequences from 2011; 113 non-public from 2009 to 2011). For H9, the OFFLU network contributed 20 pre-2011 sequences (the majority from 2009) and one 2011 sequence from Bangladesh. Among these viruses, one was selected by WHO for candidate vaccine virus preparation (clade 2.3.4.2 A/chicken/Bangladesh/11rs1984-30/2011). This virus was obtained through surveillance activities conducted by the veterinary services of Bangladesh with support from the FAO country office, and characterized by the OIE/FAO Reference Laboratory in Padova in April 2011. After the consultation, FAO and the Istituto Zooprofilattico Sperimentale delle Venezie (IZSVE) officially contacted the Government of Bangladesh to request the authorization to transfer the strain from IZSVE to the United States Centers for Disease Control and Prevention (CDC), which was provided.

The Future

More developments are foreseen in the field of testing by OIE/FAO Reference Centres of ferret antisera, enabling earlier and more systematic screening of antigenically variant viruses. The very satisfactory and increasing level of information-sharing from many countries and scientists is to be acknowledged. The outcomes of the consultancy process are published on the WHO web under: Antigenic and genetic characteristics of zoonotic influenza viruses and development of candidate vaccine viruses for pandemic preparedness (available at http://www.who.int/influenza/resources/documents/characteristics_virus_vaccines/en/).

At FAO, food security remains the priority, concurrent with protecting livelihoods, eliminating poverty, ensuring sustainable natural resource management, good nutrition and food safety, as well as good governance and policies in agriculture, forestry and fisheries practices. The One Health approach has clear advantages and can readily facilitate achieving these organizational mandates. While the etiology of One Health stems from infectious diseases, it is clear that the application of this approach can contribute to ensuring global food security, safety and improved nutrition.

BOX 4.11

Integrated control of zoonotic diseases provides an ideal platform for the One Health approach

In addition to its commitment to global initiatives to develop and institutionalize the One Health agenda, FAO has been working actively at the country level to operationalize One Health through locally adapted approaches for improved surveillance, joint outbreak investigations, increased community awareness, effective delivery of control measures, joint simulation exercises and increased and synergistic intersectoral collaboration. There are a number of endemic zoonotic diseases, such as anthrax, brucellosis and tuberculosis, for which successful control can only be achieved if multidisciplinary and integrated approaches are applied at all levels and the attitudes of communities are fully understood and taken into account when developing control policies and strategies. There are very significant benefits to human health, household food security and poverty alleviation from control and eradication of these diseases.

Collateral activities have been undertaken in response to anthrax outbreaks in Bangladesh, showing a good example of the One Health approach in action at the community level. There, the interaction and cooperation between local veterinary and public health services, as well as full involvement of anthropologists and social workers, facilitated the control of this zoonosis. Further examples of such collaboration and an integrated approach can be seen with brucellosis and tuberculosis control in developing countries. These global zoonoses present severe public health challenges and major economic burdens, particularly in developing countries with inadequate public health and veterinary services. Experience from FAO brucellosis control programme efforts in Tajikistan shows that vaccination of small ruminants, combined with public awareness, joint surveillance and close collaboration between veterinary and public health authorities, reduce the prevalence of brucellosis in animals and limit its transmission to humans. Both diseases are causing concern as emerging diseases in many countries where control programmes are not adequately implemented and pasteurization of dairy products is not a common practice in rural communities. In the case of both diseases, it was found that knowledge of the mode of infection or the importance of pasteurization significantly reduced the risk of infection, thus confirming the importance of public health education. It may be beneficial to consider promoting and facilitating small-scale or community pasteurization plants as part of the strategy to reduce the infection in humans, while a progressive control strategy was implemented to control each disease in susceptible animal populations.

Other challenges in controlling these diseases include the complex epidemiological pattern involving transmission between domestic animals and wildlife and the potential emergence at the animal-human-wildlife interface. A One Health approach is required for successful control, including the development of control strategies that are acceptable to communities and that take into account anthropological factors. FAO has been working in this direction by developing integrated control approaches with effective implementation both at national and community levels.

BOX 4.12

One Health applied: tackling rabies in communities

Rabies is a widespread, neglected and under-reported, acute and fatal zoonotic viral disease that infects domestic and wild animals and is transmissible to humans. Unvaccinated dogs can be infected with the rabies virus. Although rabies is 100 percent preventable, it is still found in over 150 countries worldwide, particularly in Africa, Asia, Latin America and the Middle East, and causes an estimated 55 000 human deaths every year. Over 95 percent of human rabies cases are caused through bites from infected dogs. In many countries, when prevention awareness is minimal, children, especially, become victims due to their frequent contact with dogs. Once rabies symptoms appear, it is almost certainly fatal.

Livestock most commonly become infected with rabies through dog or wild animal bites, including bats. Controlling the disease in dogs through vaccination and dog population management remains the most cost-effective way to protect humans from rabies exposure. Wildlife and livestock are often affected, but in much of the world rabies surveillance is limited and the extent of cases is unknown. However, current known cases worldwide in humans, livestock, wildlife and dogs demonstrate that it is a looming public health threat. Prevention and management of rabies at the country level usually involves multiple ministries and can often fall through the cracks because of this, particularly given that it is under-reported as well. Therefore, rabies disease is well-situated to be addressed by the One Health approach in order to safeguard human, animal and ecosystem life.

Conclusion

Over the past eight years, FAO has been at the forefront of the global effort to fight HPAI since its emergence in Southeast Asia. The central role played by FAO to control H5N1 HPAI has been acknowledged by major international agencies and the donor community, particularly given FAO's broad mandate in the area of developing sustainable agriculture for food security, nutrition, food safety and poverty reduction.

The success stories, challenges and lessons learned from these eight years of concerted programming in the region are helping to inform future programming against HPAI and other EIDs. Over the last three to four years FAO's role and priority have evolved. FAO has moved from a focus on emergency response to long-term capacity development to improve technologies and proficiencies in field and market surveillance, and in mechanisms for early detection and timely response in HPAI-infected and at-risk countries. It has broadened its HPAI programme to include other EIDs. And it has adopted a One Health approach to promote greater multisectoral and multidisciplinary participation.

FAO, working with national authorities in endemic countries, has developed a framework for each country. These frameworks are tailored for local differences in the poultry sector, the stage of development of the H5N1 HPAI programme, socio-political characteristics as well as the strengths and weaknesses in both the public and private sectors. Each framework comprises a mix of measures aimed at outbreak control and responses, gathering and analysing information (e.g. surveillance, disease investigations, other epidemiological studies, market chain studies and factors that influence disease reporting, including compensation), disease prevention and risk reduction. Better information allows control and preventive measures to be targeted at the areas facing the greatest threat from the disease. It also improves risk-based interventions. The range of measures builds on those already in place in each country. Each proposed activity has clear measureable objectives and also develops capacity for handling other emerging and re-emerging diseases. Enhanced capacity is especially important given decreasing availability of funds alongside the increasing number of new pathogens and diseases emerging in endemic hotspots in an environment where the interaction between livestock, wild animals and humans is increasing. The approaches to meeting each endemic country's goals are based on progressive control. Each of the identified constraints to the control and prevention of HPAI are addressed, but improvements will be gradual. The road to overcoming these constraints is long and governments and donors must understand that there are no quick fixes to the various institutional and structural issues that led to the disease becoming endemic in the first place. More details can be found in the FAO 2011 publication, *Approaches to controlling, preventing and eliminating H5N1 highly pathogenic avian influenza in endemic countries*.⁵⁶

⁵⁶ Available at <http://www.fao.org/docrep/014/i2150e/i2150e00.htm>

Without local involvement, buy-in and understanding on all sides, there will not be complete success in addressing pandemic threats or the significant TAD challenges of today. Including this involvement as part of the HPAI programme enabled sustainable successful targeted approaches customized to local needs that were concurrently placed into a regional context. Disease control and elimination efforts were thereby maximized and enhanced. The knowledge gained from HPAI has been successfully transferred to other TADs and has been the impetus behind the formulation of a concerted One Health approach. It has also formed the basis of FAO's One Health AP. Applying the One Health approach in the field, as in the case of farmer and livestock field schools and FETPV training, advantages countries, building residual capacity, knowledge and infrastructure benefits. Requests for midstream animal health work are being met with strategic work that is progressively moving beyond avian influenza. One Health is shifting to PCPs and regional roadmaps for a growing number of TADs such as FMD and brucellosis, and is addressing the semi-neglected diseases such as African trypanosomosis, rabies, African swine fever and PPR.

FAO can continue to contribute significantly as a leader on One Health initiatives and global animal health concerns. Much work remains to be done on wildlife-livestock-human surveillance, training initiatives regarding zoonotic diseases and understanding disease dynamics. FAO can also assist countries in their national efforts to formulate One Health strategic frameworks. The ultimate One Health challenge is working towards biodiversity preservation, sustainable natural resource consumption, and maintaining resilient ecosystem services while decreasing animal and zoonotic disease outbreaks and improving food security globally.