Lao People's Democratic Republic

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Operational Costs of Trade-Related Sanitary and Phytosanitary Activities

The World Bank
East Asia and Pacific Region
Poverty Reduction and Economic Management Sector Department

Lao People's Democratic Republic

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An assessment undertaken with resources from the
Trade Development Facility Multi Donor Trust Fund

The World Bank
East Asia and Pacific Region
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Foreword

The 2009 World Bank report **Lao PDR Sanitary and Phytosanitary Measures: Enhancing Trade, Food Safety and Agricultural Health** expressed concern over the insufficient funding by the Government of Lao PDR to effectively operate a viable sanitary and phytosanitary (SPS) system. Despite donor grants and lending actively supporting capacity building and investments in equipment and facilities, operational expenses in this area are needed to make sustainable use of newly created capacities.

This report, **Operational Costs of Trade-Related Sanitary and Phytosanitary Activities**, presents the work of a World Bank team, to assist the Lao PDR Government in making assessments of the minimum levels of public funding needed to carry out basic SPS tasks — performing surveillance, testing, diagnostics and risk analysis. The work involved close coordination with leading Lao Government officials in the areas of food safety, plant health, and animal health. As part of this study report, Lao Government staff and the World Bank study team visited SPS agencies in Thailand and Vietnam to gather information and learn from their experiences.

Preliminary findings were presented in a workshop held in Vientiane on December 14, 2009, for senior officials and technical staff of the offices involved in food safety, plant health and animal health. A second workshop was held on February 8, 2010, to review a draft of this report.

The work was carried out by Cornelis van der Meer and Laura Ignacio under the supervision of Richard Record, task team leader for the World Bank, with the assistance of Konesawang Nghardsaysone, and with important contributions from laboratory specialists Maria Beug-Deeb, Upali Samarajewa and Tom Deeb. Overall guidance was provided by Mathew Verghis and Geneviève Boyreau.

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Acronyms and abbreviations

AAS	Atomic absorption spectroscopy
AOAC	Association of Analytical Communities or AOAC International
ASEAN	Association of Southeast Asian Nations
AusAID	Australian Agency for International Development
CSF	Classical swine fever
DAFO	District Agriculture and Forestry Office
DOA	Department of Agriculture
DOLF	Department of Livestock and Fisheries
ELISA	Enzyme-linked immunosorbent assay
FAO	Food and Agriculture Organization
FDD	Food and Drug Department
FDQCC	Food and Drug Quality Control Center
FMD	Foot-and-mouth disease
GC	Gas chromatography
GC–MS	Gas chromatography–mass spectrometry
GMS	Greater Mekong Subregion
GT	Gobthong Thoophom
HPAI	Highly pathogenic avian influenza
HPD	Hygiene and Prevention Department
HPLC	High performance liquid chromatography
ICP	Inductive coupled plasma (for simultaneous multi-element detection)
ISO	International Organization for Standardization
Lao PDR	Lao People's Democratic Republic
LC-MS	Liquid chromatography-mass spectrometry
MAF	Ministry of Agriculture and Forestry
MOH	Ministry of Health
MTC	Ministry of Transportation and Communication
NAHC	National Animal Health Center
NCLE	National Center Laboratory for Epidemiology
NFI/BAM	National Food Institute/Bacteriological Analytical Manual
NZAID	New Zealand's International Aid and Development Agency
OIE	*Office International des Epizooties*, World Organization for Animal Health
PAFO	Provincial Agriculture and Forestry Office
PCR	Polymerase chain reaction
PPC	Plant Protection Center
PRRS	Porcine Reproductive and Respiratory Syndrome
RPBR	Rapid Bioassay of Pesticide Residues
RT–PCR	Reverse transcriptase–polymerase chain reaction
SPS	Sanitary and phytosanitary
UNIDO	United Nations Industrial Development Organization
WHO	World Health Organization
WTO	World Trade Organization

Executive Summary

The 2006 Sanitary and Phytosanitary (SPS) Action Plan for the Lao People's Democratic Republic (PDR) recommends that improved SPS capacities are needed (a) to gain and maintain market access, and (b) to better protect consumers, crops, and livestock against trade-related hazards. The Government of Lao PDR has been making efforts to build SPS capacities with external support, but major capacity gaps remain in surveillance and diagnostic services.

Adding to the urgency for capacity building in surveillance and diagnostic services is the growing trend in market access that requires information about the pest, disease, and food safety situation in the exporting country. Information obtained from surveillance is also needed as input to policymaking on SPS measures, risk management, and priority setting.

Expanding capacities can only be done selectively and gradually because of the small size of the country and its limited resources. And operational funds are critical to make sustainable use of newly created capacities.

Recommendations

This study report provides recommendations for expanding surveillance, testing, and diagnostic activities for the next 5 to 7 years, and assesses minimum levels of additional public funding needed.

Investments

Strengthened capacities should take into consideration demand and available cost-effective alternatives to several lumpy investments. Testing and diagnostic facilities and equipment require significant investments. Also, there are requirements to the efficient and sustainable use of advanced testing equipment such as sufficient volume of tests (at least 500 per year), availability of chemicals, continuous supply of power and air conditioning, regular maintenance and calibration, and participation in a proficiency testing scheme. However, in some areas there is not yet enough demand to justify investment in expensive testing equipment. A short- and medium-term alternative is to make use of rapid test kits and to subcontract laboratories abroad for confirmation testing.

Institutions

A consolidated national SPS laboratory would provide economies of scale and is — at least from a technical point of view — the preferable solution for building laboratory capacities in Lao PDR. If it is not feasible to consolidate laboratories, the next best alternative would be to design a clear delineation of functions with allocation of lead roles and specializations for each of the institutions. Lao PDR is too small to justify parallel capacities in most areas of food safety testing. The three institutions in place — Food and Drug Quality Control Center (FDQCC,) National Animal Health Center (NAHC), and Plant Protection Center (PPC) — have commonalities in various areas of surveillance and testing, such as pesticides, veterinary drugs, mycotoxins, and heavy metals. The following proposed division of responsibilities would allow for the use of each other's expertise and capacities:

- FDQCC would lead on food microbiology and food chemistry, including pesticide residues, and mycotoxins;

- PPC would lead on heavy metals and composition and quality of pesticides; and

- NAHC would lead on composition and quality of veterinary drugs and vaccines, residues of veterinary drugs in food, zoonoses in and microbiological safety of unprocessed animal products.

The above institutional arrangements also call for coordinating responsibilities and procedures, and sharing information. There should be clear procedures, especially among agencies from different ministries, on submission of samples, provision of certificates, and cost recovery mechanisms.

Funding

The amount of additional public operational funding needed to conduct the recommended volume of activities is about US$800,000 each year. It is recommended to expand the amount of funding incrementally in five annual steps of US$160,000. The table below presents the breakdown of the estimated operational costs for recommended activities for the next five years.

Summary of estimated operational costs (US$)

FDQCC (Food safety)	**170,200**
Surveillance	23,200
Microbiology	27,000
Pesticides residues, Variant 2	72,000
Mycotoxins, Variant 2	14,500
Heavy metals	17,000
Food-borne diseases	15,000
Data management	1,500
PPC (Plant health and food safety)	**156,600**
Pest surveillance	57,000
Purchased pest identification	5,000
Post-entry quarantine	3,000
Pesticide residues	22,600
Pesticide formulations	52,500
Heavy metals (soil and fertilizer)	15,000
Data management	1,500
NAHC (Animal health and food safety)	**706,000**
Surveillance	164,000
Diagnostic testing	310,000
Veterinary drug residues	25,000
Drug and vaccine quality	35,000
Animal and fish products (microbiology and zoonoses)	10,000
Safety of animal feed	60,000
Readiness, variant 2: vaccines	100,000
Data management	2,000
Total SPS	***1,032,800***

Total (additional) operational budget needed to carry out recommended expanded activities amount to about US$1 million a year (about 8.5 billion Kip). More than half (68 percent) is for animal health (and related food safety and human health protection), primarily for animal health surveillance and diagnostics, of which half is for highly pathogenic avian influenza (HPAI).

The present operational budgets allocated from Government resources are estimated to be in the range of US$50,000 annually. In some cases, temporary small budgets are available from foreign-funded projects; the main exception is the sizable external funding for HPAI, which is currently about US$237,000 for surveillance and testing. If external HPAI funding continues in the medium term, an additional public fund of about US$800,000 each year would be needed to achieve the recommended volume of activities. It is recommended to reach that level by expanding funding in five annual increases of $160,000.

Priority activities for near-future initiation include the use of rapid test kits and plant pest and disease surveillance. Subsequently, other active and passive surveillance activities can be gradually stepped up. A rolling annual plan would guide priority in allocations.

Key Requisites to Recommendations

There are requirements that will be critical to successfully expanding operational budgets:

(1) ***Institutional and legislative framework.*** Expanding capacities in surveillance, testing, and diagnostics assumes that proper institutional and legislative frameworks are already or are being put in place already with support from the Trade Development Facility and other projects.

(2) ***Volume of work.*** The volume of sample collection should be sufficient for the building and maintaining of proficiencies of staff and utilization of laboratory capacities. The current volume of samples does not justify further addition of equipment, staff, and accreditation.

(3) ***Equipment and facilities.*** In the medium and long terms, purchase of equipment, facilities, and structural adjustments may be needed to broaden the range of testing parameters.

Equipment. The following equipment purchases may be necessary; alternatives would be to subcontract with specialized laboratories in Thailand or Vietnam:

(a) Department of Agriculture (DOA) may need to invest in high performance liquid chromatography (HPLC) for testing composition of pesticides;

(b) DOA may need atomic absorption spectroscopy (AAS) for testing of heavy metals; and,

(c) NAHC may need equipment for testing veterinary drugs, antibiotics and growth enhancers.

Facilities. Quarantine work on seed and other plant material requires the establishment of a post-entry quarantine laboratory at PPC.

(4) ***Human resources.*** In all areas there is a dearth of trained specialists, inspectors, and laboratory technicians to conduct surveillance, collect samples, and to carry out diagnosis and tests. This will necessitate a well-planned gradual increase of human resource capacities.

(5) ***Information management.*** Information management should be performed by setting up a database in each of the three institutional areas and employing a staff dedicated to data management and analysis. Proper management, dissemination, and use of the information will help assure maximum benefits from surveillance, testing, and diagnostics.

I. Introduction

1. Information derived from sanitary and phytosanitary (SPS) surveillance and monitoring activities is an increasingly important requirement for market access and a crucial input for risk management and policymaking. Implementation of these activities however needs more than initial capital investments and training provided by external sources. Sustainability requires public funding of substantial recurrent costs.

2. This study report was undertaken with resources provided by the Trade Development Facility multi donor trust fund to assist the Government of the Lao People's Democratic Republic (PDR) in assessing minimum levels of public operational funding needed to expand surveillance and diagnostic activities related to the management of SPS risks in Lao PDR. It provides policy options and recommendations for expanding the scope of current SPS activities, and assessments of additional operational costs needed for sustainably performing the recommended expanded activities.

Structure of the Report

3. This introductory chapter describes SPS activities in general and the growth of SPS capacities in Lao PDR. Chapter II describes the scope and methodology of the study. Chapter III presents a basic discussion of issues and broad estimates of costs of laboratories and testing. Chapters IV-VI discuss present activities undertaken in the areas of food safety, plant health, and animal health, respectively, together with recommendations for their expansion and corresponding cost estimates. Chapter VII presents a summary of recommendations and conclusions. Annexes present the following supporting material: Annex A, Estimates of operational costs of equipment and laboratories; Annex B, Testing fees in Thai and Vietnamese laboratories; Annex C, Estimations and data for food safety; Annex D, Estimations and data for plant heath, Annex E, Estimations and data for animal health; Annex F, Lao PDR data on expenditures for agriculture and health sectors; and Annex G, List of interviewees.

Sanitary and Phytosanitary Activities

4. The purpose of SPS measures is to protect human, animal, and plant life or health. From the import-related perspective, SPS measures aim to protect against the introduction and spread of pests, diseases, and harmful chemicals in conjunction with the entry of imported agricultural and food products. Likewise, SPS measures benefit and promote domestic production, and agricultural and food export potentials by monitoring and controlling pests, diseases, and harmful chemicals along the entire food supply chain.

5. Well-enforced SPS measures comprise the following actions:

- Protect against entry and spread of health hazards;
- Detect and, subsequently, control health hazards already within the country; and

- Certify agricultural and food exports for compliance with requirements of importing countries.

6. Crucial attributes of SPS management needed to support the enforcement of SPS measures include:

- Legislation and institutional frameworks to effectively enforce and implement measures;
- Diagnostics and testing to support detection and certification activities;
- Quarantine facilities to support border protection; and
- Capacity for analysis to properly evaluate levels of risks to (a) inform decision and policymaking; and (b) provide scientific basis for SPS measures on imports and to validate SPS measures of exporting countries.

Surveillance and Monitoring

7. Surveillance and monitoring activities are especially important for countries with long porous borders, such as Lao PDR, where border controls are not the most effective or cost-efficient method to manage agricultural and food hazards. Surveillance and monitoring activities rely heavily on capable and efficient diagnostic laboratory support (at home or abroad). These should have capacities to perform physical, microbiological, and chemical analyses, which require significant investments for facilities, equipment and supplies, and human resources.

8. A well-equipped surveillance and monitoring operation will help detect and subsequently help control potential hazards. The operation will provide data and information on pests, diseases, and harmful substances that will make significant contribution to the following:

- Guiding policy makers on adopting appropriate measures, priority setting, and resource allocation;
- Providing input for risk analysis; and
- Complying with requirements of trading partners for information on the pests and diseases situation.

9. ***Surveillance in food safety.*** Food surveillance is "the continuous monitoring of the food supply to ensure consumers are not exposed to components in foods, such as chemical contaminants or biological hazards, which pose a risk to health."[1] Hazards to food safety include pathogens such as bacteria, viruses, and parasites; chemical residues (for example, residues of agro-chemicals such as pesticides, veterinary drugs, and mycotoxins); and filth.

10. An effective national food safety program is characterized by its integration with the public health system, thereby establishing a link between food contamination and food-borne

[1] Food and Nutrition Paper No. 76 (FAO 2003).

diseases.[2] Public health laboratories that examine epidemiological aspects of food-borne diseases are generally outside the food safety agencies, but cooperation and information sharing between epidemiologists and microbiologists are necessary.

11. ***Surveillance in plant health.*** Basic to establishing phytosanitary measures is pest surveillance — gathering of information on the pest situation in a country or region within a country. Pest information is increasingly important for market access. More and more, trading partners like China and OECD countries ask Lao PDR for provision of data on the pest situation. Non-compliance can block market access and adds to the risks faced by investors.

12. Countries must also protect their ecosystems by monitoring agricultural inputs such as seeds and planting materials. With growing commercialization, the entry risks from damaging pests through seed and planting material are also increasing. Also, sub-grade and forbidden agrochemical products and formulations might enter from neighboring countries or be illegally made or used by domestic blenders. Preventive activities include regulating entry of seeds and planting materials,[3] surveillance and control of agro-chemicals used in production such as pesticides[4] and fertilizers, and monitoring of chemical residues in agro-produce.

13. ***Surveillance in animal health.*** The main task of veterinary services is the prevention and control of animal and fish diseases that impact on domestic income (livestock losses), human health (zoonoses), and trade. Animal health authorities carry out this responsibility by surveillance and monitoring of animal diseases to enable early detection of diseases, and by interventions in cases of outbreaks and detection.

14. In recent years there has been strengthened emphasis on the relation of animal health management and the protection of public health. The *Office International des Episooties* (OIE), in cooperation with the Codex Alimentarius Commission, promotes the role of the veterinary services in food safety and elaborates on its dual responsibility — monitoring and gathering epidemiological information (inspection of animals, both aquatic and terrestrial) and ensuring safety of animal products.

15. Likewise, in cooperation with the private sector, veterinary authorities have a role in enabling market access by ensuring safety and safe use of veterinary drugs and antimicrobials in animal husbandry. Animal feed is another component of the food chain that has implications on both animal health and public health, therefore its safety and safe use should be monitored accordingly.

[2] The term "food-borne diseases" generally refers to diseases caused by pathogens that are commonly food-borne although diseases may result from other vectors such as water. Diarrheal diseases, for example, may be food-borne, water-borne, or transmitted person to person.

[3] *Guidelines for a Phytosanitary Import Regulatory System*, International Standards for Phytosanitary Measures No. 20 (IPPC 2004).

[4] In Lao PDR, a pesticide survey conducted by FAO Integrated Pest Management (March 2009) in Sayabouly and Xiengkhouang provinces found that WHO-rated Class 1b pesticides (highly hazardous technical grade active ingredients of pesticides) are still available in shops and being used in vegetable production.

Building SPS capacities in Lao PDR

16. The 2006 Diagnostic Trade Integration Study for Lao PDR[5] recommends that improved capacities for SPS measures are needed (a) to gain and maintain market access and (b) to better protect consumers, crops, and livestock against trade-related hazards. This was followed by successive work on the SPS capacities of Lao PDR:

- The 2006 SPS Action Plan provides an initial assessment of public and private SPS capacities and specific recommendations for various aspects of management of SPS activities in Lao PDR.[6]

- In 2008, the Standards and Trade Development Facility, in collaboration with the Aid for Trade initiative, undertook regional consultations that included Greater Mekong Subregion (GMS) countries of Cambodia, Lao PDR, and Vietnam.[7] The work examined the supply and receipt of SPS-related technical cooperation with the aim to improve delivery of donor assistance.

- A 2009 World Bank report[8] implemented one of the recommendations of the Lao PDR SPS Action Plan to study SPS requirements faced by Lao agricultural exports and imports from both the Lao Government and trading partners. The study draws attention to the growing requirement of trading partners for information on the pest and disease situation as a requisite for trade, further underscoring the need for Lao PDR to continue improving its SPS capacity. The report recommends an assessment of the minimum public funding needed to sustainably fund SPS capacities.

- A 2010 Asian Development Bank (ADB) SPS Action Plan proposes capacity building and cooperation among the GMS countries as part of the ADB trade and transport facilitation initiatives program.[9] Some of the proposed actions pertain to surveillance and diagnostic activities in food safety, plant health, and animal health.

17. The Government of Lao PDR has been making efforts to build SPS capacities. External assistance has been provided for investment and training. A multi-donor trust fund created the Trade Development Facility to help implement the Integrated Framework Action Matrix. One component, with an allocation of US$1.6 million, supports SPS capacity building on formulation of legislations and regulations, and training and application of risk management principles.

18. However, it is not sufficient for donors to provide, for example, initial laboratory equipment and training. There are considerable operational costs to SPS activities, particularly in surveillance, testing, and diagnostic activities. Improvements will only be sustainable if the level

[5] *Building Export Competitiveness in Laos* (World Bank 2006a).
[6] *Lao PDR Sanitary and Phytosanitary Standards Management: Action Plan for Capacity Building* (World Bank 2006b).
[7] Greater Mekong Subregion is comprised of Cambodia, Lao PDR, Myanmar, Thailand, Vietnam and the Yunnan Province Guangxi Autonomous Region of the People's Republic of China.
[8] *Lao People's Democratic Republic: Sanitary and Phytosanitary Measures – Enhancing Trade, Food Safety, and Agricultural Health* (World Bank 2009).
[9] *Action Plan 2010-2015 for Improved SPS Handling in GMS Cross-Border Trade* (ADB 2010).

of public funding is adequate to make use of the new investments and skills created through donor assistance. Inadequate public funding limits absorptive capacity for external support. An obstacle for this is that Government decisionmakers have little knowledge about the tasks to be performed and the costs involved. This study report seeks to provide guidance on expanding the current scope of SPS surveillance and diagnostic activities, and assessment of pertinent costs.

II. Scope and Methodology

19. The study focuses on surveillance and diagnostic activities that include the collection of samples, diagnostics of pests and diseases, and testing of safety of agricultural and food products and agricultural inputs. Inasmuch as the focus is more on gathering of information and less on adoption of good practice, or enforcement of and compliance with regulations, this study does not include inspection of food factories, marketplaces, slaughterhouses, and other establishments, although some samples needed could be collected during such inspection activities. The establishment of databases of information gathered from surveillance and monitoring activities is likewise included.

Scope -- Surveillance and diagnostic activities

20. Primary sanitary and phytosanitary (SPS) institutions are situated in the Ministries of Health (MOH) and Agriculture and Forestry (MAF). The Department of Agriculture (DOA) and the Department of Livestock and Fisheries (DOLF) of MAF are responsible for plant and animal health, respectively. Food safety, however, is a shared responsibility among various offices of both MOH and MAF. Under the MOH, the Food and Drug Department (FDD) is responsible for processed or semi-processed food products and shares the responsibility for the management of food-borne diseases with the MOH Hygiene and Prevention Department (HPD). The proper use and safe levels of pesticides in food products, safe formulations of fertilizers and pesticides and the presence of heavy metals and other pollutants in soils and fertilizers are shared concerns of the FDD with the DOA. Likewise, safe use and levels of veterinary drug residues, proper formulation of veterinary drugs and animal feed, and safety of animal and fish products are food safety concerns shared with the DOLF.

21. The following agencies provide support to relevant surveillance and monitoring activities:

- Food and Drug Quality Control Center (FDQCC) under FDD;
- National Center Laboratory for Epidemiology (NCLE) under HPD;
- Plant Protection Center (PPC) under DOA; and
- National Animal Health Center (NAHC) under DOLF.

22. The following specific activities fall under the jurisdictions of these departments and laboratories:

***FDQCC/FDD and NCLE/HPD*:**

- General surveillance of processed food products in markets
  - Tests for microbiological pathogens, and
  - Tests for chemical contaminants such as heavy metals, mycotoxins, and pesticide residues;
- Surveillance of food-borne diseases;
- Readiness for outbreaks of food-related illnesses; and
- Data and information management on food safety.

PPC/DOA:

- Crop pest surveillance and diagnostics;
- Pest identification;
- Post-entry quarantine of seed and plant materials;
- Surveillance of pesticide residues in unprocessed and primary processed agricultural products;
- Surveillance of quality and formulation of pesticides in markets and on farms;
- Surveillance for heavy metals in soils and fertilizers;
- Readiness for outbreaks of plant pests; and
- Data and information management of safety of plant products, pesticides and fertilizers.

***NAHC/DOLF*:**

- Surveillance of OIE-listed animal diseases such as foot and mouth disease (FMD), classical swine fever (CSF) and highly pathogenic avian influenza (HPAI);
- Diagnostic testing of OIE-listed animal diseases;
- Surveillance and testing of safety of animal and fish products;
- Surveillance of animal and fish products for residues of veterinary drugs;
- Surveillance of quality and formulation of veterinary drugs in markets and farms;
- Surveillance of safety of animal feed;
- Readiness for outbreaks of animal and zoonotic diseases through vaccination programs of the major contagious diseases;[10] and
- Data and information management of animal health, animal products, feed, and veterinary drugs.

Cost items

23. A core assumption of the study is that fundamental SPS capacities such as legislations and institutions have been or are being put in place with support of public funding from donors. The same assumption is made for capital investments for diagnostic and testing activities — specifically that facilities such as laboratories and certain equipment are already or will soon be available and operational. Moreover, general expenditure items that are part of regular public budget for laboratories such as utilities, and salaries of staff are not included.

24. In summary, assessments in this study report do not include the following expenditures:

- Capital expenditures on buildings, laboratories, testing, and diagnostic equipment;
- Upgrade of laboratory facilities;
- Complementary appliances such as air-conditioning or a back-up generator;
- Investment expenditures in data and specimen storage systems;
- Depreciation of equipment and building;
- Utilities such as water, power, gas, telephone, and internet;
- Glassware, instruments, and non-disposable laboratory supplies; and
- Salaries of staff.

[10] Discussion in Chapter VI differentiates between diseases that may be financed by the public and private sectors.

25. The premise is that the level of existing surveillance activities is small in all three areas of food safety, plant health, and animal health. This study assesses the additional operational costs that would be incurred if surveillance activities (and necessary diagnostics and testing) would be expanded in the areas recommended in the next chapters.

26. These additional operational costs primarily consist of the following:

- Transportation and purchasing costs for sample collection;
- Costs of chemical reagents and solvents;
- Costs of outsourcing of tests;
- Calibration and maintenance of laboratory equipment;
- Maintenance of information systems;
- Participation in proficiency testing schemes and training; and
- Cost of accreditation services for diagnostic activities.

27. *Consistency with the annual cycle.* The assessment recognizes and incorporates the annual budget cycle of activities consisting of:

(a) Design of monitoring and surveillance programs (including sampling design);
(b) Collection of samples;
(c) Subsequent diagnostics, testing, and analysis of samples; and
(d) Storage of data in systems, analysis, and reporting of findings.

28. *Consolidated budgets.* The assessment does not include consolidated SPS budgets for two basic reasons. The departments and agencies have no financial autonomy, and many items are paid on different administrative levels (such as salaries, maintenance of buildings, special budgets); and the departments and specialized agencies have many other major tasks that are not SPS related. Moreover, depreciation is not accounted for under Government accounting practices. Given the amount of work involved, estimation of consolidated SPS budgets was beyond the scope of this study; instead it was decided to focus on the needed expansion of operational costs of departments and pertinent specialized agencies.

29. *Time frame.* Expanding capacities can only be done selectively and gradually because of the small size of Lao PDR, as well as its limited resources and limited absorptive capacities. The focus is on basic capacities that can be achieved in the next 5 to 7 years. This excludes the creation of pest-free and disease-free areas and compartmentalization since it presumes qualitative and quantitative capacities that are beyond what can realistically be put in place in this period. It also excludes for this period the deployment of sophisticated equipment for expensive specialized testing and advanced diagnostics.

Methodology

30. Assessments were made based on information from three sources:

Estimates by technical staff from the SPS agencies in Lao PDR. Technical staff of the different SPS agencies identified pertinent cost items and their respective prices for the various activities they are carrying out.[11] The main limitation for this information is that for many areas, especially modern laboratory methods, no capacities exist in Lao PDR from which data can be derived. Also, at the time of the interviews technical staff had no readily available price information for a number of chemicals and other inputs, and some robust approximations are made.

Experiences of Thailand and Vietnam. Teams of Lao specialists and World Bank consultants and staff visited Thailand and Vietnam with the aim to observe some of the SPS capacities in these countries, to learn from experiences in funding their system, and to collect information on some cost elements, especially laboratory tests. The level of laboratory fees for testing in Thailand and Vietnam (see Annex B) is important for calculating cost of testing in Lao PDR. First, the fees provide an indication of cost levels in well-established laboratories in the region, and, second, purchasing these tests for fees can be an alternative to conducting tests by laboratories of Lao PDR agencies.

Estimates of the use of sophisticated laboratory equipment. In close cooperation with international laboratory specialists (Maria Beug-Deeb, Upali Samarajewa, and Tom Deeb, independent consultants), information was collected from different sources to arrive at stylized estimates for the costs of use of expensive laboratory equipment (see Chapter III and Annex A).

[11] Information and estimates are presented in Annexes C, D, and E.

III. Issues and Estimates of Costs of Laboratories and Testing

31. Analyses of microbiological and chemical substances are undertaken using either rapid test kits or conventional laboratory tests.

Rapid test kits

32. Rapid test kits with independent evaluation of their efficacy are available for many biological, chemical, medical, and veterinary tests. The function of test kits is to indicate the presence or absence of a certain contamination or substance in a sample. In case of a positive result, a conventional laboratory analysis may be required to measure the exact concentration of the tested substance. The kits can be employed at field sites, in markets, and laboratories.

33. These kits are sold in packages that contain 10-50 units or more, of which individual costs are usually in the range of US$7-10. Some tests cost very little — about US$3 per test for pesticides residue test kits from Thailand and Taiwan used by the Plant Protection Center (PPC) in Lao PDR. Rapid tests for aflatoxin, vomitoxin, and zearalenone are about US$15 per test.[12] Actual costs for the user may be 20-50 percent higher because of cost of shipping, spoilage, and the short shelf life of the rapid test kits.

Quantitative testing

34. Conventional chemical testing of food, feed, and agro-chemicals is still partly done by so-called wet laboratory methods; but nowadays it is mostly carried out by modern equipment. High performance liquid chromatography (HPLC), gas chromatography (GC), and atomic absorption spectroscopy (AAS) equipment are most commonly used for testing pesticides, veterinary drugs, heavy metals, and mycotoxins. These types of methods can perform most of the tests needed by regulators and industries. They are available in robust and more advanced versions, for low and high throughput. But their common characteristics have the following requirements:

- Uninterrupted electricity supply and an air-conditioned environment;
- Calibration and maintenance by specialists; and
- Expensive chemicals and standards.

35. These equipment are built for high volume of tests; when used for low volume workloads, the costs of chemicals per test increase and skills of staff erode. Although each piece of fitted equipment using these methods can be used for many purposes, there are important trade-offs for changing the set-up of equipment for different kinds of tests. It involves costs, requires experienced staff, and can result in damage to the equipment and false negatives or false positives if not done correctly. Therefore, multiple testing is not recommended in many developing-country situations where staff may be poorly skilled. In most cases where there are skilled staff, the volume of samples is sufficient to have similar equipment running in parallel for different tests.

[12] Information provided by Tom Deeb.

36. The actual operational cost will depend on the type of equipment, the tests performed, and the cost level of the country. Countries with so-called low-cost environment have good local services available for maintenance and calibration and have competitive markets for supplies. In contrast, high-cost environment countries may have to fly in specialists since local options are not available or more expensive. Also, their consumables are 25 percent or more expensive than in industrialized countries. For example, cost levels in many areas in India tend to be low; and in poor ASEAN countries and Africa, they appear to be relatively high. In some poor countries costs of some facilities may be prohibitively high.

Cost estimates

37. Assessments for this study report were made in cooperation with laboratory specialists. Details of derivations are presented in Annex A. This study assumes a workload of 500 tests as the minimum number of tests in a year to maintain proficiency of staff and to make efficient use of advanced equipment and facilities. Also, in practice one sample may be subjected to more than one test but for a simplified estimation of costs, the study assumes one sample to correspond to one test unless otherwise indicated.

Operational cost for equipment

38. Estimates were made of stylized operational costs of a piece of equipment (with a workload of 500 tests) using testing methods that require low levels of chemicals, for low- and high-cost environments (see Annex A, Table A-1). The estimated operational cost per test is between US$50 and $62.[13]

Operational costs for a chemical food laboratory

39. Stylized assessment for a high-cost environment was used to assess the minimum operational cost for a chemical food laboratory that can test for mycotoxins, and residues of veterinary drugs, pesticides and metals (see Annex A, Table A-2). The total operational cost for such a laboratory — with 5 HPLCs, 1 gas chromatography–mass spectrometry (GC–MS), and 1 inductive coupled plasma–mass spectrometry (ICP–MS) — would be about US$270,000. For laboratories in a low-cost environment, the minimum operational cost might be about US$220,000.

40. *Varying sizes of laboratories*. The food chemistry laboratory indicated above may not be the best choice for small less-developed countries that are starting to build their laboratory capacity. The number of tests that can be funded for different areas of food safety is usually much lower than a minimum workload of 500. Much depends on requirements for export and domestic health risks that Governments are willing to address. In such cases, a few priority areas might warrant expensive equipment while using rapid test kits and sending a limited number of samples abroad for verification could work for other areas. With increased income and exports, demands for laboratory services could increase and more funding for more testing areas could become available. Countries with larger populations can in any case afford to establish bigger laboratories than smaller countries. Operational costs for small, medium, and large laboratories

[13] If charges for labor, overhead, utilities, and depreciation are added, the costs would probably be similar as the fees charged in Thailand and Vietnam for pesticides residues (about US$100 per test).

were estimated to be US$78,000; US$217,000; and a maximum of US$630,000, respectively (see Annex A, Table A-4).

Agrochemicals testing

41. Testing quality and composition of pesticides and veterinary drugs requires the same kind of equipment as testing for residues in food. Although there are differences in sample preparation and standards used because of differences in concentration, the operational cost would be about the same as for residue testing (US$50–62 per test at a workload of 500 tests per year).

42. It is important to note that because of risk of cross-contamination there are major obstacles to using the same facilities for testing residues and for testing composition of agrochemicals. Risks of cross-contamination are highest in the sample preparation phase, which therefore requires separate rooms. The risks of cross-contamination in the testing phase can be mitigated at very low sample volumes, provided that special precautions are taken. Although it is technically possible to use the same equipment for the tests, the advantages are doubtful and may not balance the risks related to cross-contamination, the higher maintenance requirements, and possible damage to the equipment. When cross-contamination does occur, the impact of false positive results would not only damage the laboratory's reputation but could also lead to removal of valuable shipments and damage trade. If only limited equipment is available, a better option would be to share equipment for different trace methods. At high sample volumes of testing, utilizing separate sets of equipment is the superior solution; and at low volumes, outsourcing to a bigger laboratory (abroad) may be a safer and cheaper option.

Chemicals in soils and water

43. Soils and water polluted by toxic chemicals, such as heavy metals from mining and industrial waste, can form a risk for contamination of the food chains. Provided that cross-contamination is prevented, testing for most metals can be done by the same AAS equipment used for testing residues in food. Costs for both tests would be comparable.

Food microbiology testing

44. Basic microbiology testing for food safety and related human health requires less expensive equipment compared to chemical testing. Only the more advanced microbiology laboratories will employ expensive equipment. Hence, the operational costs for basic testing laboratories are relatively low and will depend on the number of parameters a laboratory can test. Although 500 tests per year should be considered a minimum for maintaining proficiency of staff, the minimum number of tests per parameter will be less critical for food microbiology testing than for chemical food testing with expensive equipment. This means that a microbiology laboratory with a smaller number of parameters might operate sustainably at an annual minimal operational cost of US$90,000–100,000 (See Annex A, Table A-5).

45. *Microbiological contaminants in soils and water*. Microbiological laboratories can test for microbiological contaminations in soil and water at costs similar to tests on food.

Veterinary testing

46. Veterinary testing includes a large array of chemical, microbiological, viral, and parasitological tests. Rapid test kits are widely used for screening. Diagnostic tests can be relatively cheap for areas of microbiology and expensive for virology. Most veterinary tests in developing countries are done for and by the public sector only, with exceptions for big commercial poultry and pig farms.

47. Cost of testing for highly pathogenic avian influenza (HPAI or H5N1) is high. The cost of consumables for polymerase chain reaction (PCR) and enzyme-linked immunosorbent assay (ELISA) for a small laboratory is estimated at about US$150,000.[14] If costs for calibration, proficiency testing, training, and literature are added, the annual cost would be about US$175,000. For the diagnostic veterinary laboratory in Vietnam, the fees of tests on Newcastle's Disease, HPAI, and foot-and-mouth disease (FMD) using ELISA and reverse transcriptase polymerase chain reaction (RT-PCR) range between US$20 and US$35 (see Annex B, Table B-2). Testing for antibodies and bacteria is generally cheap.

Testing animal feed

48. Testing the nutritional composition of feed is practiced to protect farmers and fish growers against fraudulent practices of traders. This is not part of SPS. Testing the chemical and biological safety of feed, however, is important for assuring food safety and animal health. Most of the chemical and microbiological parameters to be analyzed are the same as for food safety. These include contamination with pesticides, veterinary drugs, heavy metals, and mycotoxins. Since there are in most cases no serious risks for cross-contamination at the testing phase, the same equipment can be used as for food; and it is recommended that in countries with low sample volumes no duplicative equipment should be installed for food and feed. The costs of tests will be the same as for food testing. However, at the sample preparation, risks of cross-contamination may need to be controlled by using separate rooms.

49. Tests for some zoonotic feed safety parameters, however, may be conducted at veterinary laboratories that have the necessary expertise. Similarly, testing for safety of medicated feed might be done by the laboratory specialized in composition of veterinary drugs.

Safety of animal products

50. Most safety parameters of animal products can be analyzed in chemical and microbiology food laboratories since they are the same and there is no risk of cross-contamination. At low sample volumes it is therefore important to use capacities in the food safety laboratories. The costs will be the same as for other food testing.

51. Tests for some zoonoses, however, may better be taken care of by veterinary laboratories (or in some cases public health laboratories).

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[14] Communication by Tom Deeb, T&M Associates, and estimation by World Bank in Lao PDR.

Accreditation

52. Accreditation of laboratories by the international standard ISO 17025 is a common requirement for most products for recognition of tests in international commercial and government-to-government relations. In developing countries there is little demand for accreditation in domestic markets and traditional export markets, and public and private clients usually do not want to pay for the cost. Recognized accreditation bodies provide the accreditation for those parameters for which standards have been met. The annual cost for subscription for accreditation might add another US$1,000 per parameter to the total cost of the tests depending on the number of parameters. More basic in quality management of laboratories is to have an annual budget for training and literature, and to participate in an international scheme for proficiency testing. In particular, through participation in proficiency testing, staff and management of a laboratory can check their own performance at a cost of about US$1 per test. At the present situation with low volume of tests and clients with low requirements, accreditation is not so urgent, all the more reason because exporters have easy access to accredited laboratories in neighboring countries or countries of destination.

IV. Operational Costs of Food Safety Tasks of Ministry of Health

53. Food safety management in Lao PDR is a shared task of various ministries. The Ministries of Health (MOH) and Agriculture and Forestry (MAF) are responsible for monitoring of processed food and unprocessed agricultural products, respectively. Within the Ministry of Health, two departments, with corresponding laboratories, are involved in food safety activities: the Food and Drug Department (FDD) with its Food and Drug Quality Control Center (FDQCC), and the Hygiene and Prevention Department (HPD) with its National Center Laboratory for Epidemiology (NCLE).

Current activities

54. ***Food safety.*** Monitoring of food products for contaminants or chemical residues consists of regulatory inspections of food establishments by MOH, including testing food sample for purposes of certification or registration. The FDQCC also issues health certificates for exported foods. Its Food Laboratory Division performs limited microbiological and chemical tests on food products, mostly on bottled water, as a regulatory requirement. The safety of unprocessed animal products, including fish, is under the jurisdiction of the Department of Livestock and Fisheries (DOLF) and will be discussed in Chapter VI.

55. In 2008, of the 456 tests done on food products, more than half (64 percent) were on drinking water (Table 4.1):

Table 4.1. Tests on food products by FDQCC in 2008

Drinking water	292
Other drinks	56
Salt	23
Bakery products	18
Raw fish	11
Other food	56
Total	***456***

Source: FDQCC

56. The FDQCC has the capacity to carry out microbiological tests for total bacteria count, salmonella spp, shigella spp, vibrio cholerae, vibrio parahaemolyticus, e. coli, coliform, staphylococcus aureus, and yeast and molds. However, with the low volume of tests at FDQCC, proficiency suffers. At present, the FDQCC is able to perform chemical tests for formaldehyde, borax (qualitative), and food coloring (qualitative). Testing for heavy metals, mostly done for bottled water, requires the use of atomic absorption spectroscopy (AAS), which the laboratory does not have, therefore samples are sent to the Water Supply Laboratory of the Ministry of Transportation and Communication (MTC). The FDQCC has no capacity for virology.

57. ***Food-borne diseases.*** The HPD is responsible for the surveillance and clinical analysis of food-borne illnesses. Food-borne disease surveillance is passive and syndromic. Hospitals and outpatient centers report incidents of illnesses with symptoms of food-borne diseases (mainly

diarrheal). Further tests and information gathering to determine cause are performed only in cases of outbreaks.

58. The NCLE performs epidemiological tests on human samples sent by seven hospitals in the Vientiane area. The tests are done not as part of a regular surveillance system but as requested by the hospitals (and, in certain cases, by private individuals who seek their assistance). The NCLE performs tests on samples from provinces only when there are outbreaks or upon requests of assistance by provincial hospitals. At present, NCLE does tests on salmonella spp, shigella spp, e.coli 0157, vibrio cholerae, and staphylococcus.[15] The weekly reports on tests performed by NCLE are submitted to HPD; also monthly and yearly summaries are prepared.

59. The FDQCC and NCLE use guidelines of the Ministry of Finance for their fees.[16] Fees for microbiological tests range from 70,000 Kip (US$8) to 200,000 Kip (US$24) depending on the type of microorganism. The guidelines list fees for tests for which FDQCC only recently acquired basic capacities, which include 800,000 Kip (US$94) for mycotoxins and1,500,000 Kip (US$176) for pesticide residues using gas chromatography (GC). Table C-1 (Annex C) shows fees charged by FDQCC to the private sector for the various tests.

60. For human specimens, NCLE charges 30,000 Kip (US$4) for a test on stool, urine, sputum, etc. If the test requires a culture, there is an additional fee of 135,000 Kip (US$16).

61. ***Donor support.*** Several donor projects provide support. The United Nations Industrial Development Organization (UNIDO) is assisting in the accreditation of the microbiology laboratory. Among the components of the NZAID/FAO/WHO-supported Food Safety Project, the preparation of the National Food Safety Action Plan 2008-2013 will provide guidelines to implement strategies of the National Food Safety Policy. It includes a Contaminant/Residue Monitoring Program to be implemented in the medium to long term. Also, capacities for active surveillance in the event of an outbreak are being put in place. A standard operating procedure is being drafted on the coordination between the NCLE and FDQCC in the event of an outbreak, and questionnaires are being prepared for patient interviews. In 2009 FAO assisted in the training for pesticide and mycotoxin residue testing. However, there is no significant workload for these tests yet.

Recommended activities and estimated costs

62. This section describes recommended activities and the estimated costs, which are summarized at the end of the section in Table 4.2.

63. ***Monitoring and surveillance.*** There is need to collect more systematic information on food hazards in the country. A relatively cheap way is to carry out surveillance by using rapid test kits for common hazards such as illegal use of disinfectants, microbial spoilage, mycotoxins, and pesticides. To monitor for pesticide residues, the Plant Protection Center (PPC) of the Department of Agriculture (DOA) aims to conduct 1,200 tests on fruit and vegetables (discussed

[15] MOH gathers data on hepatitis (viral) occurrences, but these are not usually considered as food-borne.
[16] Decree of the President of Lao PDR on the Promulgation of the Charges and Fees Law (amended in 2008) (Ministry of Finance, Decree No. 03/PO, November 19, 2008).

in Chapter V). The FDQCC could aim at 1,300 tests at an average estimated cost of US$10 for a total cost of US$13,000.[17] The focus should be guided by proven and perceived risks.

64. Positive samples could be sent to FDQCC and other laboratories for confirmative testing for which about US$5,000 may be needed in additional cost for tests described below. Moreover, while applying rapid tests in the field, it could be efficient to collect samples for conventional tests on some other parameters, such as in the area of microbiology, parasites, and chemical residues. The additional cost of collecting samples would also be incorporated into the total expenditure; US$4 per sample may cover costs of travel, transport, and purchase of products for a total of US$5,200 (for 1,300 samples).

65. ***Microbiology testing.*** In order to build proficiency and make accreditation sustainable, the number of food samples should be increased to 500, excluding tests on bottled water. Assuming that, in general, 5 microbiological tests are being done per sample at a cost of US$10 per test,[18] a total budget of US$25,000 (500 samples at US$50 each) is needed. The cost of collecting samples would be about US$2,000 (500 samples at US$4 each).

66. ***Pesticide residue testing*** The proposed creation of pesticide residue testing, which FAO is supporting, will have major implications on operational budget requirement. There are 4 groups of pesticides: organo-phosphate, organo-chlorine, synthetic pyrethroid and carbamates.[19] The tests for the first 3 groups make use of gas chromatography (GC) and the carbamates group makes use of high performance liquid chromatography (HPLC), which FDQCC acquired at the end of 2009.[20] Taking into consideration the fees charged in Thailand and Vietnam (Annex B, Table B-1), and the fee in the FDQCC price list (Table C-1), it can be assumed that the operational cost for testing for residues on the GC for any of the first 3 groups of pesticides would be about US$100 per sample,[21] and about US$180 per sample for any 2 groups.[22] Testing 500 samples for carbamates at the HPLC would also cost about US$100 per sample. Assuming that on the GC testing 250 samples are tested for one group and another 250 for two groups, the total cost for the GC would be about US$70,000, and the cost of 500 samples for the HPLC would be about US$50,000.[23] Moreover, in this case probably about 750 samples every year would be required at an additional cost of about US$3,000.

67. However, it is uncertain whether this level of funding is achievable in the near future. An alternative, intermediate solution would be to keep the capacities limited in the short term by having 500 GC tests (for pyrethroids, organo-phosphate and organo-chlorine groups) for which

[17] The market price for test kits can range from US$3 per test for pesticides to US$15 per test for aflatoxin (Chapter III).
[18] Author's estimate based on NCLE data (Part E, Annex C).
[19] Some herbicides may also be identified with the present capacities for pesticide residue testing.
[20] An informal estimate by FAO project consultant provides the costs of reagents to test 500 samples for the various groups. The costs range from US$4,925 to US$28,905 (Table C-4). The estimation does not include cost for calibration and maintenance of GC and HPLC, additional calibration of balances, costs of selective participation in proficiency testing schemes, and continued need for training and literature.
[21] Fee based on Thailand fees (Table B-1, Annex B), which are US$91, US$106 and US$121.
[22] Based on fee of US$152 for 2 groups provided by Central Laboratory Thailand (Table B-1, Annex B) and Lao fees (Table C-1, Annex C), which is US$176 for organo-chlorine and organo-phosphate.
[23] Given the consideration of testing half the samples for 1 group and the other half for 2 groups, 750 samples may be required to keep proficiency for each test.

the costs would be US$70,000 for testing and US$2,000 for sample collection. If the number of samples that can be funded drops significantly below 500, it would be better to send samples to Thailand or Vietnam for testing.

68. Given the low level of fruit and vegetable exports and the low demand for tests domestically, separate testing facilities for pesticide residues at both FDD and DOA might not be justified. Thus, an arrangement is needed between the FDA (food safety) and DOA (agricultural products), especially if tests are for unprocessed agricultural exports that would require DOA certification.

69. ***Mycotoxins testing*** Public health authorities would benefit from better information about health hazards from mycotoxins. The need for mycotoxin testing by Lao agribusinesses is mixed. Coffee exporters test in Vietnam or Thailand and do not face any major problems. The maize industry, on the other hand, faces problems with mycotoxins in exporting to neighboring countries, and mycotoxins in maize also cause domestic health risks through animal feed and by direct consumption. Peanuts and other such products may also have mycotoxin contaminations. Although both MOH and MAF have interest in testing for mycotoxins, the volume of tests is likely to be low and duplication of capacities is not justifiable. Testing can be done by using rapid test kits (about US$15) and conventional HPLC tests, which would require dual use of the new HPLC at FDQCC for pesticides and mycotoxin residues, or another HPLC for mycotoxins. Many specialists recommend separate HPLC equipment for pesticide residues and mycotoxins because the regular change of the set-up of the HPLC is technically difficult and would increase the risk of breakdown of equipment and cross-contamination.

70. Depending on the desired level of sophistication, fee lists from Thailand and Vietnam suggest that the cost per test would be about US$50 for robust testing and over US$100 for testing more detailed mycotoxin parameters (Annex B, Table B-1). The annual operational cost would be at least US$25,000 for 500 tests. An initial cost-effective method would be to do 500 rapid tests at US$15 and to send 100 samples to Vietnam or Thailand for further analysis. This would cost about US$7,500 in addition to US$5,000 per year, or in total US$12,500. The collection costs would add another US$2,000 to the 500 sample tests.

71. ***Heavy metals testing.*** Once Lao PDR sets up a system of monitoring and surveillance of food, it will need to add testing for heavy metals and a few other elements. At present FDQCC subcontracts testing of heavy metals in drinking water to the MTC laboratory. Problems with heavy metals can occur in processed and unprocessed food, feed, water, fertilizer, and soils. Hence, both MAF and MOH have interest in tests in this area. If the demand from these sources goes beyond MTC capacity, it may be best to acquire one additional AAS at PPC for multiple use (provided that experts will endorse such a solution) since there will not be enough volume to justify such equipment at both laboratories.[24]

72. Fees available from Vietnam and Thailand (Annex B, Table B-1) suggest that the cost per test parameter would be about US$30, which is US$15,000 per year for 500 samples. In addition, an operational budget for collecting 500 samples is estimated to be about US$2,000. Given the

[24] See section on "Surveillance of chemical contaminants in soils and fertilizers", Chapter V.

likely low volume of AAS tests on food, approximately 200 per year, it may be most cost-effective to subcontract to MTC, PPC, or other food laboratories in Thailand or Vietnam.

73. ***Food-borne diseases.*** The surveillance of food-borne diseases should be increased to 300 human specimens per year, which at an estimated cost of US$50 per sample would cost US$15,000 (Part E, Annex C).

74. ***Readiness for an outbreak.*** If a food-borne disease outbreak occurs, timely diagnostic tests would be critical for an immediate response to determine causes and to advise the public. It requires staff with experience and basic supplies of chemicals for regular testing. In addition, modest budgets are needed for travel and collecting samples. The present situation lacks readiness. A small regulation-driven workload, which is paid through fees by the private sector, and the lack of regular funds for FDQCC does not allow for building and maintaining capacities that could effectively be mobilized in the event of an outbreak of a food-related illness. A sufficient regular workload of monitoring, surveillance and testing will increase readiness for emergency responses in the event of emergencies and outbreaks. Part of the increased capacity and budget for sampling and testing could be earmarked for outbreaks if needed.

75. ***Management of data and information.*** Food safety information is an important output from surveillance and monitoring activities on food and food-borne diseases. Data collected should be put in a database and analyzed to evaluate levels and sources of risks (a qualitative risk profile) that would, in turn, contribute to policymaking on control measures and responses, and help authorities determine priorities. The cost of staff time and setting up of an information system, as indicated in the methodology (Chapter II), is not part of this study's reporting. However, maintenance of database and software would require an operational budget estimated at US$1,500 per year.

Table 4.2. Summary of costs for recommended activities at FDQCC and NCLE

	US$
General surveillance (1,300 samples)	**23,200**
Rapid tests	13,000
Sample collection	5,200
Confirmation testing	5,000
Microbiological tests (500 samples)	**27,000**
Tests	25,000
Sample collection	2,000
Pesticide residues - Variant 1	**123,000**
Quantitative tests	120,000
Sample collection	3,000
Pesticide residues - Variant 2	**72,000**
Quantitative tests	70,000
Sample collection	2,000
Mycotoxins - Variant 1	**27,000**
Quantitative tests (500 samples)	25,000
Sample collection (500 samples)	2,000
Mycotoxins - Variant 2	**14,500**
Rapid tests (500 samples)	7,500
Quantitative tests (100 samples)	5,000
Sample collection (500 samples)	2,000
Heavy metals (250 samples)	**17,000**

	US$
Tests	15,000
Sample collection	2,000
Food-borne diseases (300 samples)	**15,000**
Data management	**1,500**
Total (with Variant 2 recommendations)	***170,200***

V. Operational Costs of Plant Health and Related Food Safety Tasks of Ministry of Agriculture and Forestry

76. The Department of Agriculture serves as the National Plant Protection Organization for Lao PDR, and its Plant Quarantine Division is responsible for phytosanitary measures. Its Regulatory Division is responsible for control of pesticides. The Plant Protection Center (PPC) provides technical support through the conduct of pest surveys, and diagnostic and testing activities. The PPC houses the plant pest and disease reference collection and also has responsibilities for testing quality and safe use of pesticides and fertilizers, which is important for food safety in the food supply chains.

Current activities

Pest surveillance

77. Pest surveillance in Lao PDR is an ad hoc activity, carried out as part of donor assistance. AusAID supports recent surveillance activities for mango, and the NZAID Phytosanitary Capacity-Building Project for maize and cabbage.

Pest identification

78. Identification of pests is necessary for the development of pest lists (list of pests endemic in the country). Pests should be identified by order, by family, by genus, and by species. Pest lists require identification by species. Lao plant health authorities can generally identify only to genus level; identification by species is more difficult.

79. For pest identification, PPC staff consults with experts, especially those from Landcare Research, an environmental research organization in New Zealand. This free consultation is part of the NZAID phytosanitary project. Support for identification from Thai colleagues has not yet been sought.

Pesticide residue testing

80. The PPC does pesticide residue testing with rapid detection test kits, such as the Gobthong Thoophom (GT) test kit from Thailand or the rapid bioassay of pesticide residues (RPBR) test kit from Taiwan, for donor-funded projects or upon request of private agribusinesses for safety certification; the charge is about 70,000 Kip (US$8) per sample. In 2008, PPC tested about 150 samples, amounting to revenue of about 10 million Kip (US$1,000). The GT kit comes in packages of 30 tests, costing 600,000 Kip (US$71) or about US$2 per test. The GT kits can be used to test for organo-phosphates and carbamates.

Main gaps in capacities

81. Conventional testing capacities for quality of pesticides, residues of pesticides in plant products, mycotoxins, and chemical contaminants in fertilizers and soils are unavailable. The country has no post-entry quarantine for seed, propagation material, and other potentially risky plant products.

Recommended activities

82. A summary of costs of the recommended activities is shown at the end of this section in Table 5.1.

Pest surveillance

83. Authorities would like the PPC to be able to carry out pest surveillance as part of its regular responsibilities and not as an ad hoc activity. Given the demands of trading partners for acquiring information on the pest situation, this is a high priority. The number of field visits per crop depends on cropping patterns and empirical knowledge of important pests. For crops that grow in both dry and rainy seasons, surveys should be conducted in both seasons. Surveys are carried out in the main cropping areas.

84. Using PPC-provided data for this study, estimates were made of costs to undertake pest surveillance. A big share of surveillance costs are the allowances and travel expenses for plant health staff. Costs, likewise, depend on the type of crop (one-season or two-season crop). Estimated operational costs range from a low 110 million Kip (US$13,000) for a one-season crop involving 5 provinces to a high 494 million Kip (US$58,000) for a two-season crop involving 9 provinces (Annex D, Table D-3).

85. A reasonable task for the coming years would be to plan to carry out 2 one-season crop surveys. One survey would be conducted in 5 provinces and the other in 9 provinces with a budget of about US$42,000. In planning for cases of potential outbreaks, support for risk analysis, market access issues, and verification of previous findings, there should be a contingency budget of US$10,000 for ad hoc surveys. Increased surveillance and diagnostics should be supported by an increased operational budget of US$5,000 for laboratory supplies.

Pest identification

86. The PPC staff will do most pest identification routinely during surveys and at the laboratory. There is basic funding for routine diagnostic work, including taxonomy. However, staff will need external support for specimens that they cannot identify. Cost of support for pest identification from independent international centers such as the Center for Agricultural Bioscience International (CABI) will be expensive. Expertise from Australia, China, New Zealand, Thailand, and countries in the region may be less expensive alternatives. Modalities of support could be electronic exchange of images, visits by foreign specialists or visits by PPC staff to laboratories in other countries. An annual budget of US$5,000 (for pests that cannot be identified locally) might be a necessary expense and best managed by DOA and PPC.

87. There is no recommended additional budget for maintenance of the pest and disease specimen collection. Present facilities are operating at reasonable standards; and maintenance costs, primarily for utilities to support humidity and temperature requirements, are low and covered in current basic funding.

Post-entry quarantine

88. A post-entry quarantine unit is priority for Lao PDR. Since the expertise needed is in part similar to that of the plant diagnostic laboratory, the unit should be located at the PPC. The staff, which would require a plant pathologist, an entomologist, and a virologist, would conduct testing on perhaps100-200 imported samples per year and need an annual operational budget of US$3,000.

Pesticide residue testing

89. Because of the expected low volume of samples and high cost of conventional tests, there is room for only one laboratory in the country to have the capacity and be responsible for the quantitative testing of pesticide residues. Given existing capacities, the FDQCC has the capacity to be the lead agency for quantitative testing of pesticide residues. Depending on the importers' requirement, exporters may choose PPC (use of rapid test kits) or FDQCC (quantitative testing) to conduct tests for compliance;[25] although PPC would still have to certify for conformity.

90. The DOA through PPC may want to expand rapid testing activities by conducting its own monitoring of pesticide residues on unprocessed and primary processed products (for example on farms at pre-harvest or in certain markets). It may send positive samples to the FDQCC or to a laboratory in Thailand or Vietnam for confirmation and quantification. To test 1,200 samples would cost about US$3,000 for the test kits and US$4,800 for sample collection (Part B, Annex D). Assuming that DOA wants to send 150 samples to FDQCC for confirmation by conventional testing method, it should have an additional budget of US$100 per sample or in total US$15,000. An arrangement may have to be worked out between FDD and DOA over the issuance of conformity certificates. Also, in the event that PPC would request FDQCC to perform quantitative tests, a cost recovery mechanism might need to be established between the 2 agencies.

Surveillance of pesticide formulation

91. Sub-grade and forbidden substances readily circulate in the marketplace. Growers, traders, and consumers would benefit from monitoring and controlling the quality of pesticides available in the market and being used in farms. However, additional HPLC equipment would be needed for testing. And the chemicals needed for the test of pesticide formulation are expensive. There is no cheap option for rapid test kits. Cost of testing would be about US$100 per sample, and 500 samples per year would cost US$50,000. Collecting samples would require travel, transport, and purchase of products in the market. This may boost the cost to another US$5 per sample for a total of US$2,500. Sending samples to a neighboring country could be the more cost-effective option.

[25] Experience from other countries suggests that in case the private sector has free choice, main exporters might select laboratories in the country of destination. Similarly for Lao, neighboring countries have excellent laboratories that could be used.

Surveillance of chemical contaminants in soils and fertilizers

92. The most important parameters in testing soils and fertilizers for SPS are pollution with toxic metals. Pollution of soils can occur through waste from mining and industries, and sewage. Some fertilizers may have overly high contents of cadmium or other toxic elements. The AAS equipment is the most appropriate for testing. Given the likely intensity of use, the equipment might best be located at PPC where it may also offer tests for heavy metals in feed and food. Assuming that 500 tests would be conducted per year and that the cost per test is US$30 (see Annex B for fees in Thailand and Vietnam), the total cost for testing would be US$15,000.

Readiness for an outbreak

93. In the event of an outbreak of plant pests and diseases, it is imperative to have the capacity to confine the spread and minimize adverse impacts on crops. Part of the increased capacity and budget for surveillance and identification could be earmarked for outbreaks if needed.

Management of data and information

94. Data and information gathered from surveillance and monitoring activities is needed for DOA policymaking. It should be properly stored in a phytosanitary database and regularly analyzed. Although the set-up of the database and staff needed for data storage and analysis is not included in this study's assessment, maintenance of databases and software would require additional annual operational budget of US$1,500.

Table 5.1. Summary of costs for recommended activities at PPC

	US$
Pest surveillance	**57,000**
Two one-season crop surveys	42,000
Ad hoc surveys	10,000
Laboratory supplies	5,000
Pest identification (purchased)	**5,000**
Post-entry quarantine (100-200 import samples)	**3,000**
Pesticide residues	**22,600**
Rapid tests (1,200 samples)	2,800
Sample collection	4,800
Qualitative tests (150 samples)	15,000
Pesticide formulations	**52,500**
Tests	50,000
Sample collection (500 samples)	2,500
Heavy metals (soils and fertilizers) (500 samples)	**15,000**
Data management	**1,500**
Total	***156,600***

VI. Operational Costs of Animal Health and Related Food Safety Tasks of Ministry of Agriculture and Forestry

95. The Department of Livestock and Fisheries (DOLF) is responsible for veterinary services and safety of animal products in Lao PDR. The National Animal Health Center (NAHC) undertakes diagnostic testing. The NAHC also has responsibilities for testing quality and safe use of veterinary drugs and feed, which is important for food safety in the food supply chains.

Current activities

Animal health surveillance

96. There is active serological surveillance only for the highly pathogenic avian influenza (HPAI). For all the other diseases, clinical (passive) surveillance — suspected cases showing clinical signs of diseases are reported — and serological surveillance is done only with outbreaks or when there is a request from provincial authorities to investigate suspected cases. The DOLF relies on information and reports from farmers, veterinary village workers, and provincial livestock officers. (However, often the information comes too late when a number of animals have already been infected, making control more difficult). Samples of suspected cases are taken, tested, and confirmed through NAHC-performed laboratory diagnostic tests. For example, given the significance of HPAI, an average of 10,000 sera, 10,000 swabs, and 300 carcasses are tested in a year, with the cost of chemicals amounting to about US$130,000 (see Annex E, Table E-2), which is largely donor funded.[26]

Monitoring of animal and fish products

97. There are District Agriculture and Forestry Office (DAFO) livestock staff stationed at slaughterhouses to inspect live animals and meat products. Sick animals are removed from the premises. Meat products are inspected visually, for example, for parasites. If there is visual evidence of disease, the meat products are removed and sent to NAHC for formal tests. There is hardly any control on the safety of fish.

98. The Livestock Product Quality Assurance Unit also tests for safety certification for animal-based products for export, such as salted skin of buffalo and cattle. Laboratory testing capacities of biological and chemical contaminations for meat products are very limited.

Testing of animal feed

99. The Animal Feed Laboratory is a unit under the Livestock Farming Technical Standard Control Center of the DOLF. Currently, the laboratory tests for nutrients and chemical compositions of locally produced and imported feed samples (from China, Thailand, and Vietnam). It tests on average 1,100-1,300 samples in a year.

[26] There is multi-donor support for HPAI because of its significant threat to the country and region. In Lao PDR, there had been 18 reported outbreaks during 2006-2008 and 2 cases of human fatalities.

Main gaps in capacities

100. The DOLF does not have capacities to undertake testing for veterinary drug formulation,[27] and for microbiological and chemical contaminants (veterinary drug residues, heavy metals, and mycotoxin) in animal feed and animal products. At present there are no quarantine facilities.

Recommended activities

101. In general, early detection of listed animal diseases and rapid response would be beneficial to the country and various stakeholders. However, priorities among stakeholders are not necessarily the same. Neighboring countries want Lao PDR to strengthen its surveillance on priority trans-boundary animal diseases such as HPAI, foot-and-mouth (FMD), and classical swine fever (CSF). Such expanded capacities will also be beneficial to Lao farmers. However, priorities of neighboring countries are not necessarily a priority to all Lao farmers, many of whom may prefer increased help for diseases that affect livelihood income such as hemorrhagic septicemia, fowl cholera, and Newcastle's disease. Moreover animal health authorities may give special attention to re-occurrence of endemic diseases and the control of the introduction of new diseases such as Porcine Reproductive and Respiratory Syndrome (PRRS). Consequently, actual priority setting for increased surveillance is not easy and depends on many factors. Since increased surveillance capacities can be applied for different diseases, this assessment of operational costs will be partly indifferent to the annual priorities. A summary of costs associated with the following recommended activities is provided in Table 6.1 at end of this section.

Animal health surveillance and diagnostics

102. Notwithstanding that surveillance and corresponding diagnostics for the more prevalent diseases (HPAI, FMD, and CSF) are currently being undertaken with significant support from donors,28 it is recommended that a steady budget stream be made available to make sustainable use of capacities. The present budgets are very unevenly distributed.

103. Staff of the NAHC provided estimates of costs of diagnostic activities for the more high-impact diseases for specific number of samples (see Annex E for details). There are also estimates, using varying approaches, of costs to collect serological samples that, to a large extent, include allowances and travel expenses of staff. The cost of surveillance therefore depends on the frequency of surveys, extent of coverage, and the number of samples.

- ***HPAI.*** Estimation for HPAI involves many samples: on average10,000 sera, 10,000 swabs, and 300 carcasses in a year. The cost of consumables, maintenance, and proficiency tests is about US$155,000. Training costs an additional US$56,000. With the surveillance cost of US$82,000,[29] the estimated annual budget is US$293,000.

[27] The FDQCC does not have such capacities either.

[28] The Lao-Australia Animal Health Research Project that provided support to FMD and CSF activities officially ended June 2009.

[29] A sampling plan is made by a team of FAO-HPAI and NAHC staff. Ideally, there should be surveys every 3 to 6 months, however surveys depend on availability of budget and donor assistance.

- ***FMD and CSF.*** Assuming 1,000 sera samples, the cost for consumables is about US$26,000. The cost to collect samples, assuming 4 times in a year, is about US$11,000. Two training courses — for outbreak investigation and sample collection — cost about US$14,000. The total estimated cost for FMD and CSF is US$51,000.

- ***Bacterial diseases.*** Two scenarios were considered to estimate costs of diagnostic activities for the more damaging bacterial diseases such as hemorrhagic septicemia, anthrax, and Blackleg. A passive surveillance scenario using 20 carcasses and 100 organs has an estimated cost of US$4,000. The active surveillance scenario using 50 carcasses and 500 organs costs US$10,000.

104. If the budget for surveillance and diagnostics for FMD, CSF, and all other listed diseases would be the same as for HPAI — probably a realistic ambition — the annual budget would be US$82,000 for surveillance and US$155,000 for diagnostic activities.

Safety of animal- and fish-based products

105. Similar to the FDQCC, almost all NAHC-conducted tests on animal-based and fish and meat products are for regulatory private sector safety certification. This capacity should expand to allow for routine tests of animal and fish products for public health concerns. Since the likely number of samples of animal products is small, having parallel investments in expensive equipment at NAHC and FDQCC for testing residues of veterinary drugs, pesticides, mycotoxins, and heavy metals is not justifiable. It is recommended that NAHC takes responsibility for testing zoonoses and microbiological safety of animal products, which would cost perhaps US$10,000; other tests will be the main responsibility of FDQCC.

Testing for veterinary drug residues in fish and animal products

106. Testing for residues of veterinary drugs and antibiotics is expensive. Most products require HPLC; other groups require the more expensive ion-pair chromatography method.[30] An expensive option would be to invest in HPLC and test 500 samples per year, which would cost about US$35,000 (at US$70 per sample). The less expensive solution would be to use rapid test kits for the main chemical residues and to send part of the samples (about 200) to Thailand or Vietnam. Five-hundred rapid tests would probably cost about US$10,000, including related travel to markets and production sites. The cost of collecting the 500 samples and testing fees abroad would probably be about US$15,000, depending on the parameters.

Control of quality of veterinary drugs and vaccines

107. Due to risks of substandard and illegal products being traded and applied, there is need to build capacity for testing quality and composition of veterinary drugs. This requires the same kind of equipment as for testing residues. However, because of risk of cross-contamination, parallel sets of equipment and separate laboratories are recommended. There is no option for using rapid test kits. Whether samples are sent for testing in Thailand or Vietnam or tested by HPLC installed within the country may not make a big difference for a volume of only 500

[30] The purchase of an ion-pair chromatography application is not considered at this stage given its high operational cost.

samples per year. The ion-pair chromatography method is expensive, making it difficult to justify in this circumstance. Therefore, samples would have to be sent abroad. The total cost would be about US$35,000. At a sample volume lower than 500, testing abroad would be the cheaper option.

Monitoring of animal and fish feed

108. The DOLF should have capacity to tests animal and fish feed for biological and chemical contaminants on a regular basis. Safety tests on animal feed are mainly the same as for food. Given the small number of tests that can be expected in the foreseeable future, purchase of expensive equipment will not lead to sustainable use. If precautions are taken to prevent cross-contamination, feed samples can be tested at the FDQCC and PPC for pesticides, mycotoxins, and heavy metals. Alternatively, samples could be sent abroad. Responsibilities of NAHC would be to conduct tests on zoonoses, and medication and hormones used in feed. Some samples may be sent for testing to Thailand or Vietnam. Altogether, testing 300 feed samples for different parameters (pesticides, mycotoxins, heavy metals, pathogens, and veterinary drugs and growth enhancers) could cost up to US$200 per sample, or US$60,000 per year.

Prevention and readiness for outbreaks

109. Readiness and quick response should come naturally from staff experienced in surveillance and diagnostics. Effectiveness of veterinary village workers, and district and provincial staff depends on training, incentives, and motivation. Preventive actions and interventions — vaccination, animal movement controls, additional control measures on animal-based products and animals, and, in some cases, culling and destruction — are often necessary and sometimes required or expected by other countries. The NAHC staff listed amounts of vaccines for the more important OIE-listed diseases (hemorrhagic septicemia, anthrax, FMD, and CSF) and antibiotics that were actually in stock and the desirable amounts that should be in stock. In line with increased surveillance and needed capacity for response, the total value of stock should increase from about US$65,000 to about US$160,000 (Annex E, Table E-9). Since it is not likely that such a drastic increase can be achieved in the near future, a variant 2 is proposed of US$100,000 for vaccines for OIE-listed diseases only. Vaccines that are due to expire might also be used for preventive purposes in the high-risk pathways. This does not include medication for diseases for which the private sector bears the first responsibility. In cases of outbreaks, the country can, although with delays, get assistance for vaccines from Australia, China, the European Union, FAO, Thailand, Vietnam, and the World Bank. Plans are underway to establish an EU/OIE regional facility for emergency provision of vaccines to be made available in case of outbreaks. Yet, there will nearly always be need for extra allocations from the Ministry of Finance depending on the nature of the outbreak.

Quarantine

110. Given the porous borders of the country, permanent public quarantine facilities are likely to have low effect in the foreseeable future. Hence, it is not recommended to draw resources away from surveillance and diagnostic testing for quarantine, with the exception of temporary quarantine in case of outbreaks. However, if there is regular transit of animals, it would be recommended to establish private sector-managed quarantine facilities.

Management of data and information.

111. Preparation of data on animal diseases is already part of OIE requirements, although there is room for improvement. Active surveillance would yield greater information on sero-types and pathways of disease spread — information that would identify and determine levels of risks. Combining this and other information in a well-maintained database would help DOLF develop more effective measures and focus scarce resources on the most serious problems. The annual maintenance of the database and software, given the complexity of the information, is estimated at US$2,000.

Table 6.1. Summary of costs for recommended activities at NAHC

	US$
Animal health surveillance	**164,000**
HPAI	82,000
Other diseases	82,000
Animal health diagnostic testing	**310,000**
HPAI	155,000
Other diseases	155,000
Safety of animal and fish products (microbiology and zoonoses)	**10,000**
Veterinary drug residues	**25,000**
Rapid tests (500 samples)	10,000
Quantitative tests (200 samples)	15,000
Veterinary drugs and vaccines (500 samples)	**35,000**
Animal feed (300 samples)	**60,000**
Readiness:	
Variant 1 vaccines and antibiotics	**160,000**
Variant 2 vaccines for OIE listed diseases only	**100,000**
Data management	**2,000**
Total (with Variant 2 recommendation)	***706,000***

VII. Summary and Conclusions

112. The need for strengthening SPS management capacities was central in the 2006 SPS Action Plan (World Bank 2006b), which was endorsed by the Government of Lao PDR. The plan recommended capacity building for fundamental SPS activities. A follow-up study (World Bank 2009) further assessed SPS capacity constraints in Lao PDR in its trade relations with neighboring countries and ability to protect the country against trade-related health hazards.

113. Started in 2009, the Trade Development Facility is addressing some of the identified capacity gaps, especially legal and regulatory deficiencies (World Bank 2008). Remaining major gaps in capacities are in surveillance, testing, and diagnostic services. Current SPS capacities are *insufficient* in the following ways:

- Gaining and maintaining market access by meeting requests of trading partners for information about the pest, disease, and food safety situation and, if requested, providing adequate assurances about safety of products. Requirements from trading partners increasingly form constraints to market access.

- Protecting adequately the people, crops, and livestock against trade-related hazards.

114. These are areas requiring significant investment and operational budgets that have so far not been quantified. With its recommendations and conclusions, this study aims to fill that gap by offering estimates for additional operational costs needed to make good use of the enhanced capacities. It is fair to expect that in the coming years donors will be willing to invest in capacity, training, and institutional strengthening. However, until now there has been no comprehensive assessment of the operating costs for enhanced capacities at reasonable ambition levels for Lao PDR .

Principles and consideration

Timeframe and limitations

115. The focus is on basic capacities that can be achieved in the next five to seven years. This timeframe excludes the creation of pest-free and disease-free areas and compartmentalization since it presumes qualitative and quantitative capacities that are beyond what can realistically be in place in this period. It also excludes for this period the deployment of sophisticated equipment for expensive specialist tests and advanced diagnostics.

Public good

116. Activities that can be carried out independently for a direct commercial interest, such as diagnostic testing for the issuance of a health certificate and treating diseased animals, should be paid for by the benefiting farms and enterprises. However, the prevention or containment of the spread of contagious pests and diseases is an example of a public good — the benefits of which are shared by many farms or enterprises. Public goods require public actions — in this example, quarantine activities, vaccination, surveillance and monitoring of the food safety, pest and disease situation — and their costs can only be borne by the public sector. If the benefits of a public good exceed the costs, then funding by the public sector is of benefit to society. If public

funds are limited, priority should be given to public goods that have the highest benefit-to-cost ratios.

Costly investments

117. Diagnostic facilities and equipment require significant investments, and issues for investing in laboratories are complex. Purchase of expensive modern laboratory equipment such as high performance liquid chromatography (HPLC) would lead to good quality tests and sustainable use only if (a) the volume of tests is at least 500 per year; (b) chemicals for that workload are available; (c) stable power and air conditioning are secure 24 hours, 7 days per week; (d) maintenance and calibration are secured; and (e) there is participation in a proficiency testing scheme.

118. Nonetheless, for many testing and consulting services, the public services and agribusinesses can find excellent and competitive providers in Thailand and Vietnam. This means that the buildup of capacities within Lao PDR should take into consideration that there are cost-effective alternatives available to several lumpy investments.

Responding to demand

119. In some areas there is not yet enough demand to justify investment in expensive testing equipment, and the best value for public money will be to make use of rapid test kits and to subcontract laboratories abroad for confirmation testing. Once the demand for testing is sufficient (at least 500 tests per year for expensive equipment), the purchase of expensive equipment would become feasible.

Infrastructure

120. Because of its small size, Lao PDR cannot afford to have parallel capacities in most areas of food testing. The three institutions in place — FDQCC, NAHC, and PPC — have common interest in various areas of surveillance and testing. Moreover, each has its own overhead facilities and shortage of well-trained and experienced staff. A consolidated national SPS laboratory would definitely have advantages of economies of scale.

Specialization and delineation

121. If it is not feasible to consolidate laboratories, the next-best alternative would be designing a clear delineation of functions with lead role and specialization for each of the institutions and making use of each other's capacities. The following is proposed:

- FDQCC leads on food microbiology and food chemistry, including pesticide residues and mycotoxins;

- PPC leads on heavy metals (including heavy metals in food, feed, soils, and fertilizers), and composition and quality of pesticides; and

- NAHC leads on composition and quality of veterinary drugs and vaccines, residues of veterinary drugs in food, zoonoses in and microbiological safety of unprocessed animal products.

Institutional arrangements.

122. Responsibilities span across sectors and require coordination among the departments. Coordination and delineation between FDD and HPD on responsibilities and procedures, and information sharing would facilitate joint activities, especially during food-related outbreaks. The FDD and DOA should establish procedures with regard to cooperation in testing pesticide residues, heavy metals, and mycotoxins; covering submission of samples; provision of certification; and cost recovery mechanisms. The same goes for FDD and DOLF with regard to tests on safety of animal products.

Summary of estimated operational costs

123. Total (additional) operational costs needed to carry out recommended expanded activities amount to about US$1 million a year (about 8.5 billion Kip), 68 percent of which is for animal health and related food safety and human health activities, primarily for animal health surveillance and diagnostics, half of which is for HPAI (Table 7.1).

Table 7.1. Summary of estimated operational costs for SPS in Lao PDR

	US$
FDQCC (Food safety)	**170,200**
Surveillance	23,200
Microbiology	27,000
Pesticides residues, Variant 2	72,000
Mycotoxins, Variant 2	14,500
Heavy metals	17,000
Food-borne diseases	15,000
Data management	1,500
PPC (Plant health and food safety)	**156,600**
Pest surveillance	57,000
Purchased pest identification	5,000
Post-entry quarantine	3,000
Pesticide residues	22,600
Pesticide formulations	52,500
Heavy metals (soil and fertilizer)	15,000
Data management	1,500
NAHC (Animal health and food safety)	**706,000**
Surveillance	164,000
Diagnostic testing	310,000
Veterinary drug residues	25,000
Drug and vaccine quality	35,000
Animal and fish products (microbiology and zoonoses)	10,000
Safety of animal feed	60,000
Readiness, variant 2: vaccines	100,000
Data management	2,000
Total	***1,032,800***

124. About US$863,000 (7.3 billion Kip) pertains to activities of the Ministry of Agriculture and Forestry (MAF) and about US$170,000 (1.4 billion Kip) to activities of the Ministry of Health (MOH). These costs would be about 8 percent and 0.7 percent, respectively, of the 2008-09 recurrent expenditures of MAF and MOH of 94 billion Kip (US$11 million) and 194 billion Kip (US$23 million) (see Annex F).

125. At present very small budgets are allocated from Government sources, in the range of US$50,000 annually. In some cases, temporary small budgets are available from foreign-funded projects; the main exception is the sizable external funding for HPAI, which is currently about $237,000 for surveillance and testing and has a medium-term character. An additional US$800,000 per year is needed for public operational funding to achieve the recommended volume of activities.

Recommendations for Increasing Operational Funding

126. It is recommended to expand the amount of funding incrementally in five annual incremental amounts of US$160,000. Priorities for the expansion of operational funding will depend on several factors, such as the need to coordinate with external support for capacity-building activities, readiness of regulatory framework, investment and availability of equipment, and training of staff. However, some activities can be expanded sooner. Priority could be given to the use of rapid test kits and pest surveillance. Subsequently, other active and passive surveillance activities can be gradually stepped up. A rolling annual plan should be introduced to guide priority in allocations.

Key Requisites to Interventions

127. Certain requirements are needed to be able to carry out the recommended options.

Institutional and legislative framework

128. Stepping up work on surveillance, testing, and diagnostics assumes that proper institutional and legislative frameworks are already in place or being put in place with support from the Trade Development Facility and other projects.

Volume of work

129. The low volume of work in sample collection is the main constraint for developing a system of surveillance, diagnostics, and testing with adequate proficiencies. The present laboratory capacities are underutilized. Adding equipment, staff, and accreditation is only useful if this basic constraint is removed first.

Equipment and facilities

130. Purchasing equipment is a means, not an objective in itself; it should be justified by its contribution to clear objectives in the areas of food safety, plant health, and animal health. If there is no trained staff and no operational budget to make use of equipment, it should not be purchased since it will draw scarce resources from other areas that are already underfunded.

131. Purchase of equipment, facilities, and structural adjustments will sooner or later be needed to broaden the range of testing parameters. Specifically:

- For plant health, the DOA may need to acquire HPLC equipment for testing composition of pesticides, or alternatively, make arrangements with a specialized laboratory in Thailand or Vietnam for subcontracting the analyses.

- Testing for heavy metals requires AAS testing methods or arrangements with a laboratory in another country.

- The establishment of a post-entry quarantine laboratory at PPC will have to precede quarantine work on seed and propagation material.

- The purchase of equipment for testing veterinary drugs, antibiotics, and growth enhancers should precede the activity, or an alternative arrangement with a laboratory in a neighboring country is needed.

Human resources

132. In all areas there is a dearth of laboratory technicians with proficiencies and adequate training to carry out proposed increases in the number of tests and to perform various specialist functions. This will necessitate a well-planned gradual increase of human resource capacities.

Information management

133. A well-managed information database should be set up in each of the three areas and should employ staff solely working in data management and analysis. Without ensuring proper use of the information, benefits from surveillance, testing and diagnostics will be meager.

Annex A. Estimates of Operational Costs of Equipment and Laboratories

Operational costs for equipment

1. Table A-1 shows estimates of operational cost of a typical piece of equipment with a workload of 500 tests per year using testing methods that require low levels of chemicals, for low- and high-cost environments. Costs were added for participation in proficiency testing schemes, for training and purchase of literature. The operational cost per test as defined here is between US$50 and $62.[31] It is important to note that the cost per test will increase with decreasing number of tests because of increased fixed cost and cost of consumables per test, and relatively increasing cost of more frequent uploading at low levels of use.

Table A-1. Estimates of stylized operational cost for a piece of modern testing equipment

Item ***Calibrated with a workload of 500 tests per year***	***Low-cost environment US$***	***High-cost environment US$***
Consumables and maintenance for sophisticated equipment (maintenance is estimated at 20-25% of purchase prices)	20,000	25,000
Calibration services (balances, volumetric apparatus, thermometers)	1,000	1,500
Proficiency testing	1,500	2,000
Training and literature*	2,500	2,500
Total annual cost	***25,000***	***31,000***
Cost per test	***50***	***62***

Note: * Training and literature are indispensable operational cost items for maintaining proficiency of staff and keeping up with new developments.
Source: Estimates derived by Maria Beug-Deeb, Tom Deeb, and Upali Samarajeewa, independent consultants, personal communication.

2. More sophisticated equipment, such gas chromatography–mass spectrometry (GC–MS), liquid chromatography–mass spectrometry (LC–MS), and inductive coupled plasma (ICP) for simultaneous multi-element detection, are available for higher performance testing and detecting substances for which high performance liquid chromatography (HPLC), gas chromatography (GC) and atomic absorption spectroscopy (AAS) are not suitable. The requirements and cost per sample will generally be higher, especially for ICP.

Operational costs for a chemical food laboratory

3. The minimum operational cost for a chemical food laboratory that can test for mycotoxins, and residues of veterinary drugs, pesticides, and metals is estimated assuming a high-cost environment. A spreadsheet was built for consumables and reagents required for an inexpensive (low reagent intensive) method for about 500 tests per year per piece of equipment. It was assumed that the laboratory would run:

- 1 HPLC for mycotoxins,
- 2 HPLC for veterinary residues,
- 2 HPLC for pesticide residues, and

[31] If charges for labor, overhead, utilities and depreciation would be added, the costs would probably be similar as the fees charged in Thailand and Vietnam for pesticides residues (about $100 per test) (see Annex B).

- 1 GC-MS or another HPLC and 1 ICP for metals.

4. A 25 percent up-charge in cost of consumables was included for developing countries. Calibration and maintenance costs are estimated at 20 to 25 percent of instrument costs (based on rough estimates from instrument manufacturers). Computation does not include labor, benefits, facility maintenance, electricity, accreditation, overhead, management costs, quality assurance costs, utilities, disposal of solvents, and the cost of collecting samples. Total cost is estimated to be about US$270,000 (Table A-2). For laboratories in a low-cost environment the minimum operational cost might be about US$220,000.

Table A-2. Consumables and maintenance costs for chemical laboratory (US$)

	US$
Consumables, maintenance, and calibration service for 5 HPLC and 1 GC-MS	183,000
Consumables for ICP-MS[a]	18,000
Maintenance service for ICP	50,000
Maintenance and calibration service for 3 balances	1,800
Proficiency testing[b]	8,000
Training, literature, etc.[b]	8,000
Total annual operational cost of testing	***268,800***

Notes:

a. The cost of operating ICP-MS came from "Practical Guide to ICP-MS" by Robert Thomas, Marcel Dekker, Inc., NY (2005).

b. The estimates for proficiency testing, training, and literature were downwardly adjusted from Rama Rao, “Guide for assessing investment needs in chemical laboratory capacities for managing food safety in developing countries.” Vimta Labs LTD, Hyderabad, 2008, since his data refer to a relatively large laboratory.

Source: Maria Beug-Deeb, personal communication.

Sensitivity. Costs per test will be higher at lower volumes for several reasons:

- Lower test volumes mean more equipment start-up and shut-down cycles.
- Lower test volumes mean more reagent blanks and standards that need to be run per test volume.
- Lower test volumes mean higher costs per quantity of solvents and carrier gasses.
- Low budget laboratories cannot afford to take risks (such as qualifying less expensive solvents at the risk of trashing injectors and columns), nor do these laboratories usually have the expertise to do this. Cutting corners in low-budget laboratories is really not a good idea especially since the cost savings are proportional to test volume anyway.

5. ***Varying sizes of laboratories.*** Experience suggests that it is best to identify laboratories at three levels. The demand to carry out a broad range of micro-chemical tests arises mainly in highly developed economies. In many countries, exports are limited to a few items with a few critical parameters from among pesticides and residues, veterinary drugs and residues, unpermitted dyes, mycotoxins, heavy metals, adulterants, and additives tested in developed countries. Also, if availability of staff and samples is so low, then often one piece of equipment (especially GC and HPLC) could be used for several types of analysis through selection of appropriate columns and detectors.

6. Sophisticated equipment such as GC-MS, LC-MS, and ICP are needed mostly to recognize new compounds beyond the common food safety issues (such as melamine). Such tests could always be subcontracted to a laboratory elsewhere. Table A-3 identifies three different sizes of laboratories based on workloads using examples of Southeast Asian countries.

Table A-3. Workload and equipment

Size of laboratory	*Workload (Number of tests)*	*GC*	*HPLC*	*AAS*	*GC-MS*	*LC-MS*	*ICP*
Small (Lao PDR, Cambodia)	300-500	1	1	1	-	-	-
Medium (Vietnam, providing local services)	500-1,000	2	2	1	1	-	-
Large (China, Thailand, QUATEST3 in Vietnam)	>1,000	> 5	> 5	2	1	1	1

Source: Upali Samarajeewa, personal communication.

7. Based on these considerations, Table A-4 presents minimum levels of required funding of operational costs budgets for the three different sizes of laboratories.

Table A-4. Operational cost at three levels of operation

	US$		
Operational cost items	***Small laboratory***	***Medium laboratory***	***Large laboratory***
Consumables and maintenance for equipment	70,000	200,000	>600,000
Calibration services (balances, volumetric apparatus, thermometers)	1,000	3,000	>5,000
Proficiency testing	2,000	4,000	10,000
Training and literature	5,000	10,000	15,000
Total annual operational cost of testing	***78,000***	***217,000***	***>630,000***

Note: Same definition of operational cost as in Table A-2.
Source: Upali Samarajeewa, personal communication.

Food microbiology testing

8. An example of operational cost for a microbiology laboratory is presented in Table A-5.

Table A-5. Operational cost for a microbiology laboratory

Activity	**US$**
Consumables	90,400
Maintenance and calibration service	28,000
Training, literature, reference samples	10,000
Total	**128,400**

Source: Maria Beug Deeb, personal communication.

9. These costs were developed based on the US Food and Drug Administration Bacteriological Analytical Manual. Tests included are anaerobic plate count, fecal coliform, e. coli, listeria, and salmonella for various types of products (juice, meat, eggs, dry milk, fruit and

vegetables). All materials are assumed to be prepared on site versus purchasing of pre-mixed materials.

Annex B. Testing Fees in Thai and Vietnamese Laboratories

1. Thailand has many well-established laboratories with high workloads of testing for both private sector and Government. Main laboratories have accreditation for many parameters and are mostly participating in some kind of national and international proficiency schemes. The Thai Central laboratory has the highest volume of tests and is most oriented to providing commercial services to the private sector. It is an autonomous organization, which will be fully privatized and listed at the Stock Exchange. On the other hand, the laboratories of Vietnam's Department of Animal Health are still less developed and mostly oriented to serving public policy needs.

2. There are differences in fees among the laboratories in Thailand and Vietnam (Table B-1). Fees differ to some extent between the laboratories, which can partly reflect the volume of work, kind of equipment, services provided, and costs covered. Also, commercial considerations of how to operate in the market can play a role, especially in Thailand. Moreover, no details are available on discounts given for larger contracts and to certain customers. Fees in the Thai Central Laboratory tend to be lower than the other two Thai laboratories. This may well reflect the higher volume and the general efficiency in this new laboratory. Fees in Vietnam tend to be lower than in Thailand that may reflect different costing methods and different actual costs. For example, in the Vietnamese laboratories, accreditation and proficiency testing are less applied and costs of salaries are lower.

3. In Thailand, Government policy requires that laboratories cover their costs from fees. The fees are probably close to commercial rates, although there are likely to be some remaining subsidy elements since buildings and equipment were procured by Government and, for some laboratories, staff are still partly paid by Government. However, fees probably cover cost of salaries, utilities, and equipment replacement. For comparison, the study made use of recently proposed fees[32] by the Departure of Animal Health in Vietnam for approval by the Ministry of Finance. These prices, presented in Table B-1, provide an update of how these laboratories see their cost levels.

4. The fees are higher than the stylized operational costs provided in Table A-1 (Annex A) since these are basically commercial fees that include utilities, replacement costs for equipment, accreditation and, possibly, wages. Moreover, they may not be using the cheapest methods.

5. Fees for testing for veterinary drugs range from US$55 to $106; for heavy metals, from US$18 to $30; and for single group pesticides, from US$91 to $121. Fees for aflatoxins are difficult to compare since there can be several parameters under this group. Microbiology tests in Thailand range from US$9 to $18, with higher prices for some specific tests on salmonella. Tests in Vietnam for microbiology are much lower than in Thailand. It is noteworthy that all laboratories are offering rapid tests for a series of parameters.

[32] As of September 2009.

Table B-1. Comparisons of some testing fees in Thai and Vietnamese laboratories

	Thai Department of Livestock Development		*Thai Central Laboratory*		*Thai National Food Institute*		*Vietnam Department of Animal Health*	
	Method	***US$***	***Method***	***US$***	***Method***	***US$***	***Method***	***US$***
Antibiotic and drug residue								
Nitrofurans - parent			LC-MS	61	HPLC	76		
Metabolites	LC-MS-MS	106	LC-MS-MS	91	LC-MS-MS	106		
Tetracycline	HPLC	61	HPLC	55	HPLC	76		
					LC-MS-MS	106		
Chloramphenicol	ELISA	21	ELISA	21	ELISA	21		
	LC-MS-MS	106	LC-MS-MS	91	LC-MS-MS	91		
General							HPLC	44
Heavy metals & other elements								
Cadmium	AAS	30	ICP- MS	18	AAS	24	N/A	22
Mercury	AAS	30	ICP- MS	18	AAS	30	N/A	17
Lead	AAS	30	ICP- MS	18	AAS	21	N/A	22
Food additives								
Benzoic acid			HPLC	48	HPLC	58		
Sorbic acid			HPLC	45	HPLC	58		
Monosodium glutamate			AOAC	27	HPCL	45		
Borax					Test	6	Test	1
					AOAC	30		
Formaldehyde			AOAC	61	Test	18	Test	1
					AOAC	30		
Toxin & pesticides residues								
General							HPLC	44
Aflatoxin B1,B2,G1,G2	N/A	21	HPCL	67	HPCL	106	HPLC	17
Sudan I-IV			HPCL	45				
			LC-MS-MS	91				
Organochlorine group	GC	106	GC	91	GC,GC/MS	121		
Organophosphorus group			GC	91	GC	121		
Pyrethroid group	GC	121	GC	91	GC	121		
Carbamate group	HPCL	121	HPCL	106	HPCL	91		
Any two groups			CG/HPCL	152				
Microbiological								
Aerobic plate count	N/A	12	BAM	9	BAM	12		
MPN, coliform	N/A	12	BAM	9	BAM	15	ISO	6
			Petrifilm	18				
Fecal coliform	N/A	12	BAM	9	BAM	15	ISO	6
E.coli	N/A	18	BAM	9	BAM	15	ISO	8
			Petrifilm	18				
			Vidas	12				
Salmonella spp.	N/A	18	AOAC	24	BAM	30	ISO	14
			ISO	15				
			Vidas	12				

Note: "N/A" denotes unavailable information.
Average exchange rates of 33Thai Baht to US$1 and 18,000 Vietnamese Dong to US$1.
Sources: Thai data provided by the Bureau of Agricultural Commodity and Food Standards. Vietnamese data provided by the Department of Animal Health; proposed for approval by Ministry of Finance.

6. For the diagnostic veterinary laboratory in Vietnam (Table B-2), similar estimated costs were provided as discussed above.

Table B-2. Fees for veterinary diagnostic testing in Vietnam

Tests	***Method***	***Fee (US$)***
Test for virus		
Isolating Newcastle's disease	N/A	4
	RT-PRC	35
Bird flu	egg inj.	3
	HI subtype	9
	cell envir	24
	RT-PRC	35
Swine fever antibody	ELISA	9
Aujezky antibody	ELISA	4
PRRS antibody	ELISA	8
Rabies antibody	fluoresc	9
Rabies	ELISA	13
Detecting FMD	ELISA	22
FMD antibody	ELISA	20
Tests for germs		
Salmonella sp	N/A	11
E.coli isolation and identification	N/A	8
Brucellosis isolation	N/A	13
Brucellosis antibody	Rose Bengal	3
	ELISA	4
Tubercolosis isolation	N/A	14
	tuberc test	3
Tuberculosis	ELISA	10
Anthrax isolation	N/A	13
Parasites		
Trichinella spiralis antibody	ELISA	6

Note: Average exchange rate of 18,000 Vietnamese Dong to US$1.

Source: Vietnam Department of Animal Health; for approval by Ministry of Finance.

Annex C. Estimations and Data for Food Safety

A. Testing fees

1. Tests done by the Food and Drug Quality Control Center (FDQCC) on food products are paid by and done upon requests of the private sector either for certification or as compliance to regulation. Table C-1 shows the fees for the various food tests as set by the Ministry of Finance guidelines from recommendations of the Ministry of Health based on derivations by the FDQCC. It is to be noted that FDQCC still does not have the capacities for some of these analyses such as for mycotoxins and pesticide residues.

Table C-1. Fees for food analysis

Description	***Price*** ***Kip (US$ equivalent)***
Pesticide residue in water, vegetable, cereal and fish (for two groups of pesticides organo-chlorine and organo-phosphate to use gas chromatography)	1,500,000 Kip ($176)
Chemical contaminants in food: Nitrate, nitrite, and formaldehyde (to use spectrophotometer)	200,000 Kip ($24) per element
Phosphate (AAS method)	150,000 Kip ($18)
Sulphate	120,000 Kip ($14)
Borax	60,000 Kip ($7)
Sodium benzoate (by spectrophotometer)	600,000 Kip ($71)
Mycotoxin (HPLC)	800,000 Kip ($94)
Nutrients:	
Protein, sugar, vitamin and mineral (by titration)	150,000 Kip ($18) per element
Fat (extraction and drying or clavimetrie)	300,000 Kip ($35)
Soft drinks, water: Furfural (color test), Ethanol (densimeter), carbonic Color (by TLC), ammonia (color test), arsenic, cadmium (by AAS) Saccharine (spectrophotometer) Cyanur (CN), methanol, Hg, Lead, Fe, Zn, Cu, Al Hardness (titration) pH Calcium, magnesium, carbonate, bicarbonate (titration and flammeter) Potassium, Sodium (by AAS method) Caffeine (by TLC) Caffeine (by HPLC)	 60,000 Kip ($7) 150,000 Kip ($18) per element 250,000 Kip ($29) 120,000 Kip ($14) per element 110,000 Kip ($13) 50,000 Kip ($6) 70,000 Kip ($8) per element 110,000 Kip ($13) per element 300,000 Kip ($35) 800,000 Kip ($94)
Food microbiology testing: Total plate count Coliform, Shigella E.coli, Yeast and mould, Bacillous cereous, Closterium perfingen Salmonella, Staphyloccoccous aureus, V.cholera, V.paraemoticous	 70,000 Kip ($8) 110,000 Kip ($13) for 1 microorganism 165,000 Kip ($19) for 1 microorganism 200,000 Kip ($24) for 1 microorganism

Note: Average exchange rate of 8,500 Kip to US$1.
Source: Decree of the President of the Lao PDR on the promulgation of the Charges and Fees Law (amended in 2008), Decree No. 03/PO, November 19, 2008.

2. Testing fees were calculated by FDQCC as follows:

(a) Cost of equipment is spread over 5 years, and estimated for one day.

(b) Annual calibration and maintenance expenses are computed, and estimated for one day.

(c) Cost of chemicals used for one test is computed.

(d) The number of tests that could be run in a day is estimated.

(e) Testing fee = ('1 day' of equipment's cost and calibration and maintenance expenses) ÷ (estimated number of tests in a day) + cost of chemicals used for one test.

3. The estimation was done at the beginning of 2008; the document was released November 2008. A revision of the document would be done if there is a new procedure or test to be included.

B. Estimates for microbiological tests

4. Table C-2 presents FDQCC's estimated costs for chemicals to do microbiological tests for 500 food samples. A number of price items however are not available; for some of the tests, estimates are partial. The total for the 7 tests is US$36,391. The test for *staphyloccoccus aureus* is the most expensive test.

Table C-2. Estimated costs of media and reagent for microbiological tests for 500 samples

Items	*g/ml per bottle*	*Price (US$) per bottle*	*g or ml for one sample**	*g or ml for 500 samples**	*Subtotal (US$)*
For E.coli:					
Lauryl sulphate	500	101	7.3	3,650	737
EC broth	500	162	3.7	1,850	599
EMB agar	500	90	7.2	3,600	648
Tryptone water	500	100	1.2	600	120
MR-VP	N/A	N/A	0.1	50	N/A
Simone citrate agar	500	321	1.2	600	385
Kovac reagent	140	14	1	500	50
Methyl red	10	25	1	500	1,250
Subtotal					**3,789**
For coliform :					
Lauryl sulphate	500	101	7.3	3,650	737
BGB	500	N/A	4.0	2,000	N/A
Subtotal					**737**
For salmonella:					
Lactose broth	500	112	4	2,000	448
Selenite	500	175	0.5	250	88
Tetrathionate broth	500	190	0.5	250	95
Brian green	500	135	0.2	100	27
Oxydase disc B/30	50	6	1	500	60
Bismuth sulphid agar	500	161	3.5	1,750	564
HE	500	N/A	3.1	N/A	N/A
XLD	500	145	0.6	300	87
Nutrient agar	500	98	0.5	250	49
Urease	N/A	N/A	N/A	N/A	N/A
LIM	500	204	3.3	1,650	673
TSI	N/A	N/A	3.5	1,750	N/A
OMA	2	42	0.5	250	5,250
OMB	2	49	0.5	250	6,125
Subtotal					**13,466**
For shigella:					

Items	*g/ml per bottle*	*Price (US$) per bottle*	*g or ml for one sample**	*g or ml for 500 samples**	*Subtotal (US$)*
GN broth	500	150	1	500	150
Mac Conky	500	160	1.6	800	256
LIM	N/A	N/A	3.3	1,650	N/A
TSI	N/A	N/A	3.5	1,750	N/A
Nutrient agar	500	98	0.5	250	49
Polyvalent A-D	2	N/A	0.5	250	N/A
Polyvalent A,B,C,D	2	N/A	0.5	250	N/A
Subtotal					**455**
For staphyloccoccus aureus:					
Baird parker	500	58	25.6	12,800	1,485
Eggyork emulsion 20%	50	65	12	6,000	7,800
Brand heart infusion	500	286	2	1,000	572
Rabbit Plasma	8	156	0.5	250	4,875
Subtotal					**14,732**
For vibriocholerae:					
Peptone water alkalin	500	N/A	9	4,500	N/A
TCBS	500	116	3.6	1,800	418
Gelatin	N/A	N/A	2.9	1,450	N/A
GPS agar	500	150	2.1	1,050	315
Subtotal					**733**
For yeast and mould:					
KH2PO4	500	60	22	11,000	1,320
Potatose dextrose agar	500	125	7.8	3,900	975
Tartaric acid	500	92	2	1,000	184
Subtotal					**2,479**
Total					***36,391***

Note: - *Gram (g) for solids and milliliter (ml) for liquid substances.
"N/A" denotes unavailable data, thus, totals for some tests are partial estimated costs.
Source: FDQCC.

C. Estimates for chemical tests

5. Table C-3 shows the various reagents required for performing analysis on formalin, borax, histamine, sulfur dioxide, and food color. Similar to the microbiological tests, these estimates are also partial for selected chemical tests due to unavailability of prices for some chemicals. Total for the 5 tests for 500 samples each is US$22,590. Unfortunately, the incomplete information precludes the use of these data for the report.

Table C-3. Estimated costs of reagents for selected chemical analyses for 500 samples

Chemicals	*Price (US$) per unit*	*Unit*	*Approximate need for 1 sample (ml/g)*	*Approximate need for 500 samples (L/kg)*	*Estimated cost (US$) for 500 samples*
For formalin analysis					
Ammonium acetate	N/A	500g	1.2	0.5	N/A
Acid acetic	37.8	2.5 L	12ml	6	90
Acetyl acetone	80	500ml	4 ml	2	320
Formaldehyde std	40	1L	2ml	2.5	100
Phosphoric Acid	35	1L		5	175
1.8hydroxynaphtalene-3.6 sulforic acid	85	10g		0.05	425
Subtotal					**1,110**
For borax analysis					
Sodium carbonate	N/A	500g	20	2.5	N/A
Sulphuric acid 98%	15	1 L	10	5	75

Chemicals	***Price (US$) per unit***	***Unit***	***Approximate need for 1 sample (ml/g)***	***Approximate need for 500 samples (L/kg)***	***Estimated cost (US$) for 500 samples***
Chloroform	115	2.5L		9	415
2 Ethyl 1,3 hexandiol(EHD)	N/A			1	N/A
Curcumin	N/A			0.25	N/A
Acetic acid	37.8	2.5L		2.5	40
Ethanol ,aldehyd free	N/A	1L		37.5	N/A
Boric acid std. sigma cat no.B7660	N/A			0.5	N/A
Subtotal					**530**
For histamine analysis					
Benzene	N/A	1L		5	N/A
n butanol	N/A	1L		5	N/A
Sodium acatate anhydrous	72	1kg		5	360
Succinic acid anhydride	73	500g	0.1	0.05	5
Acid acetic	37.8	2.5L	5	2.5	40
Acetyl acetone reagent plus >99%	120.6	1L		5	605
P. Nitro aniline	80	1L	10	5	400
Acid chlorhydrid	40	1 L	10	5	200
NaNO2 (sodium nitrite)	N/A		4	2	N/A
Ethyl alcohol	41.4	2.5L	10	5	85
Sodium metaborate	115	500g	7.5	3.75	865
Sodium carbonate	N/A	500g	5.7	0.1	N/A
Sodium barbital	N/A	500g	10g	2.5	N/A
Sulphuric acid	30	1 L		5	150
Dilute Sulphuric acid 0.2+/- 0.01M	N/A		10	5	N/A
Methanol	60	1 L	20	10	600
4-Methyl 2- pentanone purified grade	169	1l	15	7.5	1,270
Benzaldehyde	90	1 L	2	1	90
Sodium hydroxide	70	1kg		0.5	35
Sodium chloride	50	kg	20	10	500
Standard: Histamine .2HCl code no.53300	238	1g		0.01	2, 375
Subtotal					**7,580**
For sulfur dioxide analysis					
Acid chlorhydrid 37%	40	1L	70	35	1400
Methyl red indicator	35	25g		0.125	175
Ethanol absolute	41.4	2.5L		12.5	205
Sodiumhydroxid 0.01 N	50	1l	10	5	250
Pyrogallol	180	50g		0.25	900
Hydrogen peroxid AR 30%	30.0	500ml	27	13.5	810
Nitrogen gas	N/A	cylinder		5	
Potassium hydroxid	N/A	500g		5	N/A
Potassium acid phthalate	N/A		N/A	2.5	N/A
Sulphuric acid 98%	30	1L		5	150
Sodium hydrosulphide (NaHSO3)	N/A	0.1g		0.5	
Subtotal					**3,890**
For food color analysis					**9,480**
Acid acetic	37.8	2.5L	10	5	75
Hydrochloric acid	40	1 L		5	200
Sodium hydroxide	70	1kg		5	350
n Butanol	N/A	1 L		5	N/A
Metyhyl ethyl ketone	70	1L		5	350
Ammonium hydroxide	50	2.5	10	5	100
---2 propanol	135	2.5l	20	10	540
---Chloroform	115	2.5L	5	2500	115
---Diethylamine	N/A	1L	5	2.5	N/A
Supplies					
Wool /polyamide powder	N/A		5	2.5	N/A
Whatman filter paper No.2v	N/A		1 piece	500	N/A
TLC plate(Aluminium sheets)25/pack Silica gel 60 F254 20x20cm	775	pack		10	7,750

Chemicals	Price (US$) per unit	Unit	Approximate need for 1 sample (ml/g)	Approximate need for 500 samples (L/kg)	Estimated cost (US$) for 500 samples
TLC Tank with cover (22x22 cm (outside))	N/A	ea	1	25	N/A
Food color standard					
Sunset yellow	N/A			50 g	N/A
Ponceau	N/A			50 g	N/A
Tartrazine	N/A			50 g	N/A
Brian blue	N/A			50 g	N/A
Garmoisine	N/A			50 g	N/A
Erythrocine	N/A			50 g	N/A
Subtotal					**9,480**
Total					***22,590***

Note: “N/A“ denotes missing unavailable data, thus, totals for some tests are partial estimated costs.
Source: FDQCC.

6. Table C-4 presents the reagents and corresponding costs to do 500 tests for pesticide residues for fruit and vegetables for the 4 groups of pesticides and differing methodologies. Costs for reagents for the 4 groups range from US$4,925 to US$28,905.

Table C-4. Estimated costs of reagents for pesticide residue analysis for 500 samples

Item	*Approximate need for one sample (g/ml)*	*Approximate need for 500 samples (L/kg)*	*Estimated costs for 500 samples (US$)*
I. Organochlorine and organophosphorus residues AOAC 970.52 general method			
Acetone	100	50	700
Acetonitrile CH_3CN	250	125	3,840
Ethyl ether (Ether, diethyl ether, ether) (CH3CH2)2O	150	75	2,380
Florisil	25	12.5	1,580
Petroleum ether	450	225	6,385
Sodium sulfate	30	15	825
Glass wool	N/A	N/A	N/A
Methyl-tert Bytyl Ether, MTBE	50	25	4,765
Celite filter aid	10	5	365
OP Internal standard (2-nitrotoluene)	N/A	5 vials	220
OP surrogate standard (DMNB; 1,3-dimethyl-2-nitrobenzene	N/A	5 vials	165
OC Internal std (Quintozene; pentachloronitrobenzene)	N/A	5 vials	440
OC Surrogate std (4,4 dichlorobiphenyl)	N/A	5 vials	165
Analytical standards (e.g. malathion, DDT, aldrin) depending on the needs	N/A	5 vials each	1,000
Total			**22,830**
II. Synthetic pyrethroids, AOAC 998.01 from fruit and vegetables			
Acetone	100	50	700
Acetone	200	100	1,400
Hexane	333	166.5	2,330
Acetonitrile	60	30	920
Diethyl ether	15	7.5	240
Florisil	25	12.5	5,270
NaCl	1	0.5	30
Sodium sulphate	20	10	550
Synthetic pyrethroids standards	N/A	1 vial each 8 analyte	4,000
Total			**15,440**
III. Thin-layer chromatography for organophosphorus and organochlorine, AOAC 970.52, extraction as in 970.52 without clean-up			
Aluminum oxide 60 G TLC plates	N/A	125	1,575
n-heptane		12.5	405
Silver nitrate AgNO3		50 g	N/A

Item	*Approximate need for one sample (g/ml)*	*Approximate need for 500 samples (L/kg)*	*Estimated costs for 500 samples (US$)*
2-phenoxyethanol	5	2.5	450
Acetone	100	50	700
Hydrogen peroxide	N/A	N/A	N/A
N-N' Dimethyl formamide	20	10	400
Petroleum ether	20	10	285
Methylcyclohexane	10	5	155
Tetrabromophenolphthalein ethyl ester	0.2	5 g	955
Citric acid	1	0.5	N/A
Total			**4,925**
IV. Carbamate pesticide residues, AOAC 985.23 from fruit and vegetables			
Acetonitrile	200	100	10,870
Methanol	305	152.5	5,595
NaCl	15	7.5	440
Methylene chloride (dichloromethane)	170	85	5,270
Petroleum ether	100	50	1,420
Toluene	35	17.5	320
HPLC grade water	50	25	765
Sodium hydroxide	2	1	70
Sodium sulfate	5	2.5	65
Sodium tetraborate decahydrate Na2B4O7 x 10H2O	8	4	385
o-phthaladehyde	0.1	0.05	350
2-mercaptoethanol	0.1	0.05	205
Silanized Celite 545	4.5	2.25	975
Activated charcoal	1	0.5	125
BDMC Internal standard	N/A	5 vials	700
Carbamate standard mix	N/A	5 vials	1,350
Total			**28,905**

Source: FDQCC, based on initial estimates by FAO consultant.

D. Estimates on calibration and maintenance

7. The FDQCC estimated annual expense for calibration and maintenance of all equipment being used in abovementioned tests of microbiological and chemical laboratories to be US$4,588 (Table C-5).

Table C-5. Estimated annual costs for calibration and maintenance for instruments

Instruments	*Costs (US$)*
HPLC (chemical laboratory)	1,000
GC	600
Balances	
Balance (chemical laboratory)	200
Balance (microbiology laboratory)	200
Balance (microbiology laboratory), more accurate	300
Spectrophotometer	500
Incubator (microbiology laboratory)	337
Autoclave (microbiology laboratory)	367
Biological safety cabinet (microbiology)	661
CO2 incubator	423
Total	**4,588**

Source: FDQCC, based on quotations of 2H Instrument Co. and Simazu Co., Vietnamese suppliers of laboratory instruments and equipment.

E. Estimates for tests on food-borne diseases

8. The National Center Laboratory for Epidemiology (NCLE) provided a rough cost estimate of US$50 for testing a stool or sputum sample. If the cause of illness is unidentified, samples have to be tested on average for 5 pathogens: vibrio cholerae, shigella, salmonella, E. Coli, and staphylococcus aureus. The NCLE estimates each test to cost about US$10. With regard to the sample size, WHO guidelines recommend performing tests of about 10 percent of the number of cases. In the last outbreak of vibrio cholerae, the NCLE tested 25 samples. Therefore, assuming doing tests on 300 specimens at US$50 each amounts to a total of US$15,000 as an estimate of operational cost for food-borne diseases.

Annex D. Estimations and Data for Plant Health

A. Pest surveillance

1. The Plant Protection Center (PPC) provided cost estimates for the proposed pest survey for rice.[33]

2. Since rice is grown in both dry and rainy seasons, the survey should be done for both seasons with four visits to correspond to each of the four crop stages — for a total of eight visits in a year. Since the crop is grown throughout the country, the survey covers growing areas in eight provinces and Vientiane capital. Table D-1 shows the breakdown of costs for the collection of specimens and for the preparation of specimens. Main cost items for specimen collection are allowances (49 percent) and transport (50 percent). Total cost amounts to 563,466,000 Kip (US$66,290).

Table D-1. Costs for surveillance for rice

	Unit	*Amount*	*Price (Kip)*	*Total (Kip)*
Specimen collection				**451,336,000**
Supplies				**1,016,000**
Tissue paper	Bag	16	15,000	240,000
Distilled water	Bottle	10	10,000	100,000
Cardboard for insects	Sheet	10	8,000	80,000
Brush	Brush	20	5,000	100,000
Scissors	Pair	8	12,000	96,000
Secateurs	Pair	8	10,000	80,000
Stickers	Sheet	50	4,000	200,000
Sticky tape	Roll	10	12,000	120,000
Plastic bags for specimens				
Allowance for PPC staff and local staff				**217,520,000**
Phongsali province	4 people x 7 days x 8 times		180,000	40,320,000
Louang Namtha province	4 people x 4 days x 8 times		180,000	23,040,000
Sayabouri province	4 people x 4 days x 8 times		180,000	23,040,000
Xiangkhouang province	4 people x 4 days x 8 times		180,000	23,040,000
Vientiane province	4 people x 2 days x 8 times		180,000	11,520,000
Vientiane Capital	4 people x 2 days x 8 times		35,000	2,240,000
Savannakhet province	4 people x 4 days x 8 times		180,000	23,040,000
Champasak province	4 people x 4 days x 8 times		180,000	23,040,000
Attapeu province	4 people x 4 days x 8 times		180,000	23,040,000
Local staff	2 people x 35 days x 8 times		45,000	25,200,000
Transport				**232,800,000**
Phongsali province	7 days x 8 times		900,000	50,400,000
Louang Namtha province	4 days x 8 times		900,000	28,800,000
Sayabouri province	4 days x 8 times		900,000	28,800,000
Xiangkhouang province	4 days x 8 times		900,000	28,800,000
Vientiane province	2 days x 8 times		400,000	6,400,000

[33] Data prepared by the Plant Protection Center: Mr. Khamtanh Thadavong (Head), Ms. Khonesavanh Chittarath (Pathology), Ms. Thipphavanh Silipanyo (Fertilizer and pesticide unit) and Ms. Pheophanh Soysouvanh (Entomology).

Vientiane Capital	2 days x 8 times		200,000	3,200,000
Savannakhet province	4 days x 8 times		900,000	28,800,000
Champasak province	4 days x 8 times		900,000	28,800,000
Attapeu province	4 days x 8 times		900,000	28,800,000
Costs for specimen preparation				**18,690,000**
Chemicals				**13,090,000**
Acid Fuchsin	500ml	2	250,000	500,000
Agar	1Kg	5	500,000	2,500,000
Clove oil	500ml	2	200,000	400,000
Ethylacetate	1 L	30	250,000	7,500,000
Euparul	500 ml	1	250,000	250,000
Potassium Hydroxide	500 g	2	450,000	900,000
Glucose	1 Kg	5	100,000	500,000
Glycerol	1 L	3	180,000	540,000
Supplies and materials				**5,600,000**
Material for media (potato, carrot etc.)				500,000
Slide box	Box	10	150,000	1,500,000
Slide	Box	15	40,000	600,000
Cover glass (18x18 mm)	Box	15	80,000	1,200,000
Pin no. 1, 2, 3	Box	10	100,000	1,000,000
Petri Dishes (15x100 mm)		20	40,000	800,000
Total				***470,026,000***

Notes:
1. Daily allowance from Ministry of Finance guidelines for an Administrative Position category 4 and lower includes 50,000 Kip for food, 120,000 Kip for lodging and 10,000 Kip for individual allowance. Category 4 positions include head of technical unit under a department.
2. Transport expenses represent rental cost of car/van, lower in Vientiane capital and Vientiane province.

Source: Plant Protection Center.

3. ***Variations.*** Using the proposed rice survey data as starting point for calculations, the following variations are applied:

(a) For a one-season crop covering 9 provinces (including Vientiane Capital), total costs would be lowered by 50 percent to 235,013,000 Kip (US$27,649).
(b) If the number of provinces included in the survey (for a two-season crop) were to be lowered to five (Table D-2) — Vientiane Capital, Vientiane Province and 3 other provinces — allowances and transport costs would be reduced by 59 percent to 190,400,000 Kip (US$22,400). Assuming no significant reductions in outlays for chemicals and supplies, total cost for a survey would be 210,106,000 Kip (US$24,718).
(c) For a one-season crop, survey with 5 provinces would cost 105,053,000 Kip (US$12,359).

Table D-2. Allowance and transport costs for surveillance in five provinces

	Units	*Unit cost (Kip)*	*Total (Kips)*
Allowance for PPC staff and local staff			**94,400,000**
Vientiane Province	4 people x 2 days x 8 times	180,000	11,520,000
Vientiane Capital	4 people x 2 days x 8 times	35,000	2,240,000
Any 3 provinces	3 x (4 people x 4 days x 8 times)	180,000	69,120,000
Local staff	2 people x 16 days x 8 times	45,000	11,520,000
Transport			**96,000,000**
Vientiane province (x Kip)	2 days x 8 times	400,000	6,400,000
Vientiane Capital	2 days x 8 times	200,000	3,200,000
Any 3 provinces	3 x (4 days x 8 times)	900,000	86,400,000
Total			***190,400,000***

Source: Computation by authors.

4. ***Allowance for preparatory activities.*** Surveys are preceded by preparatory activities such as training workshops on the proper collection of specimens. A rough allocation might be 5 percent of the total cost. In summary, when incorporating preparatory activities to the variations discussed above, operational costs for a year for pest surveillance range from 110 million Kip to 494 million Kip (US$13,000 to $58,000):

Table D-3. Summary of operating costs

Survey activities	*Kip*	*US$*
2-season crop, 9 provinces	493,527,300	58,062
1-season crop, 9 provinces	246,763,650	29,031
2-season crop, 5 provinces	220,611,300	25,954
1-season crop, 5 provinces	110,305,650	12,977

Note: Average exchange rate of 8,500 Kip to US$1.

B. Monitoring for pesticide residues

5. The PPC provided cost estimates for a proposed activity to monitor for pesticide residues in agricultural produce using rapid test kits. Proposed activity will cover tests for 1,200 samples — 300 samples each for Vientiane Capital and Vientiane Province, and 200 samples each for 3 other provinces. Each Gobthong Thoophom (GT) test kit consists of 30 tests and costs 600,000 Kip. Testing 1,200 samples would require 40 kits for a value of 24 million Kip (US$2,824).

6. Another cost item would be the cost to gather the samples. At US$4 per sample, the cost for 1,200 samples would be US$4,800. If part of the positive tests is also sent for confirmation with a conventional method, the additional cost for 100 samples with a unit price of US$100 would be US$10,000.

Annex E. Estimations and Data for Animal Health

A. Cost of diagnosis of animal diseases

1. ***FMD/CSF.*** Table E-1 provides the cost estimate for foot-and-mouth disease (FMD) and classical swine fever (CSF) tests for 1,000 sera. Total value is US$25,971 (220,753,500 Kip) with reagents comprising about 96 percent of total costs. Considering only the reagents, this shows a US$25 cost per sample.[34]

Table E-1. Estimated costs for diagnosis of FMD and CSF

Items	*Unit*	*Unit Price (US$)*	*Quantity*	*US$*
Reagents				**25,000**
Lab consumables				**971**
Latex gloves	Box of 50 pairs	6.47	25	162
Face masks	Box of 50	6.47	25	162
Syringes 5 ml/10ml	Box of 100	6.47	100	647
Total (US$)				***25,971***
Total (Kip)				***220,753,500***

Notes: The estimated chemicals and costs correspond to 1,000 sera. Breakdown of cost of reagents was not provided.
Average exchange rate of 8,500 Kip to US$1.
Source: Data was prepared by Dr. Phout Inthavong (NAHC/DOLF).

2. ***HPAI.*** A similar estimation for highly pathogenic avian influenza (HPAI) is presented in Table E-2 for tests on 10,000 sera, 10,000 swab and 300 carcasses. Total estimate for HPAI diagnosis is US$130,396 (1,108,366,000 Kip).

Table E-2. Estimated cost for diagnosis of HPAI

Reagent	*Unit*	*Unit Price (US$)*	*Quantity*	*Total (US$)*
Flock Chek HPAI multiS-screen ELISA	5 plates/kit	930	50	46,500
QIAamp® Viral RNA Mini Kit	50 reactions	187	50	9,350
RNeasy® Mini Kit	50 reactions	238	5	1,190
100-1500 bp DNA ladder	0,5 ml	179	5	895
Loading buffer	1 ml	35	5	175
LightCycler RNA Master HypProbe	96 reactions	582	30	17,460
primer AIV-H5 TH5 F	OD 5/1000 reactions	38	1	38
primer AIV-H5 TH5 A	OD 5/1000 reactions	38	1	38
primer AIV-N1 InfA_N1_F	OD 5/1000 reactions	38	1	38
primer AIV-N1 InfA N1_A	OD 5/1000 reactions	38	1	38
primer AIV-M Th MAT F	OD 5/1000 reactions	38	5	190
primer AIV-M Th MAT R	OD 5/1000 reactions	38	5	190
Hybridization probe H5 TH5 FL	1nmol/300 reactions	575	3	1,725
Hybridizaion probe H5 TH5 LC	1nmol/300 reactions	575	3	1,725
Hybridization probe N1 InfA_N1_FL	1nmol/300 reactions	575	3	1,725
Hybridization probe N1 InfA_N1_LC	1nmol/300 reactions	575	3	1,725
Hybridization probe MAT FL	1nmol/300 reactions	575	15	8,625

[34] Estimates were provided in dollars because activities were mostly donor-funded.

Reagent	Unit	Unit Price (US$)	Quantity	Total (US$)
Hybridization probe MAT LC	1nmol/300 reactions	575	15	8,625
Capillaries Light Cycler	5 x 96	78	50	3,900
PCR tubes 0,2ml (DNAse/RNAse free)	1000	47.2	2	94
H5-antigen	1 ml	50.00	5	250
H5-antiserum	1 ml	55.00	2	110
H7-antigen	1 ml	50.00	3	150
H7-antiserum	1 ml	55.00	3	165
H9-antigen	1 ml	50.00	3	150
H9-antiserum	1 ml	55.00	3	165
Biohazard Autoclavable Bag	Pack of 200	80	5	400
ep T.I.P.S. Dualfilter 1000 µl, PCR Clean/Sterile	rack of 96 tips	92.8	60	5,568
ep T.I.P.S. Dualfilter 200 µl, PCR Clean/Sterile	rack of 96 tips	88.8	60	5,328
ep T.I.P.S. Dualfilter 10 µl, PCR Clean/Sterile	rack of 96 tips	84.8	60	5,088
Surgery kits, small Sets,Local purchase	sets	25	100	2,500
Latex gloves	Box of 50 pairs	6.47	50	323
Face masks	Box of 50 pairs	6.47	50	324
Tuberculin Syringe	Box of 100	6.47	30	194
Syringes 5 ml	Box of 100	6.47	500	3,235
Cryovial	Bag of 500	109.95	20	2,199
Total (US$)				***130,396***
Total (Kip)				***1,108,366,000***

Notes: The estimated chemicals and costs correspond to 10,000 sera, 10,000 swab and 300 carcasses.
Average exchange rate of 8,500 Kip to US$1.

Source: Data was prepared by Dr. Phouvong Phommachanh (NAHC-DOLF).

3. Tables E-3 and E-4 show the cost data for the diagnoses of the high-impact bacterial diseases hemorrhagic septicemia, anthrax and Blackleg. Estimation assumes two scenarios — passive and active surveillance. For passive surveillance (Table E-3), fewer tests were performed on 20 carcasses and 100 organs resulting in a total cost of US$4,079 (34,671,500 Kip) per year. Active surveillance scenario (Table E-4) assumes tests on 50 carcasses and 500 organs with a total of US$10,202 (86,717,000 Kip) per year. Considering only the chemicals consumed, the cost per sample for bacterial diseases was estimated to be US$6.68.[35]

Table E-3. Estimated costs for diagnosis of bacterial diseases hemorrhagic septicemia, anthrax, Blackleg (passive surveillance)

Description	Unit	Quantity	Unit price (US$)	Amount (US$)
Culture Media				**1,517**
Blood agar base 500g	bottle	1	150	150
MacConkey Agar 500g	bottle	1	79	79
Nutrient Agar 500g	bottle	1	96	96
Brilliant green Agar 500g	bottle	1	105	105
DSA Agar 500g	bottle	1	150	150
Mueller Hinton Agar 500g	bottle	1	80	80
Triptic Soy broth 500g	bottle	1	96	96
Triptose broth 500g	bottle	1	96	96
Thioglicollate broth 500g	bottle	1	96	96
Egg Yolk Agar 500g	bottle	1	89	89
Cooked meat medium 500g	bottle	1	96	96
XLD agar	bottle	1	96	96
Urea agar 500g	bottle	1	96	96
DHL agar	bottle	1	96	96
TSI agar	bottle	1	96	96

[35] Estimation of Dr. Phengphet Vorachit (NAHC/DOLF).

Description	*Unit*	*Quantity*	*Unit price (US$)*	*Amount (US$)*
Reagents				**524**
API 20E	box/25 strips	2	55	110
API 20 NE	box/25 strips	2	55	110
TDA Reagent for API	Ampoule	2	6.60	13
MRVP Regent for API	Ampoule	2	6.60	13
V1 Regent for API	Ampoule	2	6.60	13
V2 Regent for API	Ampoule	2	6.60	13
Jame's Regent for API	Ampoule	2	6.60	13
NIT1 Regent for API	Ampoule	2	6.60	13
NIT2 Regent for API	Ampoule	2	6.60	13
Zn Reagent for API		2	6.60	13
B.Anthracis precipitating Antiserum	5 bottles	2	25	50
API 20E Analytical profile Index	box	1	75	75
Oxidation paper	box/100	5	15	75
Chemicals				**733**
$Bacl_{2\,}2H_2O$	bottle	1	N/A	N/A
H_2SO_4	liter	1	25	25
Ethanol Alcoho 95%	liter	5	18	90
Aceton	liter	3	14	42
Paraffin Oil	liter	1	11.7	12
Glycerin	liter	1	35	35
Gram Iodine solution	liter	1	N/A	N/A
Zeil-Neelsen carbol fuchin	liter	1	45	45
Biodine 500ml	bottle	10	4.11	42
Alcohol 90°c, 1000ml	bottle	20	2.58	52
India Ink, 30ml	bottle	3	N/A	N/A
Immerson Oil, 50ml	bottle	2	N/A	N/A
Formalin 40%, 450ml	bottle	5	1.50	8
Hydrogen peroxide 3%, 1000ml	bottle	1	N/A	N/A
Dettol, 1000ml	bottle	2	5.20	10
Giemsa powder 10 g	bottle	1	93	93
Methylene blue powder 10g	bottle	1	93	93
Crystal violet 10g	bottle	1	93	93
Safranin powder 10g	bottle	1	93	93
Ammonium Oxalate500g	bottle	1	N/A	N/A
Ether 500ml	bottle	5	N/A	N/A
Potassium Iodine 500g	bottle	1	N/A	N/A
Iodine 100g	bottle	1	N/A	N/A
Antimicrobioal Agents (per year)				**22**
Penicilin G Disc	50's/bot	1	2	2
Streptomycin Disc	50's/bot	1	2	2
Oxytetracyclin Disc	50's/bot	1	2	2
Amoxacilin Disc	50's/bot	1	2	2
Ganamycin Disc	50's/bot	1	2	2
Tetracylin Disc	50's/bot	1	2	2
Ampicilin Disc	50's/bot	1	2	2
Gentamycin disc	50's/bot	1	2	2
Oxacilin Disc	50's/bot	1	2	2
Enrofloxacin Disc	50's/bot	1	2	2

Description	*Unit*	*Quantity*	*Unit price (US$)*	*Amount (US$)*
Teramycin Disc	50's/bot	1	2	2
Disposable supplies				**1,305**
Spreading spatula	set	2		
Absorbent cotton	500g/roll	2	5	10
Latex gloves size M, S	box/50	20	14.70	294
Face Mask	box/50	20	6.47	129
Syringe 5 ml	box/100	5	15	75
Syringe 50 ml	box/20	5	20	100
Syringe 2 ml	box/100	5	15	75
Biohazard Autoclave Bag 8.5x11"	pack/200	2	80	160
Bottle brush		20	0.59	12
Swab with transport medium for bacteria	pack/200	20		
Aluminium foil	roll	5	2.40	12
Microscope slide76x26mm	pack/100	30	11.00	330
Cover glass22x22mm	pack/200	2	5.00	10
Filter paper Watman grade 2 diameter 125 mm	box	5	19.56	98
Total				***4,079***
Total (Kip)				***34,671,500***

Notes: The estimated inputs and costs assume passive surveillance and correspond to tests on 20 carcasses and 100 organs. Average exchange rate of 8,500 Kip to US$1.
Source: Data was prepared by Dr. Phengphet Vorachit (NAHC/DOLF).

Table E-4. Estimated costs for diagnosis of bacterial animal diseases hemorrhagic septicemia, anthrax and Blackleg (active surveillance)

Chemicals, Reagent, Media	*Unit*	*Quantity*	*Unit price(US$)*	*Amount(US$)*
Culture Media				**2,741**
Blood agar base 500g	bottle	3	150	450
MacConkey Agar 500g	bottle	3	79	237
Nutrient Agar 500g	bottle	3	96	288
Brilliant green Agar 500g	bottle	2	105	210
DSA Agar 500g	bottle	3	150	450
Mueller Hinton Agar 500g	bottle	2	80	160
Triptic Soy broth 500g	bottle	2	96	192
Triptose broth 500g	bottle	2	96	192
Thioglicollate broth 500g	bottle	2	96	192
Egg Yolk Agar 500g	bottle	2	89	178
Cooked meat medium 500g	bottle	2	96	192
Reagents				**3,078**
API 20E	box/25 strips	10	55	550
API 20 NE	box/25 strips	10	55	550
TDA Reagent for API	Ampoule	10	6.60	66
MRVP Regent for API	Ampoule	10	6.60	66
V1 Regent for API	Ampoule	10	6.60	66
V2 Regent for API	Ampoule	10	6.60	66
Jame's Regent for API	Ampoule	10	6.60	66
NIT1 Regent for API	Ampoule	10	6.60	66
NIT2 Regent for API	Ampoule	10	6.60	66

Chemicals, Reagent, Media	*Unit*	*Quantity*	*Unit price(US$)*	*Amount(US$)*
Zn Reagent for API		10	6.60	66
B.Anthracis precipitating Antiserum	5 bottles	5	25	125
API 20E Analytical profile Index	box	1	75	75
Oxidation paper	box/100	10	15	150
Chemicals				**593**
$Bacl_2.2H_2O$	bottle	2	N/A	N/A
H_2SO_4	liter	1	25	25
Ethanol Alcoho 95%	liter	10	18	180
Aceton	liter	5	14	70
Paraffin Oil	liter	2	11.70	23
Glycerin	liter	2	35	70
Gram Iodine solution	liter	2	N/A	N/A
Zeil-Neelsen carbol fuchin	liter	2	45	90
Biodine 500ml	bottle	10	4.11	42
Alcohol 90°c, 1000ml	bottle	20	2.58	52
India Ink, 30ml	bottle	3	N/A	N/A
Immerson Oil, 50ml	bottle	5	N/A	N/A
Formalin 40%, 450ml	bottle	10	1.50	15
Hydrogen peroxide 3%, 1000ml	bottle	2	N/A	N/A
Dettol, 1000ml	bottle	5	5.20	26
Antimicrobioal Agents				**44**
Penicilin G Disc	50's/bot	2	2	4
Streptomycin Disc	50's/bot	2	2	4
Oxytetracyclin Disc	50's/bot	2	2	4
Amoxacilin Disc	50's/bot	2	2	4
Ganamycin Disc	50's/bot	2	2	4
Tetracylin Disc	50's/bot	2	2	4
Ampicilin Disc	50's/bot	2	2	4
Gentamycin disc	50's/bot	2	2	4
Oxacilin Disc	50's/bot	2	2	4
Enrofloxacin Disc	50's/bot	2	2	4
Teramycin Disc	50's/bot	2	2	4
Disposable supplies				**3,746**
Spreading spatula	set	10	N/A	N/A
Absorbent cotton	500g/roll	5	5	25
Latex gloves size M, S	box/50	50	14.7	735
Face Mask	box/50	50	6.47	324
Syringe 5 ml	box/100	20	15	300
Syringe 50 ml	box/20	10	20	200
Syringe 2 ml	box/100	20	15	300
Biohazard Autoclave Bag 8.5x11"	pack/200	5	80	400
Bottle brush		50	0.59	30
Swab with transport medium for bacteria	pack/200	50	N/A	N/A
Aluminium foil	roll	20	2.4	47
Microscope slide76x26mm	pack/100	100	11	1,100
Cover glass22x22mm	pack/200	10	5	50
Filter paper Watman grade 2 diameter 125 mm	box	12	19.56	235
Total				***10,202***
Total (Kip)				***86,717,000***

Notes: The estimated inputs and costs correspond to 50 samples of carcasses and 500 samples of organs.
Average exchange rate of 8,500 Kip to US$1.
Source: Data was prepared by Dr. Phengphet Vorachit (NAHC/DOLF).

B. Allowance, transport. and miscellaneous laboratory expenses

HPAI Estimates

4. For the donor-funded HPAI surveillance, 2 rounds of surveys were done in 1 year in 33 target districts of 6 target provinces.[36] There were 24,750 households visited and interviewed. The surveys collected 10,000 sera, 10,000 swab, and 300 carcasses. Collecting serological samples for HPAI usually involves 1 livestock staff each from PAFO and (district) DAFO and 2 village veterinary workers from each village.

5. ***Per diem and travel expenses.*** Accounting for allowances and travel expenses of staff (for 6 provinces, 33 districts, 2 rounds in one year) are shown in Table E-5.

Table E-5. Per diem and travel expenses for HPAI

Target areas	***Unit***	***Cost per unit (Kip)***	***Total (Kip)***
6 PAFO	10 days x 2 rounds	225,000	27,000,000
33 DAFO	10 days x 2 rounds	110,000	72,600,000
2 Village veterinary workers	33 districts x 50 days* x 2 rounds	90,000	594,000,000
		Total (Kip)	***693,600,000***
		Total (US$)	***81,600***

Note: * One village per day. 50 target villages in each district.

6. ***Training expenses.*** Before the start of each survey, separate training sessions were held for PAFOs and DAFOs, and for village veterinary workers. The HPAI training in preparation for collection of samples had 2 phases: phase 1 for PAFOs/DAFOs and phase 2 for training of village veterinary workers by PAFOs/DAFOs, assuming a 5-day course for PAFO/DAFO training and 3-day course for village veterinary workers (Table E-6).

[36] Data and estimation from Dr. Phouvong Phommachanh (NAHC/DOLF), using average exchange rate of 8,500 Kip to US$1.

Table E-6. HPAI-related training costs

Phase 1: Training for PAFO and DAFO (5-day course)			
Per diem for 2 PAFO x 6 provinces + 2 DAFO x 33 districts	212,500 Kip per unit day	5 days	82,875,000 Kip
Travel cost for PAFO and DAFO	150,000 Kip per roundtrip	2 roundtrips x 78 persons	23,400,000 Kip
		Total per diem and travel - Phase 1 (Kip)	**106,275,000**
Phase 2: Training for village veterinary workers (3-day course)			
Per diem for 2 PAFO x 33 districts	225,000 Kip per unit day	3 days	44,550,000 Kip
Per diem for 2 DAFO x 33 districts	110,000 Kip per unit day	3 days	21,780,000 Kip
Travel cost for PAFO and DAFO	150,000 Kip per roundtrip	2 roundtrips x 33 districts	9,900,000 Kip
Per diem and travel cost for 2 village veterinary workers	90,000 Kip per unit day	50 villages x 33 districts	297,000,000 Kip
		Total per diem and travel – Phase 2 (Kip)	**373,230,000 Kip**
		Total HPAI training (Kip)	***479,505,000 Kip*** ***US$56,412***

Miscellaneous laboratory costs.

7. Other expenses include the following:

(a) ***Proficiency tests*** – There are proficiency tests in which a reference laboratory sends standard sample for the HPAI staff to test. The tests consist of 4 samples: positive control, negative control, unknown positive sample, and unknown negative sample, each sample costs US$2,500, for a total of US$10,000.

(b) ***Biosafety cabinet*** – HPAI laboratory utilizes 4 Class II biosafety cabinets to protect the staff from getting infected while performing tests and to protect test samples from getting contaminated. The cabinets are calibrated once a year for a total cost of US$15,000 a year.

8. Table E-7 summarizes HPAI activities in a year. Diagnostic testing is a big component of costs (44 percent), followed by the per diem and travel expenses to collect samples and training expenses. The estimated cost for diagnostic activities is in line with a general estimate from other countries by a World Bank consultant who calculated that the total annual cost of consumables for ELISA and PCR for a small HPAI laboratory is US$150,000 (calibration and maintenance not included).[37]

[37] Personal communication from Tom Deeb. T&M Associates.

Table E-7. Yearly HPAI activity costs

Activity	*Kip*	*US$*	*Percentage of total costs*
Diagnostic tests	1,108,366,000	130,396	44
Maintenance (biosafety cabinets)	127,500,000	15,000	5
Proficiency tests	85,000,000	10,000	3
Survey per diem and travel	693,600,000	81,600	28
Training per diem and travel	479,505,000	56,412	19
Total	***2,493,971,000***	***293,408***	

FMD and CSF estimates

9. For foot-and-mouth disease (FMD) and classical swine fever (CSF), different assumptions were used in making estimations.[38]

10. ***Collection of samples.*** The cost for daily allowances for field staff is estimated to be US$8,333 (1,000 samples at 15 samples per day x 5 persons per day x US$25). The assumption is that the survey will be conducted 4 times costing US$300 each for a total of US$1,200. Sample collection makes use of the "vacuumtainer" (1,000 units at US$1 each) and blood collecting needles (100 units that can be sterilized and re-used at US$1 each). Total sample collection cost for FMD and CSF is US$10,633 (90,380,500 Kip).

11. ***Training courses.*** The costs are based on 2 training courses (both for 5 days) for outbreak investigation and sample collection. The 2 trainings involve PAFO and DAFO from each of the 17 provinces (Table E-8).

Table E-8. Cost for FMD and CSF Training

Per diem allowance for PAFO and DAFO and trainers			
2 participants from 17 provinces (34)	212,500 Kip (US$25) per day	5 days x 2 courses	72,250,000Kip (US$8,500)
4 trainers	340,000 Kip (US$40) per day	5 days x 2 courses	13,600,000 Kip (US$1,600)
Travel expenses for PAFO and DAFO and trainers			
2 participants from 17 provinces (34)	150,000 Kip (US$17.60)	2 roundtrips x 2 courses	20,400,000 Kip (US$2,400)
4 trainers	1,300,500 Kip (US$153) per course	2 courses	2,601,000 Kip (US$306)
Training material	4,250,000 Kip (US$500) per course	2 courses	8,500,000 Kip (US$1,000)
		Total Training for FMD and CFS	***117,351,000 Kip*** (US$13,806) ***58,675,500 Kip*** per course (US$6,903 per course)

[38] Estimation of Dr. Phout Inthavong (NAHC/DOLF), using average exchange rate of 8500 Kip to US$1.

C. Cost for Antibiotics and Vaccines

12. Table E-9 gives an estimate of the amount and costs of antibiotics and vaccines (for the more common OIE-listed diseases) that should be in stock in the event of a disease outbreak. Values for antibiotics and vaccines are US$36,010 and US$125,144, respectively, for a total of US$161,204 (1,370,234,000 Kip).

Table E-9. Estimated costs for vaccines and antibiotics

Antibiotics and Vaccines	*Unit*	*Quantity*		*Unit price (US$)*	*Amount (US$)*	
		Actual	*Desired*		*Actual*	*Desired*
Antibiotics					**16,105**	**36,060**
Penstrep 100ml	bottle	1,000	2,500	7.70	7,700	19,250
Oxytetracycline 20%,50ml	bottle	1,000	2,000	5	5,000	10,000
Enrofloxacin 100,50ml	bottle	500	1,000	3.05	1,525	3,050
Genta-Tylocin,100ml	bottle	500	1,000	3.76	1,880	3,760
Vaccines/vaccine coverage*					**48,652**	**125,144**
Hemorrhagic Septicemia, 15 doses/bottle, 40%	bottle	20,000	53,000	0.83	16,600	43,990
Anthrax, 10 doses/bottle, 0.1%	bottle	100	200	1.17	117	234
FMD for cattle, 20 doses/bottle, 2%	bottle	500	2,000	14.11	7,055	28,220
FMD for pig 75 doses/bottle, 1%	bottle	100	250	58.80	5,880	14,700
CSF 10 doses/bottle, 20%	bottle	20,000	40,000	0.95	19,000	38,000
				Total US$	**64,757**	**161,204**
				Total (Kip)	**550,434,500**	**1,370,234,000**

Notes: *Vaccine coverage refers to percentage of (relevant) livestock population that may be vaccinated given indicated quantity of vaccines.
Average exchange rate of 8,500 Kip to US$1.
Source: Data was prepared by Dr. Phengphet Vorachit (NAHC/DOLF) and Dr. Signa Kittiphone (NAHC/DOLF).

D. Fees for Testing of Animal Feed

13. Table E-10 shows the fees for animal feed analysis.

Table E-10. Fees of feed analysis

Description	**Cost per sample (Kip)**
Dry Matter or Moisture	20,000
Crude Protein	30,000
Crude Fat or Ether Extractive	30,000
Crude Fiber	20,000
Total Ash	20,000
Calcium	30,000
Phosphorous	20,000
Sodium Chloride	20,000

Source: Animal Feed laboratory

Annex F. Lao PDR Data on Expenditures for Agriculture and Health Sectors

1. Budgets for SPS management are responsibility of the Ministry of Agriculture and Forestry (MAF) and Ministry of Health (MOH). Data on expenditure by these ministries on SPS-relevant activities on animal health, plant health, and food safety are not readily available.

2. An analysis of Lao PDR public expenditure shows data on a higher level of aggregation. Table F-1 presents a summary of data. Since 2000-01, public expenditure has almost tripled from 3.5 to 10 trillion Kip (almost US$1.2 billion). The share of recurrent spending has increased from 40 to 67 percent and public investment decreased from 60 to 33 percent. The share of the MAF in expenditure was only 3 percent in 2008-09 and has declined from 17 percent in 2000-01. The MOH has a share fluctuating between 3 and 6 percent. The recurrent expenditure of MAF fluctuates between 1.4 and 1.7 percent and was about US$11 million in 2008-09. The share of MOH fluctuates at close to 3 percent per year and was about US$23 million in 2008-09. Whereas MAF did have a high share of over 20 percent in public investment in the first years of the 2000s, it has declined to 7 percent in 2008-09. The share of MOH has fluctuated at a lower level without a clear trend until it surpassed MAF in 2008-09.

Table F-1. Lao PDR public expenditure, central and local levels (billion Kip and %)

	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09
Total expenditures									
All Ministries – billion Kip	3,548	3,599	4,410	4,172	5,619	6,944	8,099	8,884	10,026
All Ministries – percent	100	100	100	100	100	100	100	100	100
Agriculture – percent	16.6	11.4	11.5	6.9	5.8	6.9	4.5	4.4	3.3
Health – percent	3.7	5.0	5.8	4.3	5.8	3.2	2.8	4.0	6.3
Recurrent expenditures									
All Ministries – billion Kip	1,476	1,672	1,884	2,395	3,184	3,725	4,701	5,442	6,696
All Ministries – percent	100	100	100	100	100	100	100	100	100
Agriculture – percent	1.5	1.6	1.5	1.6	1.7	1.7	1.3	1.4	1.4
Health – percent	3.2	3.6	2.8	2.7	2.5	2.6	2.4	2.8	2.9
Capital expenditures									
All Ministries – billion Kip	2,072	1,926	2,526	1,777	2,435	3,219	3,398	3,442	3,330
All Ministries – percent	100	100	100	100	100	100	100	100	100
Agriculture – percent	27.4	19.9	19.1	13.9	11.0	12.9	8.9	9.2	7.1
Health – percent	4.0	6.2	8.0	6.5	10.0	4.0	3.4	5.8	13.3

Source: Official Gazette Database, World Bank Lao PDR.

Annex G. List of Interviewees

Lao PDR

Food safety

Mr. Chittavong Siviengxay	Deputy Director, FDQCC
Mrs. Sivilay Naphayvong	Head, Food Control Division, FDD
Mrs. Douangchay Malyvanh	Head, Food Division, FDQCC
Mrs. Khambay Phantavong	Senior staff, Microbiological laboratory, FDQCC
Dr. Noikaseumsy Sithivong	Chief, Bacteriology Unit, NCLE
Dr. Kaye Wachsmuth	Consultant, FAO
Mr. Jaakko Korpela	Technical Laboratory Officer, FAO

Plant health

Mr. Phaydy Phiaxaysarakham	Director, Plant Quarantine Division, DOA
Mr. Khamtanh Thadavong	Head, PPC
Ms. Khonesavanh Chittarath	Pathology unit, PPC
Ms. Thipphavanh Silipanyo	Fertilizer and pesticide unit, PPC
Ms. Pheophanh Soysouvanh	Entomology unit, PPC
Mr. Thongsavanh Taipangnavong	National Expert, FAO Inter-Country Programme for Integrated Pest Management in Vegetables (Lao PDR)

Animal health

Dr. Sounthone Vongthilath	Director, Livestock and Veterinary Division, DOLF
Dr. Bounlom Douangngeun	Director, NAHC, DOLF
Dr. Signa Kittiphone	Deputy Director, NAHC
Dr. Phachone Bounma	DOLF
Dr. Thongchay Xayachak	Director, Veterinary Legislation Division, DOLF
Dr. Phengphet Vorachit	Head, Diagnostic Laboratory Unit, NAHC
Dr. Phouth Inthavong	Veterinary Officer, NAHC; Project counterpart, Lao-Australia Animal Health Research Project
Dr. Phouvong Phommachanh	Head, Avian Influenza Diagnostic Laboratory, NAHC
Dr. Syseng Khounsy	PAFO, Luang Prabang
Mr. Sisouphanh Nakasene	Head, Livestock Farming Technical Standard Control Center
Dr. Thongphone Theungphachanh	Chief, Livestock Quality Assurance Unit, NAHC

Thailand

Food safety—Food and Drug Administration, Ministry of Public Health

Dr. Tipvon Parinyasiri	Director, Food Control Division,
Mr. Kitpatch Paranajindar	Post-marketing Section, Food Control Division
Mr. Amarint Nantavitayaporn	Import and Export Inspection Division
Dr. Nattapong Snitmatjaro	Import and Export Inspection Division
Ms. Uraiwan Huabcharoen	Mobile Unit team, Food Control Division
Mr. Sayan Ruadrew	Mobile Unit team, Food Control Division
Mr. Sarawut Jobsi	Mobile Unit team, Food Control Division
Ms. Panchuti Phoopuritham	Mobile Unit team, Food Control Division

Plant health—Plant Protection Research and Development Office, Department of Agriculture, Ministry of Agriculture and Cooperatives

Mr. Surapol Yinasawapun	Chief, Plant Quarantine Research Group
Ms. Prapassara Pimpan	Head, Pesticide Research Group
Ms. Srivisess Kessank	Senior Agricultural Scientist, Plant Quarantine Research Group
Ms. Oraphun Wisessang	Plant Pathology Research Group
Ms. Pornpimon Athipunyakom	Plant Pathology Research Group

Animal health—Department of Livestock Development, Ministry of Agriculture and Cooperatives

Dr. Sirikarn Chotiprasartinthara	Head, Bureau of Disease Control and Veterinary Services
Dr. Pranee Panichabhongse	Bureau of Disease Control and Veterinary Services
Dr. Neppawan Buameethub	Bureau of Disease Control and Veterinary Services
Dr. Weerapong Thanapongtharm	Bureau of Disease Control and Veterinary Services
Dr. Laddawalaya Ratanakorn	Bureau of Disease Control and Veterinary Services
Dr. Adilak Lebnark	Feed Quality Control Division
Ms. Cherdhai Thiratinrat	Director, Bureau of Quality Control of Livestock Products
Ms. Naraya Tangsirisap	Bureau of Quality Control of Livestock Products
Mrs. Nitaya Nijthavorn	Bureau of Quality Control of Livestock Products
Mr. Kitipong Sirisuthanant	Bureau of Quality Control of Livestock Products
Mr. Siripong Suktavonjareonpon	Bureau of Quality Control of Livestock Products
Mrs. Tharntip Rugchat	Chief, Foreign Relations Section
Dr. Ronello Abila	Southeast Asia Coordinator, OIE
Dr. Alexandre Bouchot	Technical Advisor, OIE

Vietnam

Plant health

Mr. Dam Quoc Tru	Deputy Director General, Plant Protection Department
Mr. Nguyen Van Ung	Director, Plant Quarantine Division
Mr. Tu	Director, Plant Quarantine Diagnosis Center
Mr Le Duc Dong	Director, Post-Entry Quarantine Station No. 1
Ms Le Thi Kim Oanh	Director, Northern Pesticide Control Centre

Animal health

Mr. Dam Xuan Thanh	Deputy Director General, Department of Animal Health
Mr. Do Huu Dung	Department of Animal Health
Mr. Nguyen Phu Thai	Quarantine system
Ms. Nguyen Hoai Nam	Head, Drug Management Division
Mr. Ta Hoaung Long	National Center for Veterinary Drugs and Bio-products, Control No. 1 (North)
Mr. Do Huu Dung	Head, Epidemiology Division
Mr. Chu Van Tuat	National Center for Hygiene Inspection, Control No. 1 (North)

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