Beyond Compliance: Project on Integrated Systems Approach for Pest Risk Management in South East Asia

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ABSTRACT

The *Beyond Compliance* project, which began in July 2011 with funding from the Standards and Trade Development Facility for two years, aims to enhance competency and confidence in the South East Asian sub-region by applying a Systems Approach for pest risk management (International Standard for Phytosanitary Measures No. 14, FAO 2002). Systems Approach involves the use of integrated measures, at least two of which are independent, that cumulatively reduce the risk of introducing exotic pests through trade. Although useful in circumstances where single measures are inappropriate or unavailable, the systems approach is inherently more complicated than single-measure approaches, which may inhibit its uptake. The project methodology is to take prototype decision support tools, such as Control Point-Bayesian Networks (CP-BN), developed in recent plant health initiatives in other regions, including the European PRATIQUE project, and to refine them

within this sub-regional context. Case studies of high-priority potential agricultural trade will be conducted by National Plant Protection Organizations of participating South East Asian countries in trials of the tools, before further modifications. Longer term outcomes may include more robust pest risk management in the region (for exports and imports); greater inclusion of stakeholders in development of pest risk management plans; more confidence in trade negotiations; and new opportunities for trade.

THE BEYOND COMPLIANCE PROJECT DESIGN

The *Beyond Compliance* project was developed in the context of several existing trade agreements for plant commodities, frequently based on single risk management measures including prohibition of trade, which were encountering limitations. Systems Approach may help solve some emerging trade issues, but can be complex to develop and negotiate due to structural and quantitative uncertainty about the system. Uncertainty can be recognized explicitly and managed using probabilistic modelling. The project will implement an innovative Control Point - Bayesian Network (CP-BN) modelling approach to develop the Systems Approach for a set of case studies in the participating South East Asian countries. This tool will clarify proposed independent and dependent control measures, include essential verification processes and ease comparisons of similar pest risks.

The project objectives are as follows:

1. To enhance competency and confidence in the South East Asian sub-region in applying Systems Approach to trade opportunities through the use of innovative decision support tools.
2. To provide and test these decision tools.
3. To implement the CP-BN method to Systems Approaches, including evaluation of this method, progression of potential trade opportunities, distillation of experience into a guidance document and/or software based tool and the facilitation of adoption and use of the CP-BN method globally.

The Origins of the Project

In a 2010 workshop funded by a Project Preparation Grant (PPG-328) from the Standards and Trade Development Facility (STDF), hosted by the Malaysian National Plant Protection Organization (NPPO), five South East Asian NPPOs (Malaysia, Indonesia, Thailand, Vietnam and the Philippines) and various regional experts gave presentations on phytosanitary capacity and needs for the sub-region in relation to pest risk management, building on results from a Pest Risk Analysis (PRA).

Under the harmonized regimes of the International Plant Protection Convention (IPPC) and the World Trade Organisation (WTO) Agreement on the Application of Sanitary and Phytosanitary Measures (SPS), the NPPOs use PRA to estimate the risk from specific trade or other pathways (e.g. wooden pallets, containers, used farm equipment, etc.) and to propose phytosanitary measures to reduce that risk to a level acceptable to the importing country. The Pest Risk Management phase is often the weakest in current PRAs (IAGPRA 2007). This phase consists of the evaluation of management options and selection of the best phytosanitary measure, or combination of measures, to apply to trade or other pathways to achieve an appropriate level of protection (ALOP). The weakness in this stage is clear even in the state-of-the-art materials. For example, in the Performance, Vision and Strategy (PVS)

tool, it only ties Risk Management in at the highest capacity level (Molins *et al.* 2009), and it was a proportionately minor component of the PRATIQUE project (Baker *et al.* 2009), which focused more on the assessment process. There has been relatively little support for capacity building in the decision-making process for the Pest Risk Management phase of PRA since the advent of the harmonized PRA approach. The project is aligned with the National Phytosanitary Capacity Building Strategy of the IPPC (FAO 2010).

The PPG-328 workshop discussions made it clear that many countries are employing or seeking to employ a Systems Approach (ISPM No. 14, FAO 2002), because of challenges such as technical concerns in importing countries about food quality and occupational safety of some single treatments (generally post-harvest chemical treatments), and the high risk of trade disruption if a treatment failure occurs. Participants in the workshop however noted difficulties relating to lack of data and uncertainty about the range of available pest risk management measures and their application when using combined measures (Whittle *et al.* 2010). This mirrors the findings of a recent global review (Quinlan & Ikin 2009) on the application of a Systems Approach.

Systems Approach involves the use of a combination of integrated phytosanitary measures, at least two of which are independent, that cumulatively reduce the risk of introducing exotic pests through trade. A notable advantage of a Systems Approach is that it can be flexible and accommodate changes in requirements over time. Several measures may be applied initially (when technical certainty or statistical confidence is low), then (after sufficient trade has taken place and data is available to increase the level of knowledge and statistical confidence) some measures may be removed. Alternatively, if unacceptable failure rates occur, additional measures may be added in an evidence-based manner. Both cases may occur while trade is on-going, often without requiring further regulatory changes.

The South East Asian participants in the PPG-328 workshop also perceived power imbalances in trade agreements in which risk management measures are imposed by importing partners, rather than developed bilaterally. Each country in the workshop emphasized a lack of confidence in the development of pest risk management plans in the context of trade negotiations. It was concluded that ongoing efforts to strengthen national capacity for conducting PRA will benefit from improved decision-making in the Pest Risk Management phase. The participants were encouraged by the prospect of moving *beyond compliance* in the trading realm, to a new level of confidence in proposing and evaluating equivalence agreements when existing risk management plans were not ideal. This led to a joint proposal for a new project, described in this paper, which was launched in July 2011 with funding from the STDF for two years and significant contributions of staff time, infrastructure etc from all project partners.

The project partners are: the NPPOs of Malaysia, Vietnam, Philippines, and Thailand, with Indonesia as an observer; two universities already working with prototypes of the decision support tools (Imperial College London (ICL), United Kingdom, and Queensland University of Technology (QUT), Australia; and the project managing agency, CABI, United Kingdom, which also provides some technical, administrative and communications support. The participating countries are all contracting parties to the IPPC and participate in its standard setting processes. Each NPPO is also active in the relevant regional plant protection organisation (RPPO), which for South East Asia is the Asia Pacific Plant Protection Commission (APPPC). The Secretariat of the IPPC and Executive Secretary of the APPPC

are participating in the project as members of the Steering and Associate Committees respectively.

The European Commission-funded FP7 project, PRATIQUE for enhanced PRA (Baker *et al*. 2009), completed in May 2011, provides extensive background in terms of reviews and discussion and some prototypes of tools that will be employed by the new project (see methodology below). ICL, QUT and CABI were partners in PRATIQUE.

Simultaneously, Australia has been investigating the potential use of the Systems Approach in the event of the potential de-registration of the domestically important post-harvest pesticides, dimethoate and fenthion. With the increasing importance of harmonized evaluation of risk management systems, the NPPO of Australia has developed a new, official policy on using Systems Approach, after consultation with private and public stakeholders (Australian Pesticides and Veterinary Medicine Authority 2010a, APVMA 2010b). While this has been focused on domestic interstate trade, the activities align with international guidance in relevant ISPMs (Nos. 2, 11, and 14). In addition to these developments in the application of Systems Approach, both Australia and New Zealand are starting to develop Bayesian Networks (BNs) to support import and other strategic decisions in plant health and biosecurity (Hood & Christian 2009; Rodriguez & Raphael 2008). In Europe, the European Food Safety Authority (EFSA) is also considering launching programmes to develop probabilistic risk assessment models (EFSA 2011). The recent *Prima Phacie* project (MacLeod *et al.* 2010) provided EFSA with a BN approach for use in the evaluation of risk management measures (EFSA PLH 2010 and 2011), following on from PRATIQUE project developments.

Project theory and methodology

Historically, guidance on Pest Risk Management has been general, as in ISPM No. 2 (IPPC 2007) and No. 11 (IPPC 2005a) on the overall PRA process, including categorization of an organism as a pest, pest risk assessment and risk management. Standards providing more detail for risk management have included ISPM No. 4 on pest free areas (IPPC, 1995), ISPM No. 10 on pest free production sites (1999) and ISPM No. 22 (FAO 2005b) on areas of low prevalence of a target pest, as well as ISPM No. 14 (IPPC 2002) on the use of Systems Approach. Although ISPM No. 14 is a more detailed standard, it has proved challenging to implement. This is largely due to the perceived complexity of calculating the combined impact of measures when the efficacy of each measure is poorly known or statistically uncertain. Importing country NPPOs therefore have been more likely to select highly documented, end-point treatments such as commodity treatments that were empirically developed under laboratory conditions to achieve a quantified impact on the described risk, even when such treatments have other disadvantages, such as cost or quality impacts. Pest-free areas also have been widely accepted by importers.

Another challenge has been that each importing country or region may have different data requirements, or even inconsistent or unspecified requirements, for analysis of efficacy of a Systems Approach. Currently when the exporting country NPPO proposes equivalent options (ISPM 24) (IPPC 2005b), there are often years of delays before the importing NPPO reaches a decision. The opaque process arises from the lack of clarity on how to determine efficacy of measures. Discussions in different trading regions may help to create a common perspective on what is “sufficient” data and which data is most important for the recognition of Systems Approach, either for new trade or as equivalent measures for trade using existing measures. A transparent approach to this question should enhance clarity on the concepts, support bilateral

negotiations and provide some useful examples for comparison and consistency for decisions internal to NPPOs. The fact that a proposed ISPM on efficacy has still not come to fruition a decade after the first Expert Working Group was held (IPPC 2004) highlights the need for broader agreement on this concept.

Scientists working in the field of pest management know that complex systems can be difficult to model and demonstrate, but recently decision tools were developed that can provide solutions (Mengersen & Whittle 2011). A Bayesian Network (BN) graphically represents and then quantifies the relationship between an outcome of interest and the variables (possibly many, interacting) that influence this outcome (Bashari *et al*. 2009). BNs are commonly used for modelling complex systems with many different information sources (Liedloff & Smith 2010). It is thus a natural methodology for a PRA or risk management plan, which involves a complex process with many factors to consider and which requires a combination of data, literature and expert knowledge.

Using a CP-BN offers a range of benefits to developing, negotiating and managing agreements on Systems Approach, compared to conventional systems:

- Using modelling based on a control point (CP) approach to risk management, as opposed to *ad hoc* consideration of the effects of phytosanitary measures, allows a more structured and objective decision-making process.
- A Bayesian approach explicitly accommodates uncertainty in the model, which in most situations will be substantial due to a lack of quantitative data (Bashari *et al*. 2009) or other sources of uncertainty such as natural biological variation or variability in performance of measures.
- A BN can incorporate expert estimates, which are often well-founded even where there is no published information (Smith *et al*. 2005).
- The sensitivity of the system to uncertainty in these estimates can then be tested, so that further data can be sought, or it can be demonstrated that additional data is not essential (Liedloff & Smith 2010).
- Developing a BN and quantifying the factors and their interrelationships with conditional probability estimates can be a highly cooperative activity among stakeholders (Robertson & Wang 2004, Smith *et al.* 2005), which will increase the sense of ownership and potentially simplify agreement on jointly developed solutions.
- A BN is a learning system, so as data becomes available during trade or during a test period, the model can be updated (Smith *et al.* 2005).
- Such a model could also provide a mechanism for the monitoring and review of the trade and its phytosanitary security. This would support one of the key advantages of Systems Approach, which is the opportunity for the monitoring of changes in key factors and assumptions in the PRA subsequently and over time, ideally allowing for adjustment of the system with additional measures or reduction of requirements without interruption in trade.
- Finally, such an approach can facilitate more rapid consideration of proposals for equivalence (ISPM 24) (IPPC 2005b). An internationally agreed framework for evaluating the impact or efficacy of phytosanitary measures (especially those other than end-point treatments) will support increased trade, while maintaining evidence-based pest management measures.

A BN is typically constructed in three main stages: model creation, model quantification, and then use of the model (Marcot *et al.* 2006). The time, expertise and data required to build a BN are the biggest limitation to this tool, although not unique to BN when attempting to capture the complexity of probability and interrelationships (Hood and Christian 2009; Dambacher *et al*. 2007). The innovation for this project consists of a process that links the PRA or similar sources of data to a risk management Decision Support System (DSS), which feeds into a new model (the CP – BN), which in turn informs the Systems Approach risk management plan as an output. This process, as shown in Figure 1, draws on some advances from the PRATIQUE project, including the risk management Decision Support System (DSS), an Excel-based tool. Feedback on the use of this tool in the innovative process will be shared with EPPO for consideration in their own application of the tool.

1. PRA → DSS
   Use a PRA to complete a series of questions in a Decision Support Scheme (in this case, a spreadsheet-based tool), giving likelihood and uncertainty for each question. A DSS tool should be comprehensible to risk managers and will assist in understanding uncertainty.
2. DSS → BN
   Use the DSS responses to automatically quantify the BNs.
3. BN → Systems Approach Output
   Use the BN probabilities to quantify the Systems Approach plan. This is a series of core evaluations and outcomes with corresponding likelihoods and uncertainties.
4. This probabilistic output provides a clear map of the production chain and impact of measures for use in internal policy decisions or in discussions for trade negotiations.

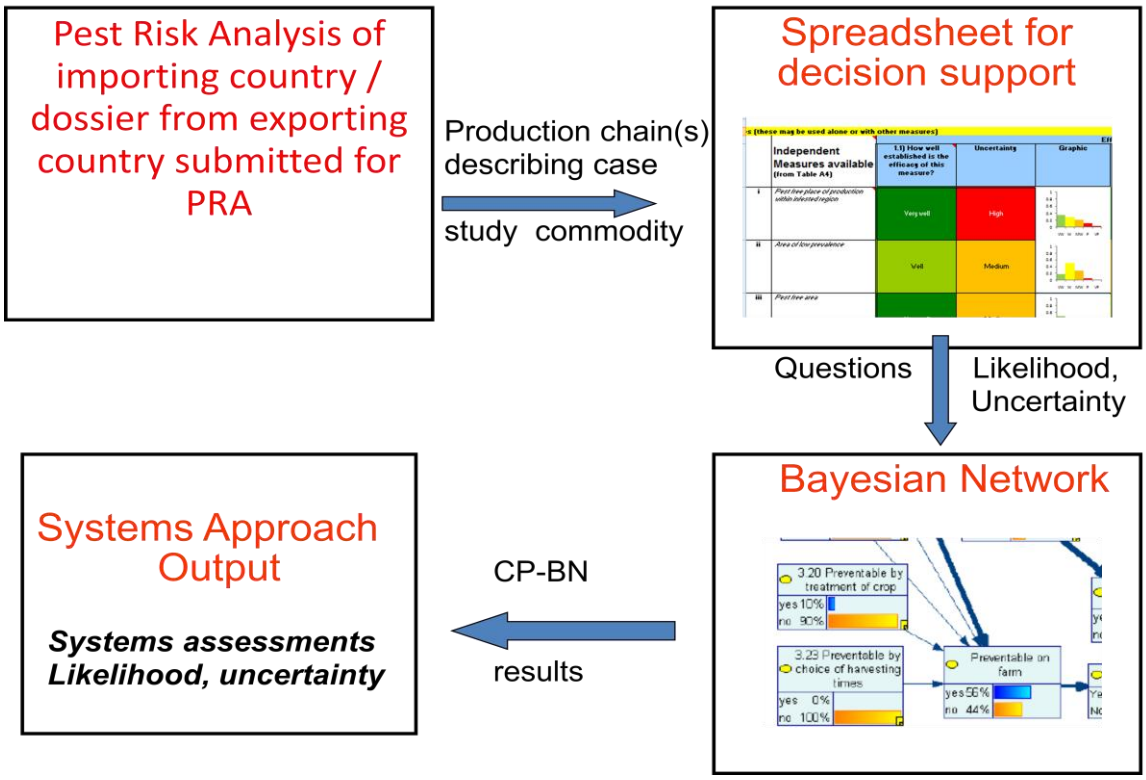

Figure 1. Technical framework of Beyond Compliance project.

Project organisation and activities

The project is structured in four work packages:

WP1: Technical framework
The objective of WP1 is to provide technical support for application of CP-BNs to Systems Approach case studies and to develop the underlying decision support tools for a harmonized framework.

This will include supporting the move from case study PRAs to the CP-BN model, establishing any additional data requirements for the proposed approach that are not routinely included in a PRA, making software choices, sharing best practice for eliciting expert opinion, validating the CP-BN approach, and developing the final decision support tools. The tools will be computer-based, using a platform of Microsoft Excel™ spread-sheets and starting with the GeNIe computer software (Decision Systems Laboratory 2005), which is freely accessible. The project budget provides for computer capacity in the case study countries.

WP2: Case studies
The objective of WP2 is to demonstrate the CP-BN method for Systems Approaches, by applying the method to priority trade case studies in the South East Asian sub-region, including both export and import examples. Proposed case studies and the exporting and importing countries are detailed in Table 1.

In addition to providing real world trade for demonstration of the tools, the case studies will be the training ground for NPPOs to master the concepts and use of the tools. As it requires hands on involvement, the intention is that this will increase knowledge and also confidence. The disciplined and structured representation of the system in the CP-BN framework also clarifies thinking as the management plan evolves.

WP3: Governance
The objective of WP3 is to support the development of a harmonized policy framework that is linked with the decision support tools resulting from the project. This will include understanding institutional approaches to Pest Risk Management, supporting enhanced stakeholder engagement, facilitating the translation of project results to an international plant health framework, and validation of the project approach and outputs. The aim is to ensure that the NPPO participants gain the confidence to return to their institutions as champions of the approach, once demonstrated, to begin the process of embedding it into the institutional processes and making recommendations for harmonized policy across the region as appropriate (with eventual global dissemination).

WP3 is also charged with selecting and applying some indicators for the impact of the project. In the area of plant health, Naumann & Lee (2009) suggest that success of SPS capacity-building programs can be measured by the number of bilateral quarantine agreements operational or under negotiation; while these have remained static or tended to grow in number very slowly in some countries, in some (the Philippines, Thailand and Vietnam) they have risen significantly. The project time frame is far too short to use the number of resulting trade agreements as an indicator.

Table 1. Proposed commodities for case studies and the exporting and importing countries.

Commodity	Exporting country	Importing country	Main regulated pest(s) of concern	Medium to long term objective	Project level objective (expressed by NPPO or other agent undertaking case study)
Budded stumps or Bud wood of rubber trees	Countries outside the region	Regional (all rubber growing countries in APPPC region)	*Microcyclus ulei*, causative agent of South American leaf blight (SALB)	To protect the South East Asian rubber industry from South American leaf blight, while facilitating trade.	To use BN model as a support system to develop harmonised phytosanitary import requirements for rubber planting material into the region.
Oil palm planting material	Countries outside the region	Regional (focus on major oil palm growing countries such as Indonesia and Malaysia)	*Fusarium* wilt, Chlorotic ringspot virus, Bagworm, Bud rot, Palm weevil	To harmonise phytosanitary requirements across the region; with enhanced surveillance and contingency planning for prevention of oil palm pests.	To use the BN model to identify key phytosanitary risk management options for regional trade in oil palm planting materials for shared action.
Dragon fruit	Vietnam	South Korea (Republic of Korea)	*Bactrocera dorsalis; Bactrocera correcta*	To provide an additional option for export with potentially lower costs for the industry to choose.	To develop a proposal detailing the costs of Systems Approach, which can then be presented as an alternative approach during discussions with stakeholders. To use BN for Pest Risk Management decisions.
Jackfruit	Malaysia	China	Fruit flies, mealy bugs and borers	To expand market access of jackfruit to an SPS stringent market.	To use the BN model to support a proposal for Systems Approach for jackfruit. To increase confidence and communication in trade negotiations.
Orchid cut flowers	Thailand	Europe	*Thrips palmi*	To maintain an important export market that is currently threatened by high pest interceptions.	To use BN to identify key control points and model efficacious alternative measures to meet phytosanitary requirements for import of orchids to Europe. To develop the knowledge of Systems Approach and BN modelling.
Avocado	Philippines	South Korea (Republic of Korea)	Surface feeders; fruit fly spp; and other pests of concern.	To develop probabilistic technical evidence that could build confidence in trade negotiations.	To develop a BN model for a systems approach for export of avocadoes to Korea.

More short-term indicators will be considered, including components of the Performance, Vision and Strategy tool developed by the InterAmerican Institute for Cooperation in Agriculture (IICA) (Molins *et al*. 2009). The PVS provides metrics for capacity in risk analysis, overall implementation of phytosanitary measures, stakeholder engagement, and equivalence. Metrics on application of Risk Management or Systems Approach *per se* were not yet identified, leaving the option of creating such an evaluation tool as part of the project.

WP4 and WP5: Communications and Administration

The objectives of these two work packages are to maintain communication within the project and disseminate results to stakeholders, (WP4) and to ensure the smooth and successful achievement of the project objectives.

Internal communications will be facilitated by regularly scheduled project remote conferencing. Additionally, a project blog will be set up to provide an online presence, enable collaboration by the project team, and to provide timely access to the latest version of project reports and other deliverables. The Technical Framework WP (WP1) will be interacting with the Case Studies WP with regular face to face meetings, which WP5 may support logistically.

External communications will be enhanced by a periodic e-newsletter and the public area of the project blog. Reports to STDF will be posted on the blog. Since the PPG workshop, a number of external stakeholders have been contacted and briefed on the ideas for the *Beyond Compliance* project. The International Advisory Group on PRA (IAGPRA) commented on the project proposal and was represented in the project launch meeting (from the NPPO of New Zealand). The project team will articulate and share the potential contribution of this project to the Asian Development Bank (ADB) SPS Draft Action Plan for GMS countries (Van de Meer *et al*. 2009) and other regional initiatives. The Commission on Phytosanitary Measures (CPM) of the IPPC will be informed through reports to the Expert Working Group on Phytosanitary Capacity Building, to the CPM itself, or by posting on the new Technical Resources page of the IPPC website. The project is aligned with the recently adopted IPPC Capacity Building Strategy and will be supported by the IPPC Secretariat in an advisory capacity.

THE BEYOND COMPLIANCE PROJECT EXPECTED OUTCOMES

The project outputs will include:

1. A review that describes pest risk management for imports and exports in the region, including design and evaluation of these measures.
2. Case studies of priority trade opportunities identified by the South East Asian project partners using Systems Approach for pest risk management (see Table 1; the tool can be demonstrated with fewer case studies, should any barrier arise to completion on any one of them).
3. Demonstration and evaluation of quantification and analytical tools (specifically CP-BN) to support the use of a Systems Approach.
4. Establishment of a competency base in the South East Asian sub-region for creating risk management plans directly linked with a PRA to the CP-BN methodology, and from this to appropriate communication with risk managers.
5. A plan for a harmonized framework for a Systems Approach to pest risk management.

Dissemination of results from the sub-region to the wider region will flow through the regular meetings of the APPPC. From there the results will pass to other RPPOs at the annual RPPO Technical Consultations. This will be made easier by the participation of the Executive Secretary of the APPPC in the project, in an advisory capacity. A harmonized framework could possibly be in the form of a regional standard, but other methods of dissemination may prove more efficient. As the approach moves from the sub-regional to the regional level, a plan for wider dissemination will be finalized.

These project outputs will directly support the implementation of ISPM No. 14, which gives guidance on the use of a combination of independent measures that, when integrated, provides effective mitigation of pest risk in a way that is the least trade restrictive. It will also apply to single measures, although these have been less problematic in the past. This project enhances the PRA framework already supported through training programs and the international standards, by applying probabilistic modelling to manage uncertainty.

The anticipated outcome of the project is related to the 2010 IPPC Strategy for Developing National Phytosanitary Capacity (Strategic Area 1, 2b and 6) in terms of enhanced implementation of ISPMs and the ability to monitor and evaluate performance, and the use of tools for phytosanitary systems that are fit for purpose and adapted to national and regional conditions. The process of stakeholder involvement in the design of a Systems Approach and the use of an agreed framework for negotiating with trade partners indirectly support Strategic Areas 5 regarding advocacy/communication by NPPOs.

Longer term impacts and conclusions

Developing countries in the South East Asian sub-region have a high dependence on agriculture and the development of the agricultural sector is essential to obtain food security, reduction in poverty and sustainable growth. This is also true in the more developed countries in the sub-region. Entry to high-value markets in global trade is a priority in the sub-region and the need for compliance with SPS requirements is clearly understood. Increased compliance with sanitary and phytosanitary requirements has been identified as a "key challenge to further unleash export potential" (STDF 2010).

The highest number of interceptions for regulated plant pests on commodity trade into Europe has come from a South East Asian country: well over 60% in 2009 (FCEC 2010). The US NPPO (USDA/APHIS) has also identified another South East Asian country as a significant source of interceptions in recent years (McCullough *et al*. 2006). Some exports from some South East Asian countries have also suffered a high number of detentions for pesticide residues. Overuse of pesticides is often in reaction to related pest interceptions of regulated pests in trade. Increased compliance will also be needed to maintain some historic trade that is currently threatened.

Protection of the environment and of the domestic agricultural resources are less emphasized in the context of export-driven policies, but equally important. South East Asian countries are just beginning to recognize the impact of import policies in this sector. Imports without adequate risk management measures have introduced numerous pests to countries in the sub-region over the past decade, with the opening of borders and increase in trade. Most countries find that detection of a new pest occurs only after it has become well established (Whittle *et al*. 2010). Contiguous countries then face new introductions along unprotected borders, so

that the sub-region becomes harmonized – not in their phytosanitary protection, but in their phytosanitary problems.

Longer term impacts of the project may therefore include, in addition to improvements in plant health regimes, reduced pesticide use and greater support of Integrated Pest Management (IPM) practices. More confident application of Systems Approach should lead to more robust pest risk management in the region; greater inclusion of stakeholders in the process; more confidence in trade negotiations; and new opportunities for trade in a phytosanitary context, possibly using bilateral agreements on equivalent measures to replace or complement existing end-point treatments.

At the macro level, the project has strong potential for linking into the Enhanced Integrated Framework (EIF) and Aid for Trade, because it will form the basis for maintaining trade and supporting new trade opportunities based on a Systems Approach for pest risk management. Agricultural and trade systems that are developed and/or identified in the project will provide opportunities for investment in the establishment of good agricultural and trade practices through the supply chain. This overall approach of following a chain of production has been proven in terms of food safety in the processed food sector. This is relatively new and unsupported in the plant health sector of South East Asia and will move the sector *beyond compliance* into a stronger negotiating position for the future.

Further information

Further information can be obtained by visiting the project blog:
http://beyondcompliance.wordpress.com/

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