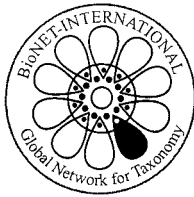




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Needs Assessment in Taxonomy and Biosystematics for Plant Pathogenic Organisms in Countries of South East Asia

**A report prepared by
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for AusAID**

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PREFACE

The Australian Agency for International Development (AusAID) manages the Australian Government's overseas aid program with the objective of assisting developing countries to reduce poverty and achieve sustainable development. Because AusAID itself is not an implementing agency, it achieves results by engaging both public and private sector contractors to design and deliver activities on the ground. AusAID has recognised the importance of building regional capacity in quarantine-related areas. It aims to do this through the development of a strategic approach, based on an assessment of needs, to assist developing countries strengthen their quarantine systems and thereby enhance agricultural and rural development.

In March 2001, the Office of the Chief Plant Protection Officer (OCPPPO), Agriculture, Fisheries and Forestry – Australia (AFFA), in collaboration with ASEANET, sought funding from AusAID to undertake a comprehensive survey of the capacity and needs of regional institutions holding collections of plant pathogens. The financial support provided by AusAID for this activity through its APEC Support Program is gratefully acknowledged.

Generous assistance in the preparation and delivery of this project was provided by Dr Soetikno S. Sastroutomo, ASEANET Technical Secretary, ASEANET National Co-ordinators and other scientists in the countries visited. We wish to thank them and other officials who spoke with us for their time, hospitality and support for the assignment.

While some countries of South East Asia have extensive lists (reports) of plant diseases occurring within their borders, the preservation of herbarium specimens has not been a priority. Many of the herbarium specimens and culture collections that do exist are not supported by essential 'passport' data and cannot meet the international standard for a pest record. Consequently, few of the countries visited can meet the obligations imposed on members of the World Trade Organization (WTO) by the Agreement on the Application of Sanitary and Phytosanitary Measures. To a greater or lesser extent, these countries cannot adequately describe the health status of their agricultural industries, thus causing difficulties in managing plant health within their borders.

The problem seems not so much a lack of capacity to identify plant diseases, but rather a failure to give priority to the preservation of herbarium specimens over time. The situation in the countries visited is not unique. Many countries have not assigned institutional responsibilities for building herbaria and collections and those that do exist are often the result of the enthusiasm and dedication of a small number of scientists working on restricted budgets. It is only in very recent times that disease herbaria and culture collections have been recognised as a priority for countries trading under WTO rules.

A number of the countries in the region are relatively well endowed with plant pathologists, some specialising in the essential disciplines of mycology, virology, bacteriology and nematology. These scientists are well placed to support the development of national plant disease herbaria and pathogen collections if asked to help. Further, ASEAN Senior Officials on the Environment have endorsed the

concept of ASEANET, providing a platform for regional collaboration in taxonomy and biosystematics. Key decision makers in agriculture also need to be briefed on the importance of herbaria and collections with strong recommendations for giving the development of these facilities a high priority. No one can expect chief executives and politicians to know how important these facilities are – they must be told in terms that they can relate to, that is national development and trade. They also need to understand that these facilities are important to all countries of the region, not just to those countries seeking export markets. Countries importing agricultural commodities need the information contained in herbaria and collections if they are to develop robust quarantine policies and, given the common borders between countries in the region, there is a strong case for collaborating for security against plant pests that may damage crops and indigenous flora.

The attached report contains a work program for moving forward. It is of necessity generic, rather than specific to individual countries. Specific needs for training and equipment will be manifested as progress is made on the more general approach to building diagnostic capacities, populating herbaria, curating the collections and managing the data contained therein.

G.E
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1. SUMMARY AND RECOMMENDATIONS

The Project Team

In March 2001 the Australian Agency for International Development (AusAID) allocated resources from its APEC Support Program for a stock take and needs assessment of disease herbaria¹ and collections of plant pathogens throughout the countries of South East Asia. The assignment was undertaken by Dr Graeme Evans from the Office of the Chief Plant Protection Officer (OCPPO), Agriculture Fisheries and Forestry – Australia (AFFA) and Dr Keng Yeang Lum of the Malaysian Agricultural Research and Development Institute (MARDI) in his capacity as Chairman of ASEANET².

ASEANET is the South East Asian LOOP of BioNET-INTERNATIONAL, an organisation that works cooperatively and on a world scale to enhance the capacity of developing nations to undertake taxonomy work. ASEANET's mission is to achieve self-reliance in taxonomy and biosystematics³ of insects, nematodes and micro-organisms for its member countries through sharing of resources and the reciprocal provision of expertise and services in plant health. Work programs focus on effective networking through the application of information and communication technologies, human resources and training, rehabilitation of biological collections and development and application of new technologies. ASEANET was established after formal endorsement at the 9th ASEAN Senior Officials Meeting on the Environment in September 1998.

The Contextual Issues

For developing countries in the ASEAN region, agricultural and rural development is vital for sustainable growth and poverty reduction. The development challenge facing these countries is to manage their plant health to maximise productivity, address food security concerns, conserve natural resources, and generate rural income by participating fully in international trade in agricultural products. The industrialised and more advanced of the developing countries of the region also need robust plant health infrastructure to manage plant pests, to preserve the integrity of quarantine borders and to support trade in agricultural commodities.

In order to address these challenges, ASEAN countries must have a detailed knowledge of their plant health status and be able to access information on the biology, distribution, host range and economic status of plant pests and pathogens⁴. Biological collections contain much of this information and are of fundamental importance to regional countries as they seek to improve their quarantine security, protect agriculture and natural resources, and underpin market access negotiations in the global trading environment.

¹ The term 'disease herbarium' is used to describe collections of plants infected by plant pathogens. The collections are preserved material, usually as dry specimens. The herbaria are in fact dual collections, that is the host plant and the pathogen. A herbarium differs from a collection of plant pathogens that may be maintained as living or dead cultures.

² With the exception of Indonesia, which was conducted by Leanne Murdoch (OCPPO) and K.Y. Lum.

³ Taxonomy and biosystematics deal with the identification (naming) and classification of all living organisms and are the foundation on which all other biological sciences depend.

⁴ Hereinafter the term pest is used to include arthropod pests, nematodes and plant pathogens.

Plant Health and Trade Policy

The establishment of the World Trade Organization (WTO) in 1995 is widely seen as providing new opportunities for trade in agricultural commodities. The reality, however, may be very different unless barriers based on health and quarantine are managed effectively under the WTO Agreement on the Application of Sanitary and Phytosanitary (SPS) Measures. SPS measures are domestic standards or regulations covering such matters as the presence of microbial contaminants, toxins, heavy metals and pesticide residues in food and pests, weeds and pathogens. The SPS Agreement removes the rights of countries to arbitrarily restrict access to domestic markets on health and safety grounds and calls on members to harmonise sanitary and phytosanitary measures on a global basis by adopting international standards, guidelines and recommendations, where these exist.

Among other things, the SPS Agreement requires prospective exporting countries and target markets to provide scientific evidence to substantiate any claims regarding the presence or absence of pests. It is not acceptable to indicate that a pest is 'not known to occur'; rather, evidence needs to be presented to support the assertion that the pest is 'known not to occur'. In this regard, diseased specimens and culture collections are the only internationally recognised evidence of the existence of a pest in a country. If a country is able to provide accurate records to validate the pest status of a region, overseas market access bids for agricultural products can be processed quickly, with obvious benefits to the rural sector. Long delays are encountered when these data are not available and this can be a source of ongoing trade friction.

Status of Disease Herbaria and Pathogen Collections in ASEAN

In Section 6 of this report the Project Team presents its observations on plant disease herbaria and collections of pathogens in the institutions that were included on their schedule of visits in Brunei Darussalam, Indonesia, Laos, Malaysia, the Philippines, Singapore, Thailand and Viet Nam. While the purpose of the assignment was to assess herbaria and collections of relevance to agriculture, the Project Team also visited the herbaria and collections of two forest research institutions in Malaysia. These differed from collections of agricultural pests in that the vast majority of the specimens are wood rotting fungi, rather than pathogens, although pathogens are retained as well⁵.

Institutional responsibilities for maintaining disease herbaria and collections of plant pathogens in a number of countries visited are ill-defined. This is reflected, in part at least, in the low level of resources allocated to maintaining diseased specimens and plant pathogens and the poor state of some herbaria. The well-being of these valuable national resources is largely dependent on a small number of dedicated scientists in government agencies, research establishments and universities⁶.

⁵ In hindsight it would have been useful to include more forest research institutions on the schedule of visits because the two in Malaysia were among the largest and best maintained of the collections visited.

⁶ In this regard the situation is not so very different from what exists in Australia, with only a few collections protected by legislation and most functioning in an environment of declining real resources when aggregate funding for agricultural research and development has remained relatively constant in real terms. Recognising the problem, and with plant health now a major trade policy issue, new money is beginning to flow to Australia's collections through Plant Health Australia.

The Project Team identified a number of matters that need to be addressed to improve the disease herbaria and pathogen collections in ASEAN countries in order to bring these to an adequate standard to support national plant health policy, including pest risk assessments to underpin market access negotiations. These matters are listed below⁷:

- A need to enhance understanding among some senior managers, and even some plant health professionals, of the importance of herbaria and collections as the most vital component of a country's plant health infrastructure;
- Insufficient numbers of plant health professionals in most agencies/institutions, especially trained specialists for identifying plant pathogens;
- A need to enhance understanding among some plant health professionals of the opportunities to use the informal global network of specialists to assist them to identify plant pathogens – providing a cost-free way of having specimens identified;
- A need to enhance the maintenance of existing herbaria and collections in some laboratories to arrest the loss of valuable records;
- A need to improve infrastructure for maintaining herbaria and collections;
- A need to improve 'passport' data on specimens to meet the International Plant Protection Convention (IPPC) standard (ISPM No.8⁸) for a pest record;
- A need to improve systems for extracting data on specimens held in the herbaria and collections;
- A need to improve understanding among scientists in regional laboratories and universities of the role they might play in supporting the development of a national herbarium and pathogen collection, such as by helping to populate the herbaria and collections and by lending their expertise to an important national project; and
- A need to improve understanding among some senior managers of the importance of plant health as a trade policy issue.

RECOMMENDATION 1

Noting the existence of a regional network of taxonomists and plant health professionals endorsed by ASEAN Senior Officials, it is recommended that consideration be given to the opportunities for delivering regional programs in taxonomy and related plant health sciences under the aegis of ASEANET. An appropriate course of action might be for donor agencies to first establish priorities for capacity building initiatives in the region and to approach ASEANET with a proposition for collaborating on activities of relevance to describing the plant health status of countries in the region, including identifying plant pathogens, building and maintaining disease herbaria and collections, and managing data contained therein.

⁷ To a greater or lesser degree, the problems identified by the Project Team are encountered in institutions in Australia and elsewhere.

⁸ ISPM No.8 refers to the IPPC standard that sets out minimum data requirements to establish a pest record.

Addressing the Problems

The Project Team is proposing a portfolio of activities that relevant donor agencies might resource to enhance the capacity of ASEAN government agencies and universities to improve the standard of their disease herbaria and pathogen collections. This has been done with a view to improving the management of plant pests and the capacity of countries in the region to address the challenges facing plant health professionals in the new global trading environment. The activities proposed are aggregated under the following broad headings:

- Establish institutional responsibility for herbaria and collections;
- Harness the expertise of a broad spectrum of plant health scientists to develop herbaria and pathogen collections;
- Technical training and development;
- Populating disease herbaria;
- Addressing the needs of the new ASEANs;
- Infrastructure needs; and
- Train-the-Trainers.

Establish Institutional Responsibility for Herbaria and Collections

While the Project Team attributes the variable state of disease herbaria and pathogen collections within ASEAN to a paucity of human resources, a lack of technical skills and ill-defined institutional responsibilities in some countries, some senior managers appear not well informed about the essential purpose of these facilities⁹. Until such time as they are informed and give the development of herbaria and collections a high priority among the competing demands for resources, then there is little point in emphasising capacity building in plant health and training through assistance programs.

RECOMMENDATION 2

Noting the need to create awareness among senior ASEAN managers and plant health scientists of the critical importance of disease herbaria and pathogen collections, it is recommended that donor agencies consider supporting a meeting to consider the issue of institutional responsibilities for these important national facilities. This might be done by including the matter on the agenda for the next ASEANET LOOP Coordinating Committee (LCC) meeting to be hosted by Brunei in 2002 and by expanding participation to include institutional managers responsible for National Plant Protection Organisations (NPPOs) and other plant health agencies. The Project Team also proposes that the third ASEANET LCC meeting seeks support for a portfolio of activities structured to build capacity in identifying pathogens, building and maintaining collections and data management. Recommendations emerging from the LCC meeting could be put to relevant ASEAN Senior Officials for endorsement.

⁹ In the context of international trade negotiations, specimens and other material contained in biological collections are the only acceptable records of pathogens that are known to exist within a country and so are vital components of quarantine policy.

Disease herbaria and pathogen collections, like other biological collections, are important national resources in need of legislative protection and good governance. The latter may be strengthened by the appointment of Boards of Management, or similar bodies, to give recognition to the importance of these collections, to provide patronage and to influence funding priorities of the institutions responsible for these resources.

Harness the Expertise of a Broad Spectrum of Plant Health Scientists to Develop Herbaria and Pathogen Collections

In the absence of any concerted effort to build a profile of the pest status of ASEAN countries, there has been no reason to seek out and harness the expertise of plant pathologists within the region to help with the task. Yet the low level of resources allocated to disease herbaria and pathogen collections could be supplemented greatly by drawing on practicing plant pathologists and academics throughout the countries of ASEAN. Most of the scientists that the Project Team spoke to are eager to participate. These professionals are an integral part of national plant health infrastructure. They also have an important role in populating disease herbaria with specimens that are encountered routinely in training students and from the disease clinics that are run in some academic and other institutions. Many plant health professionals have expertise in identifying important groups of pathogens and some rate among the global authorities in their field.

RECOMMENDATION 3

The Project Team recommends that relevant donor bodies give consideration to supporting small, regional (in-country) workshops/seminars under the aegis of the NPPO, other plant health agencies and professional societies to promote an awareness of the importance of disease herbaria and pathogen collections as an essential component of plant health infrastructure in all countries. These meetings would need to be structured to create awareness of the role that all plant health professionals have in supporting and populating disease herbaria and pathogen collections of national significance.

The Project Team envisages that the agenda for these workshops/seminars includes consideration of the opportunities to establish and formalise an in-country network of contributors that would give recognition to the role of non-NPPO plant health scientists as a vital component of national plant health infrastructure.

Topics for the workshops/seminars referred to in Recommendation 3 might include:

- An introduction to the World Trade Organization and the SPS Agreement;
- The International Plant Protection Convention;
- An introduction to pest risk assessment and risk management;
- Reporting obligations of the NPPO;
- Opportunities for improving the management of pests, including new pest incursions, when the plant health status of the country is understood;
- Best practise in maintaining collections of the major groups of plant pathogens;

- Populating disease herbaria, record keeping and data management; and
- Using the informal global network of specialists for confirming identifications.

Technical Training and Development

While there may be value in providing training for some ASEAN scientists in countries such as Australia, this may be premature. The Project Team favours supporting small regional workshops, bringing together plant pathologists from ASEAN countries, regional and other experts to work on the fundamentals viz, identification of plant pathogens, maintenance of herbaria and data management, drawing on regional expertise.

RECOMMENDATION 4

The Project Team recommends that donor agencies give consideration to supporting a series of small workshops bringing together selected scientists from member countries and an internationally recognised expert or experts to enhance diagnostic and networking skills to pursue identification of plant pathogens of regional concern. Two important objectives would be to assess the effectiveness of these workshops in promoting networking and to test the concept that regional collaboration is viable.

Further,

RECOMMENDATION 5

The Project Team recommends that relevant donor agencies approach ASEANET with a proposal to host a regional workshop bringing together plant health scientists responsible for managing disease herbaria and pathogen collections with a view to exchanging information on preservation techniques, record keeping and requirements for 'passport' data for addressing the IPPC's international standard for a pest record (ISPM No.8).

And,

RECOMMENDATION 6

The Project Team recommends that relevant donor agencies approach ASEANET with a proposal to support a small steering committee to advise on the opportunities for adopting common software for managing data contained in disease herbaria and pathogen collections of the region. This may not require major changes to existing databases, but rather the software may sit on top of existing systems to access critical data on plant pests.

The Project Team envisages that the workshops referred to in Recommendation 4 will provide an opportunity to identify plant health scientists who might benefit from further technical training and development.

RECOMMENDATION 7

It is recommended that relevant donor agencies give consideration to supporting specialised/targeted training for selected ASEAN scientists in taxonomy and related areas to enhance the capacity of plant pathologists to identify plant diseases and to improve the management of disease herbaria, including data contained therein.

Populating Herbaria

Most disease herbaria and pathogen collections in ASEAN countries are small. Some are very narrow in their coverage. Even when taken in aggregate, the herbaria do not provide adequate information to describe the plant health status of member countries, particularly as there are gaps in ‘passport’ data, raising questions about the veracity of information held by scientists in ASEAN countries. To the extent that academics and other plant health professionals are prepared to collaborate to develop the herbaria (see Recommendation 2), it is possible that specimen numbers could be expanded relatively rapidly. Even then there are likely to be significant gaps in the coverage of the information because of the emphasis on rice, industrial crops and vegetables. The Project Team perceived a significant gap in information available from some regions and on fruit crops in particular. These gaps might be addressed by structured surveys for plant diseases, possibly involving pathologists from more than one country. In some cases, opportunities will exist to utilise newly developed molecular diagnostic protocols.

RECOMMENDATION 8

In the interests of expanding the coverage of plant disease herbaria in ASEAN countries, it is recommended that relevant donor agencies give consideration to sponsoring a number of structured surveys of crops for plant pathogens. This might be done in collaboration with plant pathologists in the new ASEANs who need to develop skills and begin the task of building basic plant health infrastructure around diagnostic capability and records of pathogens in those countries. ASEANET and plant health agencies in ASEAN countries could be asked to identify particular crops/countries and regions to be surveyed and to nominate regional plant health scientists who might lead these surveys. Opportunities for scientists from Australian and other countries to collaborate also need to be considered.

Addressing the Needs of the New ASEANs

Laos¹⁰ is not well supported by plant pathologists and the country has little basic plant health infrastructure. In contrast, Viet Nam is relatively well endowed, although the Project Team is not in a strong position to comment on the expertise of the scientists within the country. Doubtless many would benefit from development opportunities. There appeared to be a strong bias in Viet Nam towards nematology as a discipline that may not be justified given the relatively small emphasis that is given to the discipline in most other countries. This bias could reflect the interests of academics responsible for training plant pathologists in Viet Nam and/or institutional links with European laboratories with skills in nematology.

Support provided by ACIAR and AusAID for plant health initiatives in Viet Nam indicates that these agencies have assessed a need to develop the diagnostic skills of plant health scientists there. The Project Team considered the options for assisting the new ASEANs and concluded that the model developed by Professor Burgess from Sydney University working with students and plant health scientists at Hanoi Agricultural University could be adopted for other new ASEANs.

RECOMMENDATION 9

Noting the progress that has been made in fostering the development of diagnostic skills among some plant health scientists in Viet Nam through collaborative programs surveying for plant diseases in the country, it is recommended that consideration be given to adopting the model for Laos, and possibly for Myanmar and Cambodia as well. Such an initiative would develop skills and assist in populating national disease herbaria. These activities would complement the surveys proposed in Recommendation 8.

Plant health agencies of the industrialised and more advanced members of ASEAN are generally well supplied with essential laboratory equipment for identifying plant pathogens and for maintaining disease herbaria and pathogen collections, although access to literature was raised as an impediment. Some scientists raised concern about the low level of recurrent funding from their institutions for servicing equipment, much provided by donor agencies. Some were to complain about the lack of access to/availability of semi-automated technologies for identifying pathogenic bacteria and 'kits' for identifying some viruses that utilise molecular probes to detect differences in DNA/RNA. While acknowledging the problems identified by our hosts, the Project Team recognises that these could be addressed, in part, by making use of the ASEANET network of plant health professionals. Further, given the stage of development of the disease herbaria in most ASEAN countries, there is considerable scope to build traditional skills for identifying pathogens using morphological features and pathogenicity testing. Modern, sophisticated and expensive technologies may speed identification and discriminate subtle differences in pathogens, but these are advances at the margin and could not be considered essential for

¹⁰ And possibly Myanmar and Cambodia as well.

some of the laboratories visited. Further, molecular technologies are not available for the vast majority of plant pathogens.

Institutions in some of the industrialised and more advanced members of ASEAN were not providing adequate accommodation and resources for disease herbaria and pathogen collections. This may be more an issue of the priorities accorded to these resources in agencies that have no institutional responsibility for maintaining disease herbaria and pathogen collections than an overall lack of resources.

RECOMMENDATION 10

Noting the problems of recurrent funding for maintaining essential diagnostic facilities and deficiencies in accommodation provided for disease herbaria and pathogen collections, it is recommended that relevant donor agencies give consideration to the opportunities for providing what would be relatively modest support for plant health infrastructure.

In contrast to the situation in the industrialised and more developed members of the Association, the new ASEANS are generally not so well endowed with essential infrastructure. That stated, infrastructure in Viet Nam is variable with some laboratories/institutions relatively well equipped with essential infrastructure. Laos on the other hand was poorly equipped.

RECOMMENDATION 11

It is recommended that relevant donor agencies give consideration to the opportunities for selectively providing essential laboratory equipment to the new ASEANS to match advances in the capacity of their scientists to make use of the equipment.

Train-the-Trainers

A subject that emerged several times in the course of this assignment was training in pest risk analysis (PRA). The subject has been mystified to the point that scientists in the ASEAN region feel uncomfortable with their lack of understanding about it.

In practise, PRA is nothing more than a process for providing transparency to the systematic assessment, based on scientific principles and knowledge about the biology of pests, of the risks posed by moving agricultural commodities and other goods from one region to another.

The Project Team supports the need for training for ASEAN scientists, quarantine officials and other professionals in PRA¹¹, drawing on the expertise of professionals from within the region. Competency in English is a prime requisite for people who might be asked to deliver regional training because it is the one language common to the region. Competency in English would be less important for people who might be trained to deliver PRA training in their native tongue.

RECOMMENDATION 12

Noting the need to enhance the knowledge base about PRA in ASEAN countries, the Project Team recommends that consideration be given to an initiative to ‘Train-the-Trainers’. The objective of such an initiative would be to disseminate knowledge of the process among many plant health professionals and to provide detailed training in PRA to more select groups responsible for assessing/preparing market access bids. Understanding the process will highlight the precise nature of information that countries need to assess risks and the critical role of data contained in disease herbaria and pathogen collections. Moreover, it will throw into sharp relief the paucity of data in most countries of the region.

¹¹ In May 2001, staff of the Office of the Chief Plant Protection Officer delivered training in pest risk analysis to plant health scientists and quarantine professionals in Thailand. As a part of the assignment, AusAID was provided with a training manual and a handbook of exercises that would form the basis for any future training in pest risk analysis.

2. INTRODUCTION

For developing countries in the South East Asian region, agricultural and rural development is vital for sustainable growth and poverty reduction. The development challenge facing these countries is to manage their plant health to maximise domestic productivity, address food security concerns, conserve natural resources, and generate rural income by participating fully in international trade in agricultural products.

In order to address this challenge, these countries must have a detailed knowledge of their plant health status and be able to access information on the biology, distribution, host range and economic status of plant pests and pathogens. Biological collections, and the associated expertise in taxonomy, are repositories of such information and are of fundamental importance to regional countries as they seek to improve their quarantine security, protect their natural resources, and underpin market access negotiations in the global trading environment.

2.1 BACKGROUND TO THE ACTIVITY

This activity is an initiative of the Office of the Chief Plant Protection Officer (OCPPO) and ASEANET, a Technical Cooperation Network for sustainable development through capacity-building in taxonomy.

ASEANET was established after formal endorsement at the 9th ASEAN Senior Officials Meeting on the Environment in September 1998. It is the South East Asian LOOP of BioNET-INTERNATIONAL, an organisation that works cooperatively and on a world scale to increase the capacity of nations to undertake biosystematic work. A particular goal of BioNET is to enhance the ability of developing nations to identify, document and understand their arthropods, fungi, nematodes and other microorganisms. The organisation encompasses biosystematic issues relevant to agriculture, forestry, fisheries, international trade, international treaties and conventions, natural resource management, conservation and biodiversity.

The regional subgroups of BioNET are known as ‘LOOPS’ (Locally Organized and Operated Partnerships) and comprise a regional secretariat and a contact institution in each member nation. ASEANET’s mission is to achieve self-reliance in taxonomy and biosystematics for ASEAN member countries through sharing of resources and the reciprocal provision of expertise and services in plant health. Four work programs to build capacity in taxonomy and biosystematics have been proposed by ASEANET. These programs cover:

- Development of information and communication services
 - Includes establishing a standardised database system which links regional institutions involved in taxonomy to facilitate common access to information both within and between countries.
- Human resource development and training
 - With the objective of improving access to formal training courses in taxonomy and biosystematics in the region.

- Rehabilitation of resources
 - This program encompasses both the rehabilitation of centres holding collections of regional importance and the repatriation of collection information.
- Development and application of new technologies
 - This includes the acquisition and/or development of biochemical, molecular and computer-based diagnostic systems, including electronic keys.

The rehabilitation of biological collections, together with the adoption of information technology to improve access to the valuable data lodged in the collections, has been identified by ASEANET as a priority area for member countries. However, the implementation an effective work program to build capacity in this area is dependent on having an understanding of the relative strengths, weaknesses, and needs of countries in the region.

It was against this background that the OCPPO and ASEANET sought financial support from AusAID to undertake an assessment of the needs of regional institutions holding plant pathogen collections. The collaborating agencies outlined their objectives for the needs assessment in the following terms:

- To conduct a survey of regional countries to gather comprehensive information with respect to the status of institutional capacities and practices in taxonomy and identification of pathogens, including collection management, data handling, information management, infrastructure and human resources.
- To assess the existing level of diagnostic and taxonomic expertise available to support pathogen collections and the areas of critical need.
- To determine the needs of regional countries to achieve realistic self-reliance as envisaged for an operational regional network in taxonomy.

Because pathogen collections do not exist in all countries of the region, the needs assessment focused on those countries that have some capacity in taxonomy and biosystematics for plant pathogens. These countries are Brunei Darussalam, Indonesia, Laos, Malaysia, the Philippines, Thailand, Singapore, and Viet Nam.

3. THE CONTEXTUAL ISSUES – WHY THE FOCUS ON PLANT HEALTH?

The completion of the Uruguay Round of trade negotiations under the General Agreement on Tariffs and Trade and establishment of the World Trade Organization (WTO) in 1995 are seen as holding particularly significant implications for plant health and crop protection. The WTO Agreement on the Application of Sanitary and Phytosanitary (SPS) Measures sets conditions, based on scientific principles and risk assessment, to protect agricultural industries from exotic pests¹², yet at the same time facilitate trade in agricultural commodities. The Agreement allows members to restrict access to their markets on health and safety grounds, but these restrictions must be transparent and technically justified.

In order for countries to benefit from the spirit of trade liberalisation embodied in the agreement establishing the WTO and participate fully in international trade, they must be able to comply with SPS obligations. The basic infrastructure underpinning plant health is vital if quarantine services are to meet the requirements of the SPS Agreement for a scientific analysis of the risk of moving pests with traded commodities. 'Basic plant health infrastructure' encompasses such matters as:

- A capacity to accurately and rapidly identify pests; and
- An ability to provide detailed records on the occurrence and distribution of pests, based on voucher specimens and effective monitoring and surveillance systems.

Capacity in plant health is also important to promote sustainable development and protect biodiversity. In this section, we discuss the role of plant health in:

- *Trade* - countries seeking to export agricultural commodities must know what pests could affect those commodities and be able to provide scientific data to support market access negotiations.
- *Sustainable development* - plant pests continue to reduce productivity in all agricultural enterprises. Countries that have an accurate knowledge of their plant health status, and the ability to detect, identify and manage incursions of exotics, are better able to assess the risks associated with the importation of commodities from overseas and develop sustainable pest management programs, providing improved protection to the rural sector.
- *Environmental protection* - pests of agricultural commodities can also threaten ecosystems and natural habitats. Sustainable pest management, including the prevention, containment and control of invasive species, is vital for both biodiversity conservation and agricultural production.

¹² The term 'pest' is used to include both arthropod pests and plant pathogens.

3.1 PLANT HEALTH AND TRADE

A key element in negotiations for market access is the capacity of quarantine services to provide a detailed pest risk analysis (PRA), based on records of the occurrence and distribution of plant pests in exporting countries. PRAs cover such matters as:

- The plant health status of agricultural industries in the country or region from which the commodities are to be sourced;
- The likelihood of pests of concern being transported with commodities and establishing in the importing country;
- Potential damage that introduced pests might cause to crops and native flora; and
- The efficacy of phytosanitary treatments that might be used to manage identified risks.

Under the SPS Agreement, both the prospective exporting country and the target market must be able to provide scientific evidence to substantiate any claims regarding the presence or absence of plant pests. This information should include details about a pest's geographical distribution, its biology and economic importance. It is not acceptable to indicate that a pest is 'not known to occur'. Rather, evidence needs to be presented to support the assertion that the pest is 'known not to occur'. If a country is able to provide accurate records to validate the pest status of a region, overseas market access bids for agricultural products can be made quickly, with obvious benefits to the rural sector. Long delays are encountered when these data are not available and this can be a source of ongoing trade friction.

3.1.1 What Constitutes a Pest Record

The SPS Agreement identifies the International Plant Protection Convention (IPPC) as the international organisation responsible for phytosanitary standard-setting and the harmonisation of measures affecting trade. The IPPC complements the SPS Agreement by providing the international standards that help to ensure that phytosanitary measures have a scientific basis for their implementation and are not used as unjustified barriers to international trade.

The IPPC has recognised that all importing and exporting countries need reliable information concerning their plant health status if they are to conduct risk analyses, establish and comply with phytosanitary regulations, develop pest management programs, and maintain pest free areas. To assist countries meet their obligations under the SPS Agreement for the provision of accurate plant health data, the IPPC has set out the requirements for a pest record in the standard *Determination of Pest Status in an Area* (ISPM No.8). The standard identifies the basic information that is needed to constitute a pest record, namely:

- Current scientific name of the organism;
- Life stage or state (e.g. larva, fruiting bodies);
- Taxonomic group (e.g. family, order);
- Identification method (e.g. taxonomic description by a specialist);
- Date recorded;
- Place (locality);

- Prevalence;
- Scientific name of the host(s), where appropriate;
- Host damage, or circumstances of collection; and
- References or other information pertaining to the observation.

3.2 SUSTAINABLE DEVELOPMENT

Incursions of exotic pests pose an ongoing threat to sustaining primary production in all enterprises. The impact of the movement and establishment of exotic organisms varies considerably, depending on the biology of the pest and its host range. In some cases, existing measures applied to manage endemic pests will control the exotic pest at no additional cost to the rural sector. In other instances, an exotic incursion may have major implications for specific agricultural industries through crop losses, increases in production costs, and immediate loss of markets. There is also the possibility that the threat posed by new exotic pest will extend beyond agriculture, to amenity flora, environmental ecosystems and the general public.

The potential impacts of an exotic incursion may include one or more of the following:

- Yield loss in host crops and/or downgrading of quality;
- On-going increases in production costs due to additional control measures;
- Economic losses due to market access restrictions;
- Increased costs to growers incurred as a result of disinfestation of host produce for domestic and overseas markets;
- Rejection by consumers of fresh produce that has been treated (sprayed, dipped, fumigated) for the pest;
- Additional research and development costs;
- Damage to environmental ecosystems and/or amenities (private gardens, parks, nature strips, etc); and
- Risks to human health.

The ability to manage endemic pests and address exotic threats through contingency planning is vital for countries seeking to increase agricultural production and the export performance of the rural sector. Pre-emptive strategies underscored by a strong capability in taxonomy, plant health data management, diagnostics and surveillance are central to any biosecurity strategy and are increasingly important in international trade as a result of the SPS Agreement.

3.3 ENVIRONMENTAL PROTECTION

The transborder movement of invasive species is widely recognised as potentially causing environmental harm. Under the Convention on Biological Diversity (CBD), contracting Parties have an obligation to *prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats and species*. This includes plant pathogens, arthropod pests, weeds and other organisms that threaten the stability of managed (agriculture and forestry) and natural ecosystems.

However, the control and management of invasive species presents a substantial challenge because it requires an understanding of their biology, population dynamics, status in the country, and ecological and economic impacts. Basic capacity in plant health, including the ability to identify, control and monitor these organisms, is vital if countries are to fulfil the requirements of the CBD for the prevention of the movement of invasive species and the mitigation of their impacts on biodiversity.

4. COLLECTIONS OF PLANT PATHOGENS

4.1 THE PURPOSE AND FUNCTIONS OF COLLECTIONS

Disease in agricultural crops and native flora is caused by numerous pathogens in the major groups of fungi, bacteria, viruses and nematodes, and the smaller groups of phytoplasmas, viroids and rickettsias. Collections of these pathogens serve a number of important functions. In particular, they:

- Facilitate the preparation of market access bids for agricultural products and ensure that quarantine decisions are appropriate;
- Support the timely identification of crop diseases; and
- Record biodiversity.

4.1.1 The Role of Collections in Trade

Information on the presence or absence of a pest is available from many sources and has varying levels of reliability. However, in the context of international trade, records based on voucher specimens that are held in properly curated collections provide the most reliable evidence of a country's plant health status. This is because these specimens can be re-examined to prove their veracity or to obtain more precise data on the circumstances under which the specimens were obtained and on their distribution.

On the other hand, published records that are not supported by voucher specimens cannot be validated and are a potential impediment to agricultural trade. Erroneous records can be extremely difficult, time-consuming and expensive to disprove to the satisfaction of a prospective trading partner. As a result, specimens and other material contained in biological collections provide a country with a powerful tool to assist bids for market access and to justify measures to exclude potentially harmful exotic species.

4.1.2 Collections and Diagnostics - The Key to Plant Protection

Collections of plant pathogens, and the associated taxonomic expertise, provide critical support to decision makers during the development of quarantine measures and response strategies for incursions by exotic pathogens because they hold vital information concerning a pathogen's distribution, life cycle and alternative host(s). These resources also underpin the day to day management of endemic disease problems.

In the case of incursions by exotics, a decision on whether to control, eradicate or manage an outbreak must be taken quickly and is heavily dependent on the ability to obtain a fast and reliable diagnosis of the organisms involved. Reference collections containing well-curved specimens and cultures provide the soundest basis with which to compare unknown organisms and facilitate the rapid and accurate identification of exotic pathogens.

Accurate identification is important because a correct diagnosis will minimise economic and environmental losses. Conversely, the incorrect identification of a pathogen can have

serious implications, particularly in terms of productivity, quality and trade. Inappropriate control measures may be applied and/or opportunities for eradication lost.

4.1.3 Collections and Biodiversity

The rich biodiversity of countries in the South East Asian region is well recognised. Taxonomy and biosystematics have an important role in conserving these valuable resources. These disciplines provide the scientific tools to identify, catalogue and monitor biodiversity. Collections contribute to our knowledge of biodiversity and also hold data on pathogens that threaten natural ecosystems as well as agriculture. This information is vital for countries seeking to protect their natural resources and meet their international obligations under the CBD.

Systematic biology also affords access to biological information crucial to support the sustainable use of natural resources. For example, the ability of plant protection officers to develop integrated pest and disease management programs in order to minimise reliance on pesticides is dependent on the accurate identification of biological control organisms, such as natural predators and parasites.

4.2 PROTECTING AND MAINTAINING COLLECTIONS

Pathogen collections frequently contain several thousand disease records, including dry and mounted specimens, 'wet' specimens stored in preservatives, and living cultures. Given the value of these collections for agriculture and the environment, it is absolutely critical that they have appropriate protection and are adequately maintained. In this section, we discuss their security and curatorial needs.

4.2.1 Security

Collections require physical security as well as recognition of their value by government.

Statutory protection is vital to ensure that legal arrangements are put in place for the permanent care and curation of important biological collections. In terms of physical security, the specimens need to be housed in secure, fire-proof and temperature-controlled premises. Dry and 'wet' specimens must be correctly maintained to prevent their deterioration and living cultures of microorganisms need to be kept in conditions best suited to their long-term survival. Ideally, collections should be located in the same building or nearby the associated taxonomists and curators.

4.2.2 Curatorial Needs

The maintenance and curation of collections would not be possible without staff skilled in taxonomy and with knowledge of the principles and practices of biosystematics. Biosystematics is the identification of pest and disease organisms as they relate to biological systems (eg. in terms of host range and disease symptoms). In this sense it differs from pure taxonomy, which focuses only on morphological characteristics and is

the basis for the identification and classification of organisms to the genus, species and sub-species levels. The development of any collection is dependent on continued research in both of these disciplines.

Staff responsible for the curation of collections need access to diagnostic keys, specialist scientific literature, as well as reference cultures, antisera, molecular probes and/or serological assay systems. With the exception of viruses, the facilities required to maintain plant pathogen collections (fungi, bacteria and nematodes) are relatively simple, with a light microscope and appropriate storage cabinets being key requirements. Maintenance of virus collections is more resource-intensive and requires access to an electron microscope, ultracentrifuge, and growth cabinets for handling live cultures.

In addition to looking after the collection and providing taxonomic support to quarantine services and agricultural industries, taxonomists increasingly need to be proficient in the use of electronic databases to manage disease records and other data held in the collection. Many curators regard access to computer indexing or databasing systems as a priority.

While it is difficult to judge how many people are required to support any one collection, there is a need for adequate staffing to:

- Curate the collection;
- Validate existing records;
- Provide specialist identifications of new specimens;
- Maintain a database of disease records;
- Undertake research into particular groups of organisms;
- Build links with national and international specialists; and
- Provide advice to quarantine authorities, scientists, diagnostic services, and industry.

Taxonomic resources are in a state of decline in most countries and expertise is often lost as specialists retire or move from research positions into management roles. For this reason, succession planning is vital to ensure the long-term security of collections.

4.3 INFORMATION MANAGEMENT

4.3.1 Networks

While most general plant pathologists would be able to identify the more common diseases of plants, the ability to identify rare or exotic pathogenic organisms to the species level requires specialist skills and experience. It is unlikely that any collection would have associated with it staff that are skilled in the identification of all possible pathogenic organisms. Therefore, taxonomists need to be part of a network providing ready access to the skills of national and international experts on the identification of specific groups. One of the goals of ASEANET is to establish such a network of specialists for the South East Asian region.

Networks make it possible for material to be sent to the relevant specialists within the network for identification - although this may involve increased costs and delays. International networks can also assist taxonomists to keep up to date with advances in

their field of expertise (eg. in relation to new diagnostic techniques) and exchange knowledge with their overseas counterparts. For instance, advances in molecular diagnostics are already having an impact on the way in which many plant pathogens are identified. These techniques can greatly assist taxonomists identify different sub-species and strains of pathogens. In addition, a working relationship with specialists in other countries can enable staff to obtain important reference specimens and cultures that they would not have otherwise had access to.

4.3.2 Databasing

Under the IPPC and WTO, countries have an obligation to maintain accurate records of their plant health status and to provide these on request to other countries. These records, based on curated specimens, are of particular importance in securing access to overseas markets and in providing details for PRAs by importing countries. As a result, specialist staff associated with collections are frequently called upon by officers in quarantine and plant health services to provide information on the identity, occurrence and/or distribution of plant pathogens. This can pose some problems: firstly, unless the disease records are properly managed and available to the user organisation electronically, the information can be extremely difficult to retrieve in a timely manner; and secondly, some curators are reluctant to release data where there is some question as to the veracity of the disease record.

Given the importance of the information contained in plant pathogen collections, there is clearly a need for the disease records to be fully databased and available to users electronically. Specialised information technology systems are available which facilitate the convenient and rapid location of specimens and disease records held in collections. The software needed for this task is relatively inexpensive, however the process of 'populating' the database is more costly. Data capture is a persistent and widespread problem during the early stages of database development and consequently an on-going commitment is required from the relevant institutions to allocate resources for data entry. Another major consideration in the development of any database is the quality and quantity of the underlying information. In many institutions, a significant amount of work is required in the taxonomic area, both in validating existing records and clearing a backlog of unidentified specimens. It is also important that countries establish minimum data standards for their pest records to ensure that they can meet the international standard set out under the IPPC.

In most countries there is no central repository of plant health information since reference collections holding disease records are usually scattered among numerous institutions. This impedes the ready flow of information and, because different levels of priority may be accorded to the individual collections, the quality of the data can also be highly variable. Recent developments in information technology mean that it is now possible to overcome this problem. Distributed database technology enables diverse, geographically isolated databases to be linked so that all of the available data can be accessed from a single point. In a sense, the technology creates a single, virtual national (or regional) database that can be maintained and regularly updated at the local level. The disease records can then be accessed via an internet web site, with appropriate consideration given to ownership, access control and authorisation (certain data may be password-protected).

User queries can generate lists of species, and provide information on their distribution and host range.

A distributed database system that has the capacity to collect and integrate plant health data from a number institutions is possible provided that:

- Institutions responsible for pathogen collections have their disease records held in an electronic database that has an internet connection;
- Resources are available to develop/adapt the specific 'gateway' or 'broker' software needed to link the diverse underlying database sources; and
- The institutions are willing to share their data and have an ongoing commitment to maintain their collection as part of the network (this will include meeting agreed minimum data standards).

An example of the successful implementation of distributed database technology is the NABIN network which links 25 specimen-based biodiversity databases associated with major collections in the USA and Mexico. This technology is currently being used to develop a national pest and disease database in Australia.

5. AGRICULTURE IN SOUTH EAST ASIA - COUNTRY PROFILES

The needs assessment focuses on eight countries in the region where some capacity in taxonomy and biosystematics for plant pathogens is known to exist. These countries are Brunei, Indonesia, Laos, Malaysia, the Philippines, Singapore, Thailand and Viet Nam. This section provides an overview of the status of agriculture in these countries, particularly in relation to production, exports and development plans for the agricultural sector. Except where otherwise indicated, the information and statistics have been sourced from the ASEAN Agriculture section of the Malaysia Agricultural Directory & Index 2001/02 (published by Agriquest Sdn. Bhd).

Important food crops grown in South East Asia include rice, maize, soybean, and root crops, and the major industrial crops are rubber, oil palm, coconut, tea, coffee and cocoa. The region currently contributes a number of agricultural commodities to the world market including oil palm (Malaysia and Indonesia), rubber (Thailand, Malaysia and Indonesia) and rice (Thailand, Viet Nam and Philippines). Those countries with a strong positive balance of trade in agricultural products include Thailand, Malaysia and Viet Nam. Liberalisation of the global market is expected to encourage farm diversification, production and trade of higher-value products.

5.1 BRUNEI DARUSSALAM

Oil and gas are the mainstay of Brunei's economy. Agriculture is a very small sector, contributing less than 3% to Gross Domestic Product (GDP) in 1998. As a result, the country is heavily reliant on imported food products, although the government is trying to diversify the economy and increase food production. The aim is to improve self-sufficiency levels, particularly for rice, fruits and vegetables. In 1998 domestic production of rice, the staple food, was only about 1,000 tonnes.

5.2 INDONESIA

Agriculture is a major employer and important source of income in Indonesia, accounting for 23% of GDP in 1998.

The varied agro-ecological conditions in Indonesia support a wide range of crops. The inner islands of Java, Madura and Bali, which have fertile volcanic soils, are the centre of production and are intensively cultivated with food crops. The poorer soils of the outer islands are planted mainly to tree crops. Spices (including clove, nutmeg and pepper) are produced in the Indonesian archipelago.

Indonesia is a major world producer of coconut, oil palm, coffee, cocoa and rubber. Other important crops include rice and cassava (the major crops are listed in Table 1). In many cases, the yield and quality of crops are limited by poor genetic material and/or the use of cultivars not suited to specific locations.

Table 1: Production of major crops in Indonesia (kt), 1998

Industrial Crops		Food Crops	
Product	Production (kt)	Product	Production (kt)
Cocoa	175	Banana	2,500
Coffee	421	Cassava	16,318
Cotton	8	Coconut	141.5
Jute	12	Dry beans	500
Palm oil	5,000	Groundnut	1,037
Pepper	56.3	Maize	7,987
Rubber	1,750	Papaya	355
Sugarcane	23,121	Peanuts	34
Tea	163	Potato	554
Tobacco	84	Oranges	380
		Rice	47,770
		Soybean	1,881
		Vegetables	4,722

The government has recognised that the existing structure of the agriculture sector in Indonesia, based on primary commodities and reflecting the centrist planning and control approach to policy, is no longer appropriate. The Ministry of Agriculture is keen to develop a new approach to rural development based on the empowerment of rural communities and a facilitating role for government. In its Agricultural Development Program for the period 2000-2004, the Ministry outlined priority areas, which included the development of:

- A Food Security Enhancement Program to enhance the availability of the main food commodities with adequate quality, yield and productivity increases; and
- A globally-oriented Agribusiness Development Program to promote the development of businesses that are able to produce competitive agricultural products, add value to increase income, create employment opportunities and promote regional and national economic development.

5.3 LAOS

Agriculture is a major component of the economy in Laos, contributing 51.5% to the GDP in 1997, and employing about 85% of the labour force.

Rice is the main crop, accounting for about 80% of the planted area or 630,000 ha. However, a lack of irrigation means that production is largely dependent on rainfall and many provincial governments are now trying to produce a satisfactory dry season crop. In 2000, the wet season rice crop was about 1.64 million tonnes and the dry season crop was only 390,405 tonnes. The major non-rice crops grown in Laos are maize, soybean, tuber crops, peanut, tobacco, cotton, sugarcane and vegetables.

The Ministry of Agriculture and Forestry recently conducted its first agricultural census. The survey collected data on the crops cultivated, inputs, farm size, labour and livestock, and is intended to assist in planning for the future.

5.4 MALAYSIA

The agricultural sector is continuing to expand in Malaysia but, in relative terms, is contributing less to the national GDP, accounting for 9% of the GDP in 1999.

Plantation crops, including oil palm, rubber and cocoa, dominate the sector. Malaysia is the world's largest producer of oil palm and its associated products (palm kernel oil and cake). It is also an important producer of rubber, cocoa and pepper. All of these crops require intensive labour inputs for harvesting and processing. These high labour costs have seriously affected the profitability of rubber plantations in Malaysia and consequently there has been a shift to oil palm.

More than 90% of Malaysia's agricultural products are exported and there is an increasing trend towards the export of processed commodities as the government encourages value-adding by the sector.

Rice is the only food crop grown in significant volumes (1,940 kt in 1998), although production does not meet local demand. The government is concerned about the reliance on imports and has launched a number of incentives to increase food security. As a result, fruit and vegetable production are important growth areas.

5.5 PHILIPPINES

Although the economy is dominated by the services, manufacturing and construction sectors, agriculture remains a major employer in the Philippines. However, poor land distribution and low productivity mean that its share of the GDP is decreasing steadily. In 1997, agriculture accounted for 13.5% of GDP.

The Philippines produces a wide range of crops, but coconut and rice (8,555 kt in 1998) dominate. Coconut is a major agricultural export, accounting for nearly half of world production. Fruits, including bananas, pineapples and mangoes, are also important in terms of exports (see Table 2).

5.6 SINGAPORE

Given its small land area and highly industrialised nature, Singapore is anything but an agricultural powerhouse. Agriculture (together with fisheries) accounts for only 0.2% of the GDP and the country is heavily reliant upon agricultural imports from neighbouring countries, particularly Malaysia and Indonesia, and to a lesser extent Australia. Nonetheless, Singapore is an important producer and exporter of orchids and some other ornamental plants. In 1999, exports of orchids and aquatic plants were valued at S\$40 million. There is also some production of fruits and vegetables for domestic consumption (18,928 tonnes in 1999).

**Table 2: Main agricultural export earnings for the Philippines
(US\$ million), 1999**

Commodity	Value
Banana	241
Coconut (oil)	342
Coconut (dessicated)	89
Copra cake	18
Mango	32
Pineapple (canned)	82
Sugar	70

5.7 THAILAND

In recent years, Thailand has moved from an agricultural economy based on the export of rice, rubber and teak, to an industrialising country that is more reliant on services and construction. However, half of the population still depends on agriculture for their income and the sector contributed 11% to GDP in 1997.

Rice, sugarcane, rubber and cassava are among the main commodities produced by Thailand's agricultural sector (see Table 3). In fact, Thailand is the leading exporter of rice in the world, but the production is from a large area with low yield. It is also the largest producer of natural rubber, however its low market price has meant that the government is now proposing to fell 47,000 hectares of rubber a year for replanting with other crops.

**Table 3 - Production & exports of Thailand's main agricultural products (kt),
1999/2000**

Commodity	Production (kt)	Exports (kt)
Cassava	18,750	5,320
Coffee	80	28
Maize (livestock-feed)	4,390	68
Oil palm	3,510 (fresh palms)	?
Pineapple	2,350	475 (canned pineapple)
Rice (main- & off-season)	23,330	6,840
Rubber	2,200	2,030
Soybeans	340	?
Sugarcane	53,140	3,890 (sugar exports)

[Source: Annual Report 2000 (1 April 1999 - 31 March 2000),
Bank for Agriculture and Agricultural Cooperatives, Thailand]

Although vast, Thailand's agricultural sector is hampered by low productivity. This is primarily because most of the production is by smallholders with limited access to technology, irrigation, financial resources and infrastructure. The Thai government has recognised the need to improve the productivity of the agricultural sector. In a bid to

reform the sector, in mid-2000 it introduced a new set of incentives to encourage agricultural investment. These include longer tax exemption periods and duty-free imports of raw materials and machinery.

5.8 VIET NAM

Viet Nam is largely agricultural with 80% of its population rural-based. Agriculture contributes about 25% to the national GDP, however it is gradually being overtaken by the faster-growing industry and services sectors.

Rice is the major food crop and good yields have enabled Viet Nam to position itself as one of the top rice exporters in the world. Other important crops include coffee and rubber (see Table 4). In 1997, Viet Nam became the fourth largest exporter of coffee in the world and the largest in the region, mainly due to increased plantings and extremely good yields. Almost all of the crop is the cheaper Robusta variety which is exported for 5% of the country's export earnings.

Table 4: Agricultural production in Viet Nam (kt), 1997

<i>Industrial crops</i>		<i>Food crops</i>	
Product	Production (kt)	Product	Production (kt)
Coffee	400.3	Cassava	1,983
Cotton	14.1	Groundnut	353
Jute	22.3	Maize	1,641
Rubber	180.7	Other cereals	2,916
Sugarcane	11,428	Rice	27,646
		Sweet potato	1,643
		Soybean	102.5

6. CURRENT STATUS OF HERBARIA AND PATHOGEN COLLECTIONS IN ASEAN

Prior to undertaking this needs assessment the Project Team developed a questionnaire to capture information on the disease herbaria, pathogen collections and the human resources underpinning these in each of the countries to be visited. The questionnaire was sent to the ASEANET National Coordinators with a request that they distribute these to plant health agencies to complete and return. In the event only two were returned in advance of the on-site visits, although most National Coordinators¹³ had these for the Project Team on arrival, with others promised. A copy of the questionnaire is at Attachment 1¹⁴.

In drafting the questionnaire the Project Team was cognisant of the difficulties faced by scientists from non-English speaking backgrounds and avoided asking respondents to distinguish between records and reports of plant pathogens in the country. In the context of international trade, records of plant pathogens based on voucher specimens deposited in properly curated herbaria provide reliable evidence of the plant health status of the country. Voucher specimens can be re-examined to prove their veracity or to obtain more precise information on the circumstances under which the specimens were obtained. On the other hand, published reports that are not supported by voucher specimens cannot be verified. Misidentifications leading to erroneous reports cannot be easily corrected and can be time consuming and expensive to disprove to the satisfaction of a potential trading partner.

6.1 BRUNEI DARUSSALAM

The visit to Brunei was organised by Mr Jamaluddin Hj. Mohd. Yusoff, ASEANET National Coordinator for Brunei. Mr Jamaluddin is Head, Plant Pests Unit, Brunei Agriculture Research Centre, Department of Agriculture. The schedule of visits was as follows:

- Round table discussions with the Assistant Director of Agriculture (Research and Development) (Hajah Normah S.H. Jamil), Mrs Fuziah Haji Hamdan, Senior Plant Pathologist and Mr Yusoff;
- Dr Haji Mohamad Yusof Bin Haji Mohiddin, Director of Agriculture;
- Plant Pathology Unit, Brunei Agriculture Research Centre; and
- Post entry quarantine facility.

At the Brunei Agriculture Research Centre the Project Team inspected the small disease herbarium (some 500 dry specimens) and pathogen collection (about 150 living cultures). The standard of maintenance and presentation were very high. The specimen collection included adequate passport data to meet ISPM 8. The scientist in charge, Mrs Fuziah Haji Hamdan, is well trained in fungal taxonomy, although she would undoubtedly benefit

¹³ With the exception of Viet Nam (Dr Tuat), all local arrangements for the needs assessment survey were made by the respective ASEANET National Coordinators.

¹⁴ Completed questionnaires are held by the Office of the Chief Plant Protection Officer, Agriculture Fisheries and Forestry – Australia.

from more contact with other scientists – like Australia, Brunei also suffers from the tyranny of distance. Her laboratory would benefit through an increase in staff numbers, including specialists in virology and plant bacteriology and advice on managing data on the herbarium specimens and collection. Access to scientific literature was raised as a problem.

Management of plant health in Brunei, especially through quarantine, is particularly important to other countries in the region because of: (a) the diversity of grain, fruit and vegetables imported for domestic consumption (some 85% of all fruits and about 40% of vegetables consumed in Brunei are imported); (b) the common border with Malaysia; and (c) limited resources to undertake pest risk assessment and to oversee phytosanitary measures that may be required to manage risk¹⁵. As a consequence, Brunei could be a gateway for entry of exotic pests into the region. A regional approach to manage the risks involving Malaysia and Indonesia could have merit and be of benefit for much of South East Asia.

Brunei's problem is its small size and limited number of plant health scientists. That aside, the Project Team was impressed by the quality of the scientists in Brunei working in plant health.

6.2 INDONESIA

The Project Team's itinerary in Indonesia was organized by Dr Soenartono ("Tony") Adisoemarto (formerly Director of the Zoological Museum-LIPI) on behalf of Dr Effendy Sumardja, ASEANET Country Coordinator and Assistant Minister for Global Environment. The Project Team met initially with Dr Sumardja to brief him on the purpose of the visit and discuss opportunities for progressing ASEANET's objectives for strengthening regional capacity in biosystematics. In his position as Assistant Minister, Dr Sumardja represents Indonesia in many global environment/biodiversity fora, but also has a good appreciation of the need to improve regional plant health infrastructure to support trade in agricultural products.

In Indonesia, scientists responsible for managing collections and identifying pathogenic organisms are situated in organisations under the Ministry of Agriculture (MOA), the Indonesian Institute of Sciences, and the universities. The schedule included visits to the following institutions:

- Agency for Agricultural Quarantine, MOA, Jakarta;
- Research Institute for Spices and Medicinal Crops, MOA, Bogor;
- Research Institute for Food Crops Biotechnology, MOA, Bogor;
- Research Institute for Veterinary Science (BALITVET), MOA, Bogor;

¹⁵ The Director of Agriculture in Brunei expressed concern about the adequacy of quarantine in the country, but with his background in soil science and newness to the position he had not come to understand the opportunities for assessing risk and putting in place risk management measures to suppress risk to an acceptable level.

- Southeast Asian Regional Centre for Tropical Biology (SEAMEO BIOTROP), Bogor;
- Indonesian Institute of Sciences (LIPI)
 - Microbiology Division, Research Centre for Biology, Bogor,
 - Cell Biology and Tissue Culture Division, Research Centre for Biotechnology, Cibinong; and
- University of Indonesia Culture Collection (UICC), Depok.

The institutions visited were all located in Jakarta or the nearby regions of Bogor, Cibinong and Depok. Significant collections of plant pathogenic organisms are reportedly held at the Bogor Agricultural University (IPB) and the Gajah Mada University in Yogyakarta, however staff in these institutions were occupied with semester examinations during the week of our visit and were unavailable to meet with the Project Team.

6.2.1 Agency for Agricultural Quarantine

Plant Quarantine Laboratories have been established within five quarantine stations located in Jakarta, Medan, Palembang, Surabaya and Makasar; in all there are 78 plant quarantine stations throughout Indonesia. The facility in Jakarta acts as a reference laboratory and training centre for quarantine officers based at regional quarantine stations. The Project Team met with Dr Suwanda, who currently heads the Division of Co-operative Affairs within the Ministry of Agriculture. He was formerly in charge of the laboratories that we visited and indicated that he was looking forward to returning to this position sometime during the year. Dr Suwanda seemed to be well informed of the importance of plant health and quarantine in general under the WTO SPS Agreement and said that improving the Agency's capacity to undertake pest risk analysis is regarded as a priority by the Ministry, but that considerable work is required to develop facilities (such as diagnostic laboratories and collections) to support risk analysis.

The Agency has laboratories for biotechnology, virology, bacteriology, nematology and microbiology, among other things. These facilities were built some 3 years ago and are modestly equipped although they do have equipment for conducting PCR and ELISA tests. The institution holds a very small collection of wet disease specimens for training purposes, a small weed seed collection and a slightly larger slide collection, however the information recorded on labels with these specimens would not meet the IPPC standard for a pest record (databasing software from CSIRO is held by the Agency but staff are not adequately trained in its use). Dr Suwanda said that they are planning to upgrade the laboratories and collections – these will be run by nine staff members who are currently undergoing training (mostly at the Masters level) at various overseas institutions and expected to return towards the end of the year.

Staff in the Agency maintain a list of quarantine pests and meet on an annual basis with a working group of scientists from regional quarantine stations, research institutes and universities to revise the list. It was not clear how often the regional quarantine stations conduct surveys to support these revisions or whether they retain specimens collected during surveillance activities. The Agency is also involved in a number of external collaborations; for example, they currently have a project with Australia (AFFA) on

fumigation for quarantine purposes, and have also worked with CAB International and CSIRO. In the past the Agency has received assistance from donor agencies in Japan and the Netherlands.

6.2.2 Research Institute for Spices and Medicinal Crops

The Institute, headed by Dr Karden Mulya, focuses on diseases of medicinal plants and spices such as ginger, black pepper, cloves, cardamom and vanilla. Staff conduct regular surveys of crops in the local district as part of an IPM program, although the emphasis of these surveys is on biological control agents. The Institute has a small collection of pathogenic fungi and bacteria as well as some beneficial microorganisms (in all, there are about 200 dry, 110 wet, and 20 herbarium specimens). Many of the specimens were collected during a collaborative project with Japan and this has meant that duplicate collections are held at the University of Hokkaido and National Institute for Agricultural Research (NIAR), Tsukuba. Since completion of this project, a lack of funding to maintain equipment needed to preserve specimens over the long term and dedicated curator of disease herbaria has meant that the collection is now neglected. Dr Mulya indicated that staff would benefit from training in data management and in the identification of rust fungi and unculturable pathogenic microbes. Some members of staff are currently involved in collaborative survey work supported by agencies in Australia (ACIAR) and France (INRA).

6.2.3 Research Institute for Food Crops Biotechnology (Pest and Diseases Division)

The Project Team met with Dr Muhammad Machmud, a pathologist who indicated that the Institute has a mandate to develop a national collection of microbe cultures (pathogens and beneficials) and plant germplasm, but this has not been implemented due to a lack of manpower (it was said that the Government has a policy of zero growth of staff numbers) and resources to support such a collection. As it was, Dr Machmud said that the Institute's collection of microbial pathogens was badly neglected, although he indicated that his freeze dryer from 1978 was still in working order but that he had no staff to assist with the identification and preservation of specimens. According to the questionnaire completed by Dr Muchmud, the Institute has about 200 live cultures of pathogenic organisms, which have been verified by subculturing and reinoculation. The Institute has some contact on an ad-hoc basis with the central Agricultural Quarantine Agency, but has no formal arrangement to conduct diagnostic work or surveys for quarantine purposes.

6.2.4 Research Institute for Veterinary Science (BALITVET)

At BALITVET, the Project Team met with the head of the Institute, Dr Darminto, and his colleagues. The Institute houses the national culture collection and reference laboratory for diagnosis of microbes of veterinary importance. It is well resourced with 65 scientists (20 PhDs, 28 MScs) and has benefited from a Government germplasm conservation program initiated in 2000 to preserve/validate cultures. Although some equipment was aging, there was a good collection of over 2000 isolates (freeze dried) and all records were databased using Microsoft Access software. If required, staff of BALITVET could

certainly contribute expertise in data management and the preservation of culture collections to plant health capacity building projects.

6.2.5 Southeast Asian Regional Centre for Tropical Biology (SEAMEO BIOTROP)

The Centre conducts a range of research and training activities and is supported by eight laboratories which cover fields such as:

- Pest and disease management;
- Biotechnology and tree breeding;
- Remote sensing and ecology;
- Ecosystem modelling;
- Pollution control;
- Natural products;
- Herbarium; and
- Services (tissue culture, DNA sequencing, food analysis etc).

Our visit was hosted by Dr Imelda Stuckle, Deputy Director for Programme and Marketing, and Dr Antonius Suwanto, a microbiologist/molecular biologist who also holds a position at the Bogor Agricultural University (IPB). Dr Suwanto is well-versed in molecular techniques and conducts training courses on the assessment of microbial diversity, both on a national and regional basis.

The Microbiology and Molecular Genetics section of BIOTROP has collections of leaf surface bacteria, plant pathogens (mainly of soybean) and rice field photosynthetic bacteria, which are held in the plant pathology unit at IPB as part of an on-going collaboration with the University. With support from the Scottish Agricultural College, University of Edinburgh, a Plant Disease Clinic has also been established at IPB and holds dried reference specimens. The Clinic conducts pest identifications and provides advice on pest management to clients (farmers, industry, government etc) and charges a fee for this service. Dr Suwanto indicated that he wanted to seek funding to facilitate a national 'specimen collection network' under the disease clinics in order to improve Indonesia's ability to describe its plant health status. A project to promote disease clinic networking has been initiated through the collaboration with the Scottish Agricultural College, and through organisations such as the Indonesian Society for Plant Pathology and the Indonesian Society for Microbiology (of which Dr Suwanto is the National Coordinator for International Collaboration). In addition, a Research Centre has been established at IPB to study Indonesian microbial diversity, including plant pathogens.

Some microbial cultures are kept at BIOTROP itself, but most of these are stored under glycerol as the Centre does not have a freeze-drier (according to the questionnaire, the Centre holds about 50 dry and 140 wet specimens, many of which have not been identified). Nonetheless, BIOTROP appeared to be better equipped with trained staff and facilities (which included a DNA sequencer and scientific library) than most of the Indonesian institutes visited by the Project Team and could make a valuable contribution to regional training initiatives, if needed.

6.2.6 Indonesian Institute of Sciences (LIPI)

LIPI is a non-departmental government research institution, which reports directly to the President. The Project Team visited the Research Centre for Biology in Bogor and the Research Centre for Biotechnology at Cibinong.

Dr Yantyati Widyastuti heads the Microbiology Division in the Research Centre for Biology. The Division is organised into four groups:

- Biosystematics and microbial genetics;
- Microbial biochemistry;
- Ecology and physiology of microbes; and
- Development of potential microbes (for bioindustry).

A culture collection of about 1400 isolates (only about 10% have been identified) is managed by staff in the Biosystematics and Microbial Genetics Group. Emphasis of the collection is on bacteria and yeasts with an ecological and/or bioindustrial importance. The specimens are stored as fresh cultures that require frequent subculturing and staff indicated that they have difficulty finding resources to maintain the collection; certainly, much of the equipment was aging or in need of repair. The Group has an active and long-standing collaboration with the Tokyo University of Agriculture – some current staff trained at the University, while others are still pursuing MSc or PhD degrees there. In 1994, the Division received a grant under the UK Darwin Initiative for staff training in microbial taxonomy and culture collection management. The funding also enabled the production of a catalogue of cultures held in the collection and the entry of data on all strains onto a database using dBASE IV dbms software.

Dr Yantyati formerly worked in the Microbial Research Group at the Research Centre for Biotechnology, Cibinong and accompanied the Project Team during our visit there. The Group sits under the Cell Biology and Tissue Culture Division, which is headed by Dr Tri Muji Ermayanti. Dr Ermayanti maintains a small collection of non-pathogenic microbes, most of which are stored as wet cultures (the Group has a collaboration with Osaka University in Japan to study soil microbes for their bioindustry potential). The laboratory has an up-to-date BIOLOG system for identification of bacteria, but as it was purchased directly from the manufacturers in the USA and there are no local agents in Indonesia, staff do not have the benefit of technical support and training to realise the full potential of the system.

6.2.7 University of Indonesia Culture Collection (UICC)

The UICC has a mission to conserve the Indonesian microbial diversity. It was established in 1980 and holds a collection of about 540 yeast and mould strains isolated from Indonesian fermented foods and various natural environments; it does not have any plant pathogenic organisms. Aside from maintaining the collection, the organisation studies the potential applications of the microorganisms in the collection for different purposes (eg. as bioremediation agents or producers of bioactive compounds).

The Project Team met with Dr Indrawati Gandjar who heads the UICC and her colleagues. She is supported by five scientists, most of whom trained to MSc or PhD level in the USA,

Japan or the UK and who divide their time between lecturing and research. The strains in the collection are stored as wet cultures and have been identified by conventional methods, however the group is seeking funds to support the re-identification all strains by molecular methods and to develop an electronic database to manage the data. Dr Gandjar indicated that the organisation is currently 'self-sustaining' and has had difficulty obtaining government funding to maintain and upgrade the facilities. The group currently has an MOU with laboratories at LIPI, Cibinong to use their freeze-drier, and PCR and DNA sequencing machines.

The UICC contributed to the preparation of a publication titled *List of Cultures of Indonesian Microorganisms* (2nd Edition 2000), which was supported by the Japan Bioindustry Association. The organisation also receives funding from UNESCO to run a number of training courses for young Indonesian researchers and lecturers from regional universities. The courses cover topics such as the isolation and identification of yeasts, and the maintenance and conservation of culture collections. Staff members were extremely enthusiastic about these activities and their work in general, and indicated a willingness to contribute to regional training programs in biosystematics, if required.

6.2.8 A Way Forward for Indonesia

For a country such as Indonesia with its large agricultural base, a capacity to describe the health status of the plant industries ought to be a priority, if for no other reason than to manage plant health and minimise losses caused by pathogens. But a capability to describe the health status of the plant industries and the natural environment has other spin offs, including the development of robust plant quarantine policy and support for market access negotiations. However, as is the case with some other ASEAN countries, institutional responsibility for building and maintaining disease herbaria and pathogen collections in Indonesia is not clear and the development of a national facility has not captured the attention it deserves, although there is considerable expertise within various agencies to undertake the task.

A first step towards building a national plant disease herbarium and pathogen collection in Indonesia would be for agencies with interests in and responsibility for plant health matters to acknowledge the importance of such a facility and to decide on its form — a centralised collection or a dispersed collection similar to the Australian model. In Australia components of the 'National' collection are in the hands of different agencies — mostly state agriculture departments. Under the Australian constitution the states have responsibility for agricultural production, not the Commonwealth. The Commonwealth has responsibility for quarantine and trade and so has a vested interest in the wellbeing of the 'National' collection, but the component parts belong to the states.

A dispersed collection has several advantages in that the component parts are usually located in agencies/institutions employing practising plant health professionals, and draws on them for the specimens that populate the collection. This helps to expand the coverage of the diseases that are in the country. Centralised collections on the other hand provide an opportunity to employ staff with a depth of expertise as a back up to professionals lost through retirements and promotions. Centralised collections rely on the activity of regional staff to populate the collection with new specimens and regular surveys. The

‘best’ model is that which serves the needs of the country, taking into account existing resources and institutional responsibilities.

The Project Team believes that a dispersed collection would best suit existing institutional arrangements for plant health in Indonesia, but that is a matter for Indonesians to resolve. The most important issue is for senior managers and politicians to acknowledge the need for developing a national collection and giving priority to building such a resource. These people cannot be expected to know just how important it is to be able to describe the health status of the country’s plant industries — they need to have these things explained to them in terms that they understand, that is national development and trade.

In order to familiarise senior managers with disease herbaria and the role that these facilities play in managing plant health and trade, the Project Team propose that senior managers be brought together in a regional forum with plant health professionals where the issues can be explained and debated. There are other options for achieving this end, including in-country seminars and workshops. The important thing is that awareness activities are targeted at people who can give priority to developing a national disease herbarium and pathogen collection for Indonesia. Without this endorsement, lower level agency managers and plant health professionals will find it difficult to negotiate respective roles and responsibilities for building a national facility in the form of a dispersed collection. Issues for managers and plant health professionals to consider will include the opportunities for co-opting expertise from agencies that have relevant expertise, but no institutional responsibility for plant health matters, gaps in expertise and how these gaps might be filled, the role of existing facilities and the location of existing collections, the need for laboratory upgrades, the role of regional laboratories in populating collections, standards and data management.

6.3 LAOS

The schedule of visits in Laos was organised by Mr Phousit Phoumavong, National IPM Coordinator in the Ministry of Agriculture and Forestry. The Project Team was to visit three plant health laboratories, none with a practising plant pathologist. We also visited operational plant quarantine staff in a laboratory near the Thai Border and border control operations at Friendship Bridge.

A meeting was arranged with the Director of the Agricultural Regulation Division, but in his absence the Project Team met with his Deputy, (Ms) Khamphoui Louangrath. At that meeting we exchanged views on the way forward for plant health in Laos. Ms Louangrath said that there are two plant pathology graduates in the Ministry, both attached to the Division of Agricultural Regulation and two undergraduates studying in China. Ms Louangrath explained that these people would form the nucleus of a plant pathology group to underpin pest management and quarantine. The Project Team took the opportunity to emphasise the need to start out on the right foot by expanding expertise in diagnostics and preserving specimens of plant diseases to build a herbarium for the future, together with a capacity to describe the plant health status of the country.

6.3.1 A Way Forward for Laos

The Project Team is aware of work done by University of Sydney's Professor Burgess in Viet Nam over the last seven or eight years and thought that this presented a model for the development of plant pathology in Laos. The model has involved reciprocal visits, with Professor Burgess leading a small number of plant pathologists from Viet Nam to survey crops there for soil borne diseases – diseases caused largely by microfungi. The scientists working on the project have visited Australia for short courses and field work. The Project Team suggest that this model could be expanded to include basic training in curatorial techniques and data management, together with more advanced training in some fields of taxonomy later on – especially since disease herbaria and databases are essential for recording outcomes of crop disease surveys. Including Lao scientists in regional plant health initiatives would expand the experience of their young scientists. Development of quarantine-related plant health initiatives will require assistance for laboratory infrastructure and an introduction to SPS obligations, including pest risk analysis.

6.4 MALAYSIA

In Malaysia the Project Team visited the following agencies/institutions:

- National Post Entry Quarantine Station, Department of Agriculture, Serdang, Selangor;
- Crop Protection and Quarantine Services Division, Dept of Agriculture, Kuala Lumpur;
- Malaysian Agricultural Research and Development Institute,
 - Bertam Research Station, Food and Industrial Crops Research Centre, Kepala Batas, Penang
 - Strategic, Environment and Natural Resources Research Centre, Serdang, Selangor;
- School of Biological Sciences, Universiti Sains Malaysia, Penang;
- Agriculture Research Centre, Dept of Agriculture, Semongok, Sarawak;
- Forest Research Centre, Forestry Department, Kuching, Sarawak; and
- Forest Research Institute Malaysia, Kepong, Kuala Lumpur.

The Project Team is aware of the small disease herbaria maintained by industry-supported laboratories — the Rubber Research Institute Malaysia and the Palm Oil Research Institute of Malaysia. These collections are crop specific, but are important components of national plant health infrastructure. Among other things, research personnel might be coopted to support national and regional capacity building initiatives.

6.4.1 National Post Entry Quarantine Station

The Post Entry Quarantine facility does not have institutional responsibility for a disease herbarium, but ‘inherited’ a small number of specimens from the now-disbanded ASEAN PLANTI¹⁶. The collection has not been maintained.

6.4.2 Crop Protection and Quarantine Services Division

At the Crop Protection and Quarantine Services Division of the Department of Agriculture the Project Team had a round table meeting with staff led by Ms Asna Booty Othman, Director of the Division. The meeting covered a number of matters relating to obligations arising from the WTO SPS Agreement, in particular, the requirement for countries to base quarantine regulations on a sound scientific footing, implying, among other things, a need to be able to describe the health status of the country in order to undertake pest risk analysis. Although the Division has national responsibility for plant protection and quarantine implementation, hence herbaria and pathogen collections, Ms Othman acknowledged the deficiencies in Malaysia’s capacity to provide verifiable pest lists. She provided the Project Team with three funding proposals that the Department of Agriculture had sent to the Australian High Commission in Kuala Lumpur seeking assistance to build Malaysia’s capacity in SPS-related areas viz.,

- Fumigation of commodities in trade, with emphasis on replacement technologies for methyl bromide;
- Diagnostics, particularly the use of new technologies using molecular probes, but including conventional skills for identifying particular groups of pests of concern;
- Rehabilitation of reference collections of plant pests; and
- Training in pest risk analysis.

6.4.3 Bertam Research Station, Food and Industrial Crops Research Centre

The Food and Industrial Crops Research Centre at Seberang Perai is located in the North of Malaysia. Here we met with Saad Abdullah, Research Officer (Plant Pathology). His work involves supporting research scientists working on rice and some other food crops. The Centre retains a small number of disease specimens, largely to provide inoculum from representative strains of plant pathogens for screening breeder’s lines for resistance. As with regionally based plant pathologists in all countries, Saad Abdulla represents the ‘eyes and ears’ of the country’s plant health infrastructure. These regional pathologists can assist in populating national plant disease herbaria that, over time, build a comprehensive picture of the health status of the country. Yet, as in many countries, their strategic value is not recognised and they are not approached to develop disease herbaria and pathogen collections or to submit specimens to other laboratories for retention.

¹⁶ ASEAN PLANTI was a US-funded initiative for developing regional capacity in plant health, with a central laboratory located in Serdang, Selangor, Malaysia. The facility was disbanded for the want of financial support from regional governments and donor organisations.

6.4.4 Strategic, Environment and Natural Resources Research Centre

The Strategic, Environment and Natural Resources Centre of the Malaysian Agricultural Research and Development Institute houses a small herbarium representing post harvest diseases of fruit. Like many disease herbaria it reflects the interests and dedication of one individual, rather than explicit institutional purpose. The herbarium largely represents the work of Dr Sepiah Muid, now with the Faculty of Resource Sciences and Technology, Universiti Malaysia, Sarawak. Since Dr Muid's departure from MARDI, and in the absence of a replacement plant pathologist/mycologist, the herbarium has remained unattended. While it remains in good condition, it will need attention soon if it is not to deteriorate.

Dr K.Y. Lum (of the Project Team) is located at this Centre. He holds a collection of plant pathogenic bacteria from Malaysia and some other countries of South East Asia, but there are no matching specimens of the diseased hosts.

In the absence of an explicit directive from the senior managers within the Department of Agriculture, the development of a national plant disease herbarium and pathogen collection in Malaysia is likely to languish, and particularly while there is an erosion of expertise through retirements and resignations and no replacement staff in training. Worse still, the erosion of plant pathology expertise in Malaysia creates a very real risk that the collections will deteriorate to the point where the specimens and data have no credibility.

6.4.5 School of Biological Sciences, Universiti Sains Malaysia

Our host here was Dr Baharuddin Salleh, Professor in Plant Pathology and Mycology. Dr Baharuddin is an international authority on a genus of microfungi known as *Fusarium*. The genus contains many important plant pathogens that cause diseases of fruits and seeds, roots and stems. Some species are important vascular pathogens. Dr Baharuddin has a collection of about 3 000 living cultures with a further 400 that have not been identified. Not all are pathogens. The collection of pathogens is not supported by herbarium specimens.

During the course of our visit Dr Baharuddin raised concerns about the future of traditional plant pathology/mycology with the University with most students shunning these fields for molecular biology. As a consequence, there is an erosion of national expertise that could be exacerbated without commitment to plant health science in existing agencies. He also expressed concern that his collection of pathogens and records could be lost unless steps are taken to preserve these. Dr Baharuddin and about a dozen like-minded mycologists in Malaysia have discussed these concerns and approached scientists with microbial collections with a view to 'joining forces' to secure important collections of plant pathogens. At this stage there has been little progress.

6.4.6 Agriculture Research Centre, Semongok

Here the Project Team met with scientists from three agencies as follow:

- Mr Teo Chan Hock (Agriculture Research Centre, Semongok);

- Dr Sepiah Muid (Faculty of Resource Science and Technology, Universiti Malaysia, Sarawak); and
- Mr Abang Yusuf Abang Hassan (Head of Plant Quarantine, Department of Agriculture, Sarawak).

There was no disease herbarium or collection of pathogens at the research centre – our visit here was more an opportunity to talk to scientists from regional laboratories concerned with plant health. Scientists at the Agriculture Research Centre and the University are important components of Malaysia's plant health infrastructure and can play an crucial role in building a national plant disease herbarium and culture collection. Our hosts reflected on the difficulties of gaining the attention of key decision makers whose knowledge of the importance of plant health in national development and trade may need to be enhanced. They also expressed a view that awareness campaigns targeting plant health professionals would be a way of capturing information on plant health.

6.4.7 Forest Research Centre, Forestry Department, Kuching

Our host, Dr Lucy Chong, was in a long-term acting position of Director pending resolution of the future of the Centre that may be corporatised. Uncertainty about the future of the Centre has left the issue of replacement staff in a state of limbo. As a consequence, there were vacancies in plant health.

The Forest Research Centre houses a relatively large collection of forest pest and a relatively large herbarium consisting of wood rotting fungi and forest pathogens, including nematodes.

While resources are in a state of limbo, maintenance of the herbarium and collections is minimal. Nevertheless they appeared to be secure for the present. These facilities are well provided with scientific literature, books and records. Book and card D-base records are being incorporated into Microsoft Access, but Dr Chong expressed a need for advice on managing the information contained in the collection.

6.4.8 Forest Research Institute Malaysia

Our host at the Forest Research Institute Malaysia (FRIM) was Dr Su See Lee, Forest Pathologist. Our visit here and a later visit to the Forest Department in Kuching brought home to the Project Team the potential value of regional forest pathologists to capacity building initiatives in plant health throughout ASEAN. Dr Lee and her counterpart in Kuching, Dr Lucy Chong are highly trained and well motivated scientists. Their host institutions hold significant collections of pathogens and wood rotting fungi. Dr Lee is connected to an international network of forest pathologist and participates in development assistance projects funded by ACIAR. Dr Lee's expertise and that of Dr Chong could be of great benefit in areas of diagnostics, pest risk assessment and the maintenance of disease herbaria and culture collections.

Dr Lee's collection of forest pathogens and wood rotting fungi is relatively small with about 500 live and 1000 dry specimens, according to her response in the questionnaire. It is maintained in a simple, low-tech, air-conditioned building, with dehumidifier for the

area in which the herbarium is located. Specimens are held in sealed plastic bags containing silica gel. Some live cultures can be matched to disease specimens. The specimens and data held on the herbarium collection would meet the IPPC standard (ISPM 8) for pest records.

6.4.9 A Way Forward for Malaysia

With the exception of commodities produced from industrial crops such as rubber and palm oil, agricultural exports contribute little to the Malaysian economy. On the other hand, Malaysia is a significant market for agricultural commodities produced in other countries, thus introducing the need for a robust plant health infrastructure and quarantine service to protect the country from the risk of introducing serious exotic pests of agriculture and natural vegetation. Some senior politicians have expressed concern about the imbalance in food exports and imports and have proposed initiatives to lift domestic production. Irrespective of whether Malaysia maintains its current import trade or seeks import replacement, the health status of the plant industries is important both to Malaysia and other countries in the region.

Historically, plant health has been relatively well supported in Malaysia, but the Project Team noted an air of pessimism about plant health infrastructure in the country – a lack of resources to replace retiring staff and a lack of interest in traditional plant pathology/mycology among students. As a consequence there is concern about the capacity of responsible agencies to describe the health status of the country's plant industries to underpin agricultural development and trade. These difficulties notwithstanding, Malaysia's plant health scientists are well trained and could be enlisted to support a national plant disease herbarium and pathogen collection. A small collection already exists within MARDI but it is in need of support and it needs to be expanded.

There is no compelling reason for a 'national herbarium and plant pathogen collection' to be centralised. Rather it is possible for Malaysia to build a dispersed herbarium based on collections in different agencies. However, the development of a National Plant Disease Herbarium and Pathogen Collection, whether dispersed or centralised, requires a measure of collective institutional support in order to be viable. This support may be expressed through legislation providing protection and/or funding as part of recurrent institutional expenditure. Further, responsible agencies will need to formulate a plan and enter into some form of agreement or understanding setting out the broad objectives and the roles and responsibilities of various plant health agencies in building a national plant disease herbarium and pathogen collection. An awareness campaign targeting plant health scientists will be important in order to tap their collective expertise in identifying pathogens and to populate the collection.

6.5 PHILIPPINES

In the Philippines the Project Team met with staff in the following institutions¹⁷:

- National Crop Protection Centre, Los Banos;
- National Institute of Molecular Biology and Biotechnology (BIOTECH);
- International Rice Research Institute (IRRI);
- Department of Plant Pathology, College of Agriculture, University of the Philippines, Los Banos;
- Philippines Rice Research Institute (PhilRice);
- National Science Research Institute, University of the Philippines, Diliman, Quezon City.

Our hosts in the Philippines were Dr Horacio O. San Valentin, ASEANET National Coordinator and Dr Bonifacio Cayabyab, Plant Quarantine Support Laboratory, National Crop Protection Centre, UPLB.

6.5.1 National Crop Protection Centre

The National Crop Protection Centre (NCPCC) is the lead agency for all crop protection in the Philippines.

Crop protection research is funded by the Philippines Department of Agriculture through an agency known as the Bureau of Agriculture. The Bureau of Agriculture in turn funds research in twenty-three networks. So far as the Project Team could determine, the Department of Agriculture does not fund disease herbaria and collections of plant pathogens.

*This agency is involved in the diagnosis and identification of agricultural pests. It is a provider of biosystematic services for agriculture and plant quarantine. It is well staffed with highly trained personnel mostly with post-graduate degrees capable of providing identification services to farmer clients. It has a fairly good reference collection of agricultural pests and natural enemies and pests of quarantine importance.*¹⁸

¹⁷ In spite of these onsite visits and reference to limited published material, the project team does not feel that it has an adequate understanding of the institutional responsibilities for plant pathology and disease herbaria in the Philippines. We continue to seek additional information.

¹⁸ Horacio O. San Valentin (1999). *In* Proceedings First Meeting of the Loop Coordinating Committee of ASEANET. The reference to collections of agricultural pests is understood to refer to arthropod pests, not plant pathogens. The Project Team understands that there is expertise in plant pathology within the National Crop Protection Center that was not on the schedule of visits in the Philippines.

6.5.2 National Institute of Molecular Biology and Biotechnology (BIOTECH)

BIOTECH houses the Philippines National Collection of Microorganisms, headed by Dr Rosario Monsalud. Among other things, BIOTECH is the Headquarters for the Philippines Network of Microbial Culture Collections (PNMCC) that includes:

- The University of the Philippines Culture Collection of the Natural Sciences Research Institute;
- The Biofertilizer Germplasm collection of the International Rice Research Institute;
- University Culture Collection of the Museum of Natural History; and
- Industrial Technology Development Institute Culture Collection (DOST).

None of the collections holds any significant number of plant pathogens. The significance of the PNMCC to the AusAID assignment is that it is a cohesive network with expertise that might be drawn upon in regional initiatives to assist in developing disease herbaria and plant pathogens collections. The Network has a Management Board with a secretariat to pursue its objectives of strengthening existing collections and to support new ones by:

- Facilitating dissemination of information on culture collection management and microbial databases;
- Promoting studies on culture collection protocols; and
- Training of personnel in culture collection procedures.

The Project Team judged the collection at BIOTECH to be well maintained by high calibre professionals. It has an electronic database of some 2000 strains and serves as a central repository for cultures.

6.5.3 International Rice Research Institute

The International Rice Research Institute (IRRI) does not maintain a disease herbarium. On the other hand the staff maintain a large collection of bacterial cultures consisting of plant pathogens and potential biological control agents. IRRI staff also maintain a small collection of fungal pathogens.

6.5.4 Department of Plant Pathology, College of Agriculture, University of the Philippines, Los Banos

The Department houses an aging plant disease herbarium with more than 3 000 specimens, some (not of Philippine origin) dating back about a hundred years. It was suggested that some records were probably lost in the war years. In spite of its recent neglect, the collection contains valuable records that would form the basis of a national disease herbarium and pathogen collection, were the Philippines to embark on such a project. Collections in academic institutions usually do not have national status or legislative protection, the well being of such collections being dependent on the interests of the staff. As it was, the interests of the Professor of Plant Pathology whom we met has interests in mushrooms and toadstools, not the microfungi that are the most important group of plant pathogens.

The Department has run a plant disease clinic for some years, but the specimens are not retained, just written reports. It was our understanding that other institutions in the Philippines also run disease clinics. As in the case of Thailand (see below), these institutions have the potential to underpin national plant health infrastructure and to assist in populating a national plant disease herbarium. Institutional responsibility and funding for these clinics was not clear to the Project Team.

6.5.5 Philippines Rice Research Institute

The Philippine Rice Research Institute (PhilRice) is an institution belonging to the Department of Agriculture. Plant health research at PhilRice appeared to parallel work at IRRI, with emphasis on the major rice diseases and seed health. Work on seed health has led to in-depth study of the microflora of rice seed – including both pathogens and potential biological control agents. There was no disease herbarium as such at PhilRice, but a relatively large collection of microbes isolated from seed. Much of the research focussed on the beneficial properties of these microbes.

In terms of building a national plant disease herbarium and pathogen collection, PhilRice, as with IRRI, are of significance to the extent that they have experienced plant pathologists who could contribute expertise in microbial preservation techniques and information management. They might also be available for regional training initiatives, if approached.

6.5.6 National Science Research Institute, University of the Philippines, Diliman, Quezon City

At the National Science Research Institute, the Project Team met with staff of the Microbial Research and Services Laboratory. The laboratory maintains a small collection (about 300 cultures) of bacteria, yeasts and some filamentous fungi, but few, in any, plant pathogens. Being a research and services laboratory the emphasis is on supporting industry, such as through analytical services, including analysis of water. Laboratory staff is not generally called upon by the Bureau of Plant Industry¹⁹ to offer advice or provide identification services. As with BIOTECH at Los Banos, staff of the Microbial Research and Services Laboratory has expertise that might be drawn upon for initiatives to build national and regional capacity in identifying microbes, managing collections of plant pathogens and data management.

6.5.7 A Way Forward for the Philippines

As with some other countries of ASEAN, including Thailand and Malaysia, there is a need to enhance the understanding of senior managers of the role of disease herbaria and pathogen collections in national plant health infrastructure. Were senior managers to be appraised of this role and the low level of support for their collections, it is possible that more resources might be directed to these important national facilities.

¹⁹ The Bureau of Plant Industry within the Department of Agriculture has institutional responsibility for plant quarantine.

While the Project Team departed from the Philippines disappointed that they had less than a complete understanding of the plant health resources of the country, it seems that there is a good number of trained plant health professionals²⁰ who could be co-opted to assist in the development of a national plant disease herbarium and pathogen collection. As a first step it would be important to nominate institutional responsibility for housing such a collection and then to ensure human and other resources were made available. It is possible that some training and development of staff might be required, but there are resources and expertise allocated to the preservation of microbial collections in the Philippines that might be drawn upon to assist.

Professionals running disease clinics in academic and other institutions, researchers and other plant health professionals need to be included in any project to build a national disease herbarium. They have access to the specimens that are required to populate a collection and thus allow authorities to describe the plant health status of the country.

6.6 SINGAPORE

The Project Team's visit to Singapore was organised by the ASEANET Country Coordinator, Dr Ong Keng Ho, Head of the Plant Health Services Branch, Animal and Plant Health Inspection Division of the Agri-Food and Veterinary Authority (AVA) of Singapore. There were just two meetings in Singapore –

- The Singapore Botanic Gardens under the National Parks Board of the Ministry of National Development; and
- The Agri-Food and Veterinary Authority.

6.6.1 Singapore Botanic Gardens

The scientists whom we met at the Singapore Botanic Gardens have little direct interest in disease herbaria and collections of plant pathogens as such, but they all had a very keen interest in taxonomy and biological collections. Our hosts were able to describe the roles and responsibilities of different agencies and amateur enthusiasts holding collections of molluscs, insects and some plant pathogens.

The Keeper of the Herbarium and Library, Dr Ruth Kiew, related the history of the botanical collection dating back to colonial times. The collection contains more than 600 000 specimens from 'Malaya', including dried plant disease specimens of indigenous plants and macrofungi. The collection does not contain pathogens of agricultural crops.

Dr Kiew explained that they were in the process of developing a virtual collection based on the Brahm's system developed by Kew Gardens in the United Kingdom for cataloguing specimens.

²⁰ Additional information was available in country reports provided by delegates attending an AusAID sponsored workshop on diagnostics that was held in Brisbane in July 2001.

A small collection of plant pathogens, largely microfungi, is held at the Raffles Museum of Biological Research, Department of Biological Sciences, National University of Singapore (NUS).

With the benefit of hindsight it was unfortunate that the Project Team did not visit with academic staff at NUS because some probably have expertise such that they might be included on a list of regional experts to assist in regional SPS capacity building initiatives.

6.6.2 Agri-Food and Veterinary Authority of Singapore

The Agri-Food and Veterinary Authority has responsibility for quarantine in Singapore and runs a small diagnostic clinic for government agencies and the private sector. Staff attached to the clinic appeared to carry a heavy workload attending to a steady stream of specimens, mostly diseases of amenity horticulture (Singapore's primary quarantine concern is protecting the flora and fauna of its parks and gardens). Most specimens are discarded because of time constraints preventing the staff from preserving specimens in a disease herbarium. However, there is a very small collection of dry specimens, about two thirds of which have not been identified.

6.7 THAILAND

The Project Team's schedule of visits in Thailand was organised by the ASEANET Country Coordinator, Dr Banpot Napompeth. It included visits to universities in the north, north central and southern regions of the country as well as three agencies within Bangkok. These are as follow:

- National Biological Control Research Centre laboratories in Bangkok, Maejo University, Khon Kaen University and the Prince of Songkla University;
- Department of Plant Pathology, Kasetsart University in Bangkok;
- Microbial Resource Center (MIRCEN) in the Thailand Institute of Scientific and Technological Research (TISTR);
- Division of Plant Pathology and Microbiology, Department of Agriculture (Ministry of Agriculture and Co-operatives), Bangkok;
- Faculty of Agricultural Production, Maejo University;
- Department of Plant Pathology, Chiang Mai University;
- Department of Plant Pathology, Khon Kaen University; and
- Department of Pest Management, Faculty of Natural Resources, the Prince of Songkla University, Hat Yai.

6.7.1 National Biological Control Research Center

The National Biological Control Research Center (NBCRC) has a loose affiliation with the universities where its laboratories are situated. For the most part the Centers are staffed with university people who have research interests in biological control of weeds, arthropod and other pests, such as snails. As part of their activities the laboratories undertake regular surveys of weeds looking for natural enemies, including plant pathogens that might be used as biological control agents or mycoherbicides. They maintain a small number of live cultures of plant pathogens and dried specimens, some laminated for display purposes. While there are data on the pathogens in the display specimens, data and living cultures probably do not meet the ISPM standard for what is required as a disease record. There are checklists of the plant pathogens that have been identified, numbering about 40 or so. Plant health professionals who work in these laboratories would be useful collaborators in a national network of professionals for populating a national plant disease herbarium and pathogen collection were the Thai authorities to embark on such a program (see below).

6.7.2 Department of Plant Pathology, Kasetsart University, Bangkok

Our host here was Dr Niphone Thaveechai (standing in for Dr Supat Attathon, Head of the Department). Our initial discussions were with Dr Niphone alone, other staff being absent on business or at home – it was the mid-semester break. However, we had an opportunity to meet two other staff when we were shown around the facilities.

The Department represents a potentially large pool of expertise in plant pathology (30 professionals in all). The questionnaire filled in by Dr Attathon almost certainly does not reflect the Department's holdings of plant pathogens and we may want to seek some clarification of the Department's holdings at a later time. Suffice to say, however, that what we saw were mainly collections for teaching and research and not supplemented with dried herbarium specimens and the data needed for these pathogens to meet minimum standards as records of pathogens in Thailand. That aside, the large number of professionals in the Department represents a very significant resource for populating a national collection and supplementing/complementing diagnostic expertise elsewhere within Thailand. Doubtless some staff collaborate as part of an informal international network of specialists that assist one another in identification work on pathogens. So far as the Project Team could determine, there is little or no contact with plant health professionals within the Ministry of Agriculture and Co-operatives.

6.7.3 Microbial Resource Center (MIRCEN)

The Thailand Institute of Scientific and Technological Research (TISTR) accommodates one of the International Microbial Resource Centres (MIRCENs). These centres are academic/research institutes that network in a global collective effort to harness microbial research and biotechnological applications for development. These Centers were set up with funding from UNESCO and UNDP. The network currently consists of 34 MIRCENs in 26 countries. MIRCEN (Thailand) is now largely funded by the Thai government and serves South East Asian countries as well as Thailand.

At TISTR we met with the Director of MIRCEN (Thailand), Dr Vullapa Arunpairojana. With its collaborators, the Center develops and maintains minimum data sets on microbes that are seen to have commercial value in biotechnology in the broadest sense. It does not hold data on plant pathogens. Nor does the Center maintain any cultures, but it provides assistance in directing enquiries regarding identification of microbes.

The Project Team saw the Center as a potential resource for advising on the management of data, were it sought.

6.7.4 Division of Plant Pathology and Microbiology, Department of Agriculture

The meeting was hosted by Dr Tuanchai Boon-Long representing the Director of the Division. Others present included the mycologist in charge of the plant disease herbarium, a second mycologist specialising in diseases caused by *Phytophthora* spp., a bacteriologist and a plant virologist. Regulatory staff from the Plant Quarantine Division were not present, nor were they included on our schedule of visits.

The Division is comprised of thirteen Sections, including Administration. The Sections cover the major disciplines in plant health - mycology, plant virology, nematology and plant bacteriology, with the other eight scientific Sections covering applied microbiology, post harvest pathology, and diseases of various crop groupings. According to a published booklet provided by our hosts, in 2000 the Division had a plant health staff comprised of 9 diplomats, 37 B.Sc., 46 M.Sc. and 9 Ph.Ds. Among other things the booklet on the Division describes the 'Job Responsibilities' that include *To provide a pest list and analyze the risk of pest infestation in plant pathology*. Activities described in the booklet include:

To isolate, identify and study the biology and ecology of the pathogenic fungi of plants...
(Mycology Section)

To collect Thai plant pathogenic fungal isolates in both living and preserved forms for use in research and for use as reference sources.
(Mycology Section)

To identify plant pathogenic viruses and phytoplasmas...
(Virology Section)

To study the taxonomy of plant parasitic nematodes by identifying them into species and genomic levels...
(Nematology Section)

To identify plant pathogenic bacteria...
(Bacteriology Section)

To develop accurate and rapid detection methods of plant pathogenic bacteria ...
(Bacteriology Section) and

...to establish the Thailand Bacterial Culture Collection Bank
(Bacteriology Section)

While on location at the Plant Pathology and Microbiology Division we were shown the Plant Disease Herbarium comprised of nearly 1400 dry specimens with appropriate 'passport' data. In the questionnaire completed by the Division, the collection is reported to contain about 2500 slide specimens, identified and unidentified, and about 2300 living cultures. In hindsight, the collection may be limited to diseases caused by fungi – this needs to be clarified and we need to establish the extent of collections that might be held in the Nematology, Bacteriology and Plant Virology Sections. Be that as it may, the collection that Project Team observed had benefited from advice and assistance provided by Dr John Alcorn, formerly the curator of the plant disease herbarium and fungus collection belonging to the Queensland Department of Primary Industries at Indooroopilly. The specimens were packaged neatly in envelopes and accommodated in steel cabinets appropriate for the purpose. Further, we were advised that software was available for recording the data held on the collection, but that no data had been entered.

Curation of the collection was not a priority among staff who said that they were promoted on the basis of research output, not the sort of activities that are involved in building and maintaining a collection of plant pathogens. Moreover, the collection was in a state of neglect - it was not treated routinely to protect the specimens from attack by arthropod pests and the collection was not housed in an air conditioned room that would help its long term preservation. Apparently the preservative from the envelopes in which the specimens were held was removed because staff complained about the smell. That is a reasonable reaction, but would not be a problem if the collection were held in its own room and isolated from the day-to-day activities of staff.

Notes made by the Project Team on the visit include a number of observations of interest including:

- The Quarantine Division identifies diseases intercepted at the border, but does not pass these onto the Plant Pathology and Microbiology Division for preservation.
- The Division has a mandate to undertake surveys for plant diseases but does not do so because of shortage of human resources.
- The existence of a Thailand network of culture collections covering organisms of interest to biotechnology, agriculture and medical microbiology – about five national institutions are part of this network. The network records information held in collections using 'BIOTEC' databasing software (based on Microsoft Access) developed by the National Center for Genetic Engineering and Biotechnology. In a way it looks to parallel the function performed by MIRCEN for pathogenic organisms since only selected data are lodged by network members.

6.7.5 Faculty of Agricultural Production, Maejo University

The faculty has a card index of specimens submitted to a disease clinic – diagnosticians are students (student collections). The Project Team did not meet the person who completed the questionnaire. Like other regional centres, this small group represents a resource to provide specimens that would populate a national plant disease herbarium.

6.7.6 Department of Plant Pathology, Chiang Mai University

Here the Project Team met with the head of the Department Dr Pipob Lumyong. Because the visit coincided with the mid-semester break, most of the staff was absent.

Dr Lumyong recognised the need for maintaining a disease herbarium and culture collection, and especially those pathogens used in published research. The Department does not maintain specimens or an extensive collection of pathogens – not even from the disease clinic. It was said that arthropod pests were a big problem when researchers attempt to maintain disease specimens. Clients include a private sector company (Fritolay) and farmers. The Department does not undertake disease surveys, but they do maintain written records of specimens submitted to the disease clinic. Interestingly, the Department lectures on quarantine related matters – a rare practise in many universities teaching plant pathology.

As in other regional universities, the Plant Pathology Department at Chiang Mai is a valuable national resource, expanding the expertise available for government agencies to draw upon as well as expanding the network of plant health professionals who could help populate a plant disease herbarium.

6.7.7 Department of Plant Pathology, Khon Kaen University

Here the Project Team met with a number of staff from the Department and the Vice President of Research – all were plant pathologists and those currently in administrative positions expect to return to teaching and research when their current appointments end.

The Department has an administrative arrangement with the Department of Agriculture to certify seed crops that are produced in the area for export. The Department also has an arrangement with up to twenty seed companies to undertake regular surveys of their seed crops produced in the north central region. In addition, the Department provides a disease clinic for extension specialists and individual farmers. Diseased specimens are not retained, but the Department has records from their surveys and disease clinic dating back a number of years (1983). They are considering recording the information using 'BIOTEC' software (see Section 6.7.4).

6.7.8 Department of Pest Management, Prince of Songkla University, Hat Yai

There are five plant pathologists in the Department, concerned mainly with teaching and research. Academics provide a diagnostic service for regional Department of Agriculture staff and have 'records' dating back a number of years. They do not maintain a plant disease herbarium as such, but have preserved specimens for teaching purposes. The laminated specimens were very good, but these and the data held would not meet the ISPM standard for a pest record.

6.7.9 A Way Forward for Thailand

There is a large number of plant pathologists in Thailand with a concentration in the Division of Plant Pathology and Microbiology, Department of Agriculture and smaller but significant numbers in the university in Bangkok and regional universities – and the Project Team may not have identified all that exist within the country. Some of the regional universities provide diagnostic and other services to the Department of Agriculture and disease clinics for farmers and a number of seed companies. Clearly the Project Team was not able to make more than a subjective assessment of the 'quality' of the people that we met, but some impressed us with their interest, outlook and support for this needs assessment. Given the very large number of plant pathologists in Thailand, the international experience of some as undergraduates and post graduates, some must be able to access the informal international network of specialists who could help identify difficult specimens and disease conditions. This, together with the fact that the pathologists are widely dispersed throughout Thailand, provides the Department of Agriculture with a valuable resource to rapidly populate a plant disease herbarium and allow authorities to describe the country's plant health status. The Division of Plant Pathology and Microbiology has a mandate to develop such a collection.

The Project Team believes that there is a need to enhance the understanding of authorities in the Department of Agriculture, and possibly even at the political level, of the importance of disease herbaria and collections of plant pathogens. Unless adequately briefed on the matter there is little reason why professionals divorced from plant health and trade matters should understand the importance of disease herbaria and pathogen collections. Were they to understand that these facilities are the most vital component of Thailand's plant health infrastructure, relevant agencies could benefit from various forms of assistance, including:

- Further capacity building in curatorial techniques;
- Training of diagnosticians and taxonomists;
- Data management - although this may be adequately covered already; and
- Training for regional plant health people who would provide much of the material to populate a national herbarium – such people need exposure to the issues such as pest risk assessment, elements of curating disease specimens, and what might be expected of them as a part of the regional network responsible for populating a herbarium.

Almost without exception our hosts were concerned about the paucity of resources for maintaining equipment for identifying and maintaining cultures - much of this equipment provided by different international aid agencies in times past. While they are undoubtedly short of money for maintaining equipment, not all agencies need the state of the art equipment that they would like to have. There is considerable scope for collaborating and making do with less sophisticated techniques that most scientists have had to use in the past.

6.8 VIET NAM

The schedule of visits for the Project Team in Viet Nam was prepared by Dr Nyugen Van Tuat, Director, National Institute for Plant Protection (NIPP), Ministry of Agriculture and Rural Development (MARD). The schedule included visits to the following laboratories/institutions:

- Institute of Ecology and Biological Resources (IEBR), a component of the Viet Nam National Centre for Natural Science and Technology;
- National Institute of Plant Protection, MARD;
- Plant Protection Department (PPD), MARD;
- Hanoi Agricultural University;
- Research Institute of Fruits and Vegetables; and
- Viet Nam Agricultural Sciences Institute.

The institutions visited were all in and around Hanoi. These appeared to be a representative cross section of plant health agencies in Viet Nam and provided the Project Team a picture of the state of disease herbaria and pathogen collections.

A more extensive schedule of visits would have expanded our knowledge of the capabilities of plant health scientists in Viet Nam to deliver in-country and regional capacity building initiatives that might be supported by donor organisations.

Completed questionnaires were provided from these laboratories/institutions, with the exception of IEBR. Questionnaires were also provided on arrival from institutions and one regional laboratory that were not on the schedule of visits for the Project Team. These are as follows:

- Department of Plant Protection, College of Agriculture, Can Tho University;
- Biological Faculty, Hanoi National University; and
- Southern Regional Plant Quarantine Office, Ho Chi Minh City.

6.8.1 Institute of Ecology and Biological Resources

The function of the IEBR, which is the ASEANET National Coordinating Institution for Viet Nam, is to study the biological resources and ecosystems of Viet Nam with a view to fostering sustainable food production (while minimising adverse environmental impacts of agriculture), recommend planning for eco-social development and environmental protection and to carry out education and training in ecology and biological resources.

The IEBR was included on the schedule of visits for the Project Team for the purpose of meeting with staff of the Department of Plant Nematology. Among other things, the Department is responsible for studying and documenting the nematodes of different ecosystems in Viet Nam:

- Nematode density as an indicator of environmental quality;
- Screening of crops for resistance/tolerance to parasitic nematodes;
- Developing sustainable systems for nematode control, including biological control of nematodes; and
- Developing and promoting the use of nematodes for the control of insects and other pests.

The meeting was chaired by Dr Le Xuan Canh, Deputy Director, IEBR. The Project Team was advised that the IEBR has seven nematologists on staff – not all concerned with plant pathogenic species. Much of our time at IEBR was taken up with a general discussion of our mission and the work of the IEBR. The Project Team did not get to see the collection of nematodes because of the lateness of the time. The IEBR nematologists have close links with scientists in Belgium and in the Netherlands. The Department has recorded about 250 species of plant parasitic nematodes, among these 25 new species.

6.8.2 National Institute of Plant Protection

The National Institute of Plant Protection is the agency with major responsibility for maintaining data on the plant health status of Viet Nam. The collection of disease specimens and plant pathogens held by NIPP is based on surveys of the major crops carried out in 1968. Very few specimens appeared to have been added in more recent times. The collection contains some 800 dried and 100 wet specimens according to the questionnaire completed by NIPP (about 1250 according to a published brochure). Irrespective of the size of the collection, it is small and ‘passport’ data would not meet the ISPM Standard for pest records. Specimens were prepared as museum displays and were not adequately preserved, as evidenced by infestation with insects. Staff responsible for the collection appeared to lack the specialised training necessary for the task.

6.8.3 Plant Protection Department, Technical Plant Quarantine Centre

The Plant Protection Department (MARD) has three functions:

- Plant protection extension;
- Pesticides – importation, formulation, registration and distribution; and
- Plant quarantine.

The Project Team met with the Deputy Director and Mr Pham Quang Huy from the Foreign Relations Division of PPD. The Deputy Director had little or no English and all communications were through Mr Huy. The discussions covered the activities of the Technical Plant Quarantine Centre and pest risk assessment. In the course of this conversation the Deputy Director acknowledged that Viet Nam’s pest list was out dated – acknowledgement of the need for support to develop the disease herbarium and pathogen collection at NIPP.

6.8.4 Department of Plant Pathology, Hanoi Agricultural University

Departmental staff have a responsibility for teaching and research and, not surprisingly, no mandate for maintaining a disease herbarium and pathogen collection. The small number of specimens on hand was mostly for research and teaching purposes. Staff from this Department provide a diagnostic service for the quarantine service, supplementing the skills within NIPP for undertaking diagnostic work on plant pathogens. The laboratories inspected by the Project Team were extremely well maintained and appeared to be well used. The Department has close links with Professors Burgess and Dale in Australia. Collections from pathogen surveys initiated by Professor Burgess are currently lodged in the herbarium maintained by New South Wales Agriculture, Orange. Data on these collections are available on CD ROM. To what extent the laboratories and work standards reflect collaboration on projects funded by ACIAR is a matter of conjecture. Suffice to point out that staff from this Department are a crucial component of Viet Nam's plant health infrastructure who could be co-opted to assist in populating the collection held by NIPP. Staff could contribute to various capacity building initiatives both within Viet Nam and throughout ASEAN.

6.8.5 Research Institute of Fruits and Vegetables (Hanoi)

The Institute for Fruits and Vegetables is a part of MARD. While primarily concerned with crop culture, the Institute has some plant health specialists on staff – but less than might be expected given the potential of pathogens to debilitate perennial stock, and destroy and downgrade production. The Institute had new screen house facilities and some relatively new buildings, with others under construction. However, plant health staff appeared not well provided for given their important role in horticultural development²¹. An important component of an expanded capability in plant health would be the preservation of disease specimens to support description of the plant health status of fruit and vegetable crops in Viet Nam. Such specimens might be maintained locally as part of a dispersed 'national collection' or lodged with a rehabilitated and expanded collection within NIPP.

6.8.6 Viet Nam Agricultural Science Institute (VASI)

Here the Project Team met with staff from the Department of Microbiology and the Department of Plant Genetics and Pathology.

VASI was established in 1952 and appeared to the Project Team to have similarities to Divisions within CSIRO, including responsibility for training post-graduate students. Plant pathology was a small component of the Department, with most resources allocated to microbiology, including legume microbiology and other beneficial micro organisms. Laboratories appeared to be well used and well maintained. There was no disease herbarium as such and only a small collection of plant pathogens, all of relevance to research at the Institute. The Institute holds a significant collection of beneficial bacteria.

²¹ The Asian Development Bank is to provide US \$40 million over about twenty years for Viet Nam to expand fruit production as an alternative to rice for which returns are low.

6.8.7 A Way Forward for Viet Nam

Viet Nam appears to be moderately well supported by scientists with training in plant pathology, although a number of the scientists that we met would benefit by further training and exposure to the international network of plant health scientists. There appears to be a real willingness to build capacity in plant health generally and in quarantine, but this is not reflected in the resources allocated to building the fundamentals, that is diagnostic capacity and disease herbaria on which other plant health initiatives depend. A commitment to develop a state-of-the-art disease herbarium would be the first step to addressing the deficiency. This could be followed by action to harness national expertise to populate a disease herbarium, including through national and regional surveys for plant diseases. Specialist training for the curator/Officer-in-Charge of the disease herbarium would be appropriate. Assistance from donor agencies to establish a herbarium will need to include funding for ancillary laboratory equipment and other resource material, including scientific literature.

ATTACHMENT 1: QUESTIONNAIRE

CONTACT INFORMATION

YOUR NAME:

NAME OF YOUR INSTITUTION:

ADDRESS:

PHONE:

FAX:

E-MAIL ADDRESS:

COLLECTION DETAILS

1. Please specify the type and size of the existing collection(s) of plant pathogens:

TYPE OF SPECIMEN	COLLECTION SIZE	
	Number of identified specimens*	Number of unidentified specimens
1. Preserved specimens:		
<input type="checkbox"/> Dry		
<input type="checkbox"/> Wet		
<input type="checkbox"/> 2. Slide specimens		
<input type="checkbox"/> 3. Live cultures		
4. Others (please specify below)		
<input type="checkbox"/>		
<input type="checkbox"/>		

*‘Identified’ here refers to those specimens identified down to species, genus or family level or any other Recognisable Taxonomic Unit (RTU).

2. Please indicate if the following information is recorded for identified specimens:

- | | | |
|-----|------------------------------|--------|
| 2.1 | Scientific name of pathogen | yes/no |
| 2.2 | Scientific name of host | yes/no |
| 2.3 | Date and place of collection | yes/no |
| 2.4 | Name of identifier | yes/no |

3. What percentage of specimens held in the collection is relevant to agriculture:

- None
- 25%
- 50%
- 75%
- All

4. What is the source(s) of specimens received by your institution:

5. Is the number of specimens to be identified increasing each year? yes/no

If yes, please indicate the number of unidentified specimens received each year:

- < 100
- 100 – 400
- 400 – 800
- > 800

6. Is the identification of unidentified specimens regarded as urgent? yes/no
7. Are specimens obtained from regular surveys for diseases? yes/no

If yes, what crops are being surveyed:

8. **A.** To what extent does your institution access the expertise of *national* specialists:

- Never
- Occasionally
- Frequently

Please indicate which national specialists/organisations you have contact with:

B. To what extent does your institution access the expertise of *international* specialists:

- Never
- Occasionally
- Frequently

Please indicate which international specialists/organisations you have contact with:

9. Do you know if type and other specimens collected in your country are held in overseas institutions? yes/no

If yes, please indicate how many, where they are held, and if there is any opportunity for repatriating this material:

10. Are any parts of the collection in need of rehabilitation? yes/no

If yes, please provide details:

HUMAN RESOURCES

11. For staff associated with your collection, please indicate how many are permanent/contract, as well as the age, area of expertise, and level of staff:

	NUMBER OF STAFF
TYPE OF EMPLOYMENT	
Permanent	
Contract	
AGE	
20 - 30	
31 - 40	
41 - 50	
50+	
AREA OF EXPERTISE	
Bacteriology	
Mycology	
Nematology	
Plant Pathology	
Virology	
Other	
LEVEL	
Professional	
Technical support	

12. Does your institution have a plan for replacing staff nearing retirement? yes/no

13. Do staff require training in the identification of important groups? yes/no

If yes, please provide details:

14. Do you have difficulty accessing key scientific literature? yes/no

15. How many staff have skills in information management (eg. use of electronic databases) to support the collection:

16. What percentage of staff time is spent on maintaining the taxonomic adequacy of the centre (include activities such as curation & research, but not administration):

STANDARDS

17. Have the specimens been verified in recent times? yes/no

If yes, please provide details (i.e. by whom, when and how):

18. Would the material held in the collection meet the standard for pest records as set out by the IPPC (*ISPM8: Determination of Pest Status in an Area*)? yes/no

If no, please indicate reasons:

INFORMATION MANAGEMENT

19. Are the records of plant pathogens held in your collection easily accessible by your National Plant Protection Organisation? yes/no

If yes, can other institutions access this information (please indicate how):

20. Are these records available electronically (eg. computerised database)? yes/no

If yes, please indicate the type of databasing software used:

21. Does your country have a national database of plant pest records? yes/no

SECURITY

22. Do you consider the building in which the collection is housed to be adequate, in terms of space, physical security (fireproof), etc? yes/no

If no, please identify key concerns:

23. Is the reference collection protected by legislation? yes/no

24. Which organisation(s) owns, and is responsible for, the reference collection:

25. How does this organisation(s) relate to the government Ministry(s) responsible for agricultural trade-related issues:

--

FUNDING

26. What is your estimate of the level of *government* funding that is specifically allocated for reference collections and taxonomic work:

--

27. What are the main sources of funding *external* to your organisation, including aid agencies/programs (funds received from 1998 - 2001):

FUNDING SOURCE	AMOUNT (\$)
1.	
2.	
3.	
4.	
5.	

IDENTIFIED NEEDS

28. What are the major challenges facing your institution:

- Staffing
- Infrastructure
- Funding
- Accessing information
- Training in new technologies
- Other

29. Do you have any additional comments:

--

**ATTACHMENT 2:
LIST OF REGIONAL CONTACTS**

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