INDEPENDENT END-OF-PROJECT ASSESSMENT OF THE STDF PROJECT:

“Mitigating pesticide residue through promotion of biopesticides in Asia”

(*STDF/PG/634*)

FINAL REPORT

Singapore, July 2024#
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#APAARI updated the data by duly informing Dr.Christopher Oates

Abbreviations

ADB	Asian Development Bank
AFA	Asian Farmer Association
APAARI	Asia-Pacific Association of Agricultural Research Institutions
ASEAN	Association of South East Asian Nations
EQ	Evaluation Question
EU	European Union
FAO	Food and Agriculture Organisation of the UN
GLP	Good Laboratory Practice
IR	Interregional Research Project
KM	Knowledge Management
LDC	Least Developed Country
MEL	Monitoring, Evaluation, and Learning
MRL	Maximum Residue Limit
PHI	Pre Harvest Interval
SAARC	South Asian Association for Regional Cooperation
STDF	Standards and Trade Development Facility
SPS	Sanitary and Phytosanitary
WTO	World Trade Organization's

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1. Executive summary

This evaluation covers the STDF funded project originally called "**Asia Pesticide Residue Mitigation through the Promotion of Biopesticides and Enhancement of Trade Opportunities" (STDF/PG/634).** This **pilot** project aimed to address Sanitary and Phytosanitary (SPS) challenges that restricted market access and trade for countries in the ASEAN and SAARC regions. The project focused on Maximum Residue Limit (MRL) issues and also prioritized high-value crops that are important for trade and economic growth in the target countries but which are overlooked in terms of pesticide registration (minor-use crops). The project sought to mitigate pesticide residues and facilitate trade in Asian countries through a collaborative and regional approach. It aimed to reduce pesticide MRL export violations by promoting the use of biopesticides, which are naturally derived and typically do not produce residues, thus exempting them from MRL requirements.

The project's **innovative approach** involved the use of biopesticides late in the growing season as an alternative to conventional pesticides, to mitigate residue violations in export markets while providing pest control during the pre-harvest interval. The project developed decline residue data to develop a relationship between pesticide residues and time, which is essential for determining the timeframe for switching to a biopesticide-based pest management program. The project's relevance is highlighted by its response to specific SPS issues impacting trade, its advocacy for regional collaboration and synergies across pertinent government agencies and the private sector in ASEAN and South Asian countries. The project involved several Least Developed Countries (LDCs), other Developing Countries, and more advanced economies in ASEAN and South Asia in a collaborative and regional project to address these issues.

The STDF Working Group committed a total of US$899,586 in financial support for the project, covering general training and coordination activities, field trials, laboratory work, and other implementation related costs.

The main objectives of this assessment were to: (a) assess the extent to which the project achieved the objectives and indicators set out in the project documents; (b) determine the effectiveness, impact and sustainability of the project; (c) examine the risks encountered during the project, the mitigation measures implemented, and the responses received; and (b) identify best practices that can be replicated or expanded at the national, regional, or global level.

The pilot project has successfully demonstrated a novel approach to address the challenge of Maximum Residue Limits (MRLs) for minor crops. This will be particularly beneficial for countries lacking sophisticated analytical equipment. The project's primary focus was on ensuring MRL compliance in harvested produce through the application of biopesticides in the final spraying stage.

An additional advantage was the provision of tools for participants to monitor pesticide residues. This strengthened their technical capabilities to tackle trade restrictions and Sanitary and Phytosanitary (SPS) issues associated with pesticide residue limits in both local and international markets.

The project's concept holds promise for impacting the 'minor use' crop value chain. However, it necessitates continued support and commitment from donors and national governments to establish the necessary infrastructure. This will enable the approach to become a standard farming practice and thereby achieve the project's long-term objectives.

The project's relevance was confirmed, based on the assessment of key questions, as aligning well with the institutional priorities and needs of the participating countries. This highlights the project's strength in its design and implementation, with a strong focus on taking into account local contexts, stakeholders, and processes.

Despite significant delays mainly due to the COVID pandemic and changes in the technical team, the project was delivered efficiently, with results produced economically and in a timely manner. The project's success can be attributed to a robust and adaptable management team, a skilled technical team, effective activity sequencing, and a strong commitment to training.

The project's achievements have had a significant impact on the participating countries by enhancing their technical capacity to conduct residue trials and monitor pesticide residues. The project has also fostered a team spirit among regional SPS institutions through joint activities and regional event participation, leading to positive outcomes such as biopesticide harmonisation and improved confidence in supply safety among partners.

The capacities developed by the project are likely to be sustainable, although they will require long-term support. This project has set a precedent for future initiatives in this field, demonstrating the potential for significant impact and sustainable change.

The following recommendations are proposed for the design phase of future projects:

1. **Define key roles and responsibilities**: Allocate resources to identify key national decision-makers and stakeholders. Clearly define roles and responsibilities of each team member and assign a backup individual for each critical role within the team.
2. **Thorough planning and review process**: Adopt a comprehensive planning and review methodology, including needs analysis, risk evaluations, contingency planning, and ongoing scrutiny.
3. **Address project sustainability in initial design**: Embed sustainability considerations into the initial design phase and establish institutional commitment to the sustainability of key outputs, in writing, at the outset.
4. **Adopt successful model for future projects**: Future initiatives should adopt the model that was successfully implemented in this project. The structure of the national teams in this project has demonstrated its effectiveness.
5. **Establish feasible timelines**: Carefully determine and define project timelines, incorporating contingency strategies and subsequent actions. Incorporate a mid-term review within this timeline.
6. **Identify project indicators after thorough assessment**: Meticulously evaluate potential risks and success factors prior to the establishment of indicators for goals, outcomes, and outputs. Indicators should be pragmatic and assigned a quantifiable value.

For the implementation phase, the following recommendations are proposed:

7. **Periodically assess activity implementation**: Convene debriefing sessions at both national and regional levels upon the successful delivery of each significant output.
8. **Generate and keep backup copies of records**: Regularly update work plans, supplemented by situational notes as needed. Create mailing lists and log key communications, storing all such information centrally.
9. **Diversify training methodologies**: Explore and implement a variety of capacity enhancement methodologies, including online training. Trained individuals must transfer their knowledge to their peers.
10. **Enhance private sector engagement**: Devise innovative strategies to bolster private sector involvement in areas that stand to gain from their expertise.
11. **Enhance identification of concurrent projects and research**: Allocate resources towards the identification of the relevant activities of other donors and academic institutes.
12. **Remain updated on changes in the political or work environment**: Conduct a comprehensive evaluation of the political climate and work environment at the initial design phase and consistently throughout the implementation phase.

1.1 Project Bio

Project Overview

Title: Mitigating pesticide residue through promotion of biopesticides in Asia
Project number: *(STDF/PG/634)*
Start Date: 20 February 2020
Original End Date: 20 January 2023
Final End Date: 31 December 2023
Project extension: 1st extension 30 September 2023 (approved 1 July 2022); 2nd extension 31 December 2023 (approved 21 August 2023)
Project Value (US$): 1,269,603
STDF Contribution (US$): 899,586
Beneficiaries: Bangladesh, Cambodia, Indonesia, Laos, Nepal[1], Malaysia, Pakistan[2], Sri Lanka, Thailand, Vietnam
Implementing Entity: Asia-Pacific Association of Agricultural Research Institutions (APAARI)
The Project office was located in Bangkok, Thailand.
Partners

- USDA
- CropLife Asia
- Singapore Food Agency
- Asia Farmers Association (AFA)

Technical implementing partners

- Ag Aligned Global

[1] Nepal was originally included in the project but after several attempts by APAARI and the STDF Secretariat, there was no engagement from the country, and it was decided to leave the country out of the project.
[2] Pakistan was not an STDF beneficiary but joined because USDA was funding a project there.

1. Introduction

1.1 Objective of the independent end-of-project assessment

This independent end-of-project assessment, following the Terms of Reference (ToRs) (Annex 1) and assessment framework, sets out to examine the performance, outcomes, and lessons learned from the STDF-funded project (STDF/PG/634). The assessment was guided by the indicators outlined in the project's logical framework, the STDF Monitoring, Evaluation, and Learning (MEL) Framework and relevant STDF program-level indicators. The STDF Monitoring, Evaluation and Learning Guidance[3] for STDF Project Implementing Organizations and STDF Guidelines for the Evaluation of Projects Funded by the Standards and Trade Development Facility[4] served as a reference for this assessment.

The primary objectives of this assessment were to:

- Conduct an unbiased and factual assessment of the project's performance and the results achieved at national, regional, and global levels, including impacts on Sanitary and Phytosanitary (SPS) capacity and trade.
- Examine the risks encountered during the project, including the impact of the COVID-19 crisis, the mitigation measures implemented, and the responses received.
- Based on the assessment findings, identify best practices that can be replicated or expanded at the national, regional, or global level. Additionally, the assessment will highlight lessons learned and propose practical recommendations for the project's sustainability and/or scaling up aimed at relevant stakeholders.

The intended audience for this assessment includes the project implementation team - Asia-Pacific Association of Agricultural Research Institutions (APAARI) and Ag Aligned Global LLC, the project's steering and advisory committee, country partners, organizations implementing other STDF biopesticide projects (ICGEB and IICA), the STDF Secretariat, and members of the STDF global partnership (i.e., FAO).

The assessment's scope encompasses the activities carried out throughout the entire project cycle. This includes the design and initial consultations phase (to assess relevance and ownership), the implementation phase, and the completion and exit phase. As the project was primarily intended to act as a catalyst for change, the assessment will also consider activities and achievements by beneficiaries and implementing agencies and partners outside the project's scope, to assess potential spillover effects and sustainability.

1.2 Description of the policy context and institutional environment

The project under assessment was executed within the framework of the World Trade Organization's (WTO) Sanitary and Phytosanitary Measures (SPS) Agreement. This agreement promotes the harmonization of food safety measures, such as Maximum Residue Limits (MRLs) for pesticides, in line with Codex guidelines (as per Article 3 and Annex A of the Agreement). However, it also allows members the flexibility to impose stricter MRLs, given they can provide scientific justification for their measures.

In an ideal world, Codex MRLs would be universally accepted and used for all pesticides and minor crops, thereby removing MRLs as an obstacle to global trade in these goods. However, the current situation is far from this ideal due to the lack of established Codex MRLs for numerous pesticide/minor crop combinations and the subsequent need for an absence of measurable residue in the harvested product. Certain members, or food businesses, may impose stricter MRLs. The project aimed to assist countries in complying with Codex MRLs and

[3] https://standardsfacility.org/sites/default/files/STDF_Guidance_MEL_PG_Implementing_Partners.pdf
[4] https://standardsfacility.org/sites/default/files/STDF_214_Evaluation_Guidelines_2021_Final.pdf

other pesticide-related trade requirements by providing scientific evidence to integrate biopesticides into strategies for managing pesticide residues in harvested crops.

Regarding biopesticide registration, there is a noticeable lack of harmonization across Asia, leading to a subdued interest in their broader adoption. The Association of South East Asian Nations (ASEAN) has formulated "Guidelines on the Regulation, Use and Trade of Biological Control Agents" (endorsed by the ASEAN Ministers on Agriculture and Forestry (AMAF) in 2014). The guidelines encourage regional harmonization of bio-pesticide registration data requirements, aligning with the interests of member states. Regrettably, these guidelines have not seen widespread adoption.

Institutional environment: A description of the institutional structure is presented elsewhere in this report (See Sub-EQ 15).

Roles in the Project

- **APAARI**– Project Management, Knowledge Management, Microbial Biopesticide Manufacturing Workshop, Monitoring and Evaluation, Functional Capacity Building, Logistics, Budget, Procurements MoUs, Reporting
- **Ag Aligned Global** – Under sub-contract with APAARI provided Technical Coordination (including Consultants), Technical Workshops, Meetings, Capacity building (lab and field), Regulatory Harmonization, Reporting

1.3 Project Overview

The project under assessment was conceived to tackle the pervasive Sanitary and Phytosanitary (SPS) challenges that obstruct regional countries' market access, thereby stalling trade and development. The primary emphasis was on Maximum Residue Limit (MRL) issues, a significant concern within the SPS Committee, and a substantial influencer of agri-food trade. The project was also focused on minor-use crops as these are generally high-value crops that have cultural importance or are important for trade and economic growth in developing countries. These crops are also often overlooked in agriculture since they represent a relatively low proportion of total product output and planted area. Minor crops are essential to nutrition security, sustainable agriculture, and biodiversity. They are often important for trade and economic growth in developing countries. In Asia, examples of minor use crops of potential economic value include Basil, Dragon Fruit, Papaya, Mango, Cashew Nut and Chilli Pepper.

The project's relevance is highlighted by its response to specific SPS issues impacting trade, its advocacy for regional collaboration and synergies across pertinent government agencies and the private sector in ASEAN and South Asian countries. The project involved several Least Developed Countries (LDCs), other Developing Countries, and more advanced economies in ASEAN and South Asia in a collaborative and regional project to address these issues.

The project capitalized on the preceding ASEAN STDF Project (STDF/PG/337), adopting the implementation approach and technical methods for developing high-quality residue data with enhanced Good Laboratory Practice (GLP).

STDF/ PG/337 proposed two solutions to the trade issues impacting minor crops: (1) the development of new MRLs, often unfeasible for LDCs and difficult for the more developed economies in Asia due to the lack of sophisticated analytical equipment; and (2) residue mitigation, which provides a self-help approach for these countries.

This project aimed to mitigate pesticide residues and facilitate Asian countries' trade through a collaborative and regional approach. It aimed to reduce pesticide MRL export violations by promoting the use of biopesticides, which are naturally derived and typically do not produce residues, thus exempting them from MRL requirements.

The use of biopesticides late in the growing season, as an alternative to conventional pesticides, is one way to mitigate residue violations in export markets while providing pest control during the pre-harvest interval (PHI). In support of this "innovative" approach to controlling product MRLs, the project aimed to develop decline residue data and a better understanding of how time and end-of-season mitigation impact residues. The project included work on residue decline studies of synthetic pesticides to develop a relationship between pesticide residues and time, which is essential for determining the timeframe for switching to a biopesticide-based pest management program. In this respect, the **project can be regarded as being a pilot**, to test the innovative approach detailed above.

One of the project's key strengths in controlling SPS risks is that it balanced the benefits of conventional pesticides (generally lower cost and greater efficacy) with the advantages of a biopesticide at the end of the season (lower residues while providing sufficient pest control).

The project prioritized speciality and tropical crops[5] due to their high value and large potential market, including niche markets in the EU and other parts of Asia. For various reasons, many of the pesticide/crop combinations for these products do not have an associated codex MRL and residue levels are set at the limit of detection.

While the project was not expected to establish new Codex MRLs, the work on residue decline studies of synthetic pesticides will also help to indirectly build the capacity of the participating countries to develop the residue data required for establishing Codex MRLs.

The project was also designed to mainstream the Common Framework on Capacity Development for Agricultural Innovation Systems (AIS) of the Tropical Agriculture Platform[6] in all technical activities of the project. The objectives were to:

- Support the partner countries in developing their capacities for innovation, not just technical but also institutional;
- Expand the partner countries' thinking beyond their technical areas of work, to develop a system thinking; and
- Build the partner countries' soft skills (functional capacities) that would effectively lead to the application of the technologies promoted by the project in practice.

As such, all technical programmes under the project were designed collaboratively to develop these capacities and system thinking. The project's technical capacity development (CD) activities were integrated with the development of the functional capacities (soft skills) particularly needed for innovation in the thematic context of the project.

Furthermore, the project used the Framework's three-dimension model for capacity development, building capacities not only at the individual level but also organizational and institutional (enabling environment) to make capacity development more effective[7].

The STDF Working Group committed a total of US$899,586 in financial support for the project, covering general training and coordination activities, field trials, laboratory work, and other implementation related costs. This funding facilitated participation in a variety of activities and, in specific cases, materials, equipment, and transport of samples.

[5] Basil, Chili Pepper, Dragon Fruit and Cabbage

[6] APAARI is an active member of this network hosted by FAO. The Common Framework promotes capacity for innovation, specifically: capacity to navigate complexity, to reflect and learn, to collaborate, and to engage in political processes; https://tapipedia.org/framework

[7] https://tapipedia.org/framework/3-dimensions-capacity-development

The project's intervention logic and theory of change

The project document effectively communicates its objective, which is to address the issue of pesticide residue violations. This is expected to unlock markets that are currently inaccessible due to regional farmers' inability to comply with established or non-existent international standards. A prior STDF-funded project (STDF/PG/337) underscored that traditional methods would not offer viable solutions to this problem, thus necessitating innovative approaches.

In response, this STDF project implemented a novel strategy, grounded in scientific rationale, to mitigate pesticide residue MRL export violations by employing biopesticides. This approach balances the benefits of conventional pesticides, such as cost-effectiveness and higher efficacy, with the advantages of using biopesticides at the end of the season. These biopesticides result in lower/no residues while still providing sufficient pest control. This is particularly beneficial for controlling key pests towards the end of the crop growing period, which is when pesticides contribute most to residues at harvest time.

The adoption of this innovative strategy is expected to positively influence the regional phytosanitary situation, thereby enhancing food and plant safety. This, in turn, is anticipated to boost productivity and competitiveness, leading to improved food security facilitating safer trade and enhanced market access for plant products.

Individual country field trial results

The phase of the field trials involving the use of a biopesticide as the final spray was completed by all countries only in December 2023. Results for the individual countries are summarised below and explained in more detail in the project's final report:

Positive results

Bangladesh / Chlorpyrifos / Cabbage / Neem Oil - The introduction of a biopesticide to replace the last conventional application reduced pesticide residue by up to 50% in comparison to a conventional plot with only conventional applications.

Indonesia / Profenofos / Chili Pepper / Neem Oil - The inclusion of a biopesticide to replace the last conventional application reduced pesticide residue by up to 50% in comparison to a fully treated chemical pesticide chili pepper plot.

Sri Lanka / Imidacloprid / Chili Pepper / Neem Oil - The residues in the biopesticide plot were significantly lower than the residues in the conventional plot at the 0-day and 14-day sample collection.

Thailand / Prothiophos / Chili Pepper / Neem Oil - Results showed a 2-3x reduction in residues between the biopesticide plot and the conventional plot throughout all sample collections.

Vietnam / Chlorothalonil / Dragon Fruit/ Neem Oil - Results showed a 3-5X reduction in residues between the biopesticide plot and the conventional plot throughout all sample collections.

Inconclusive/no results

Cambodia / Cypermethrin / Basil / Neem Oil - The results showed that the biopesticide and conventional plots were similar in terms of residue content, both plots were below the EU MRL of 2 ppm 14 days after the last conventional application. One possibility is that a rain event soon after the application could result in lower residues in the conventional plot.

Laos / Chlorpyrifos / Basil / Neem Oil - The results were inconclusive.

Malaysia / Acetamidprid / Chili Pepper / Neem Oil - A thrip infestation destroyed all of the plots except the conventional plot in replicate 2, therefore there were no results reported.

1.4 Indication of the consultant's independence to carry out the project assessment

The assessment has been conducted by Christopher Oates, a freelance consultant. Dr Oates is an SPS expert with around 35 years of professional experience, mostly in Asia.

Dr Oates has regularly worked in the countries participating in this project since 1998, for various development agencies (EU, FAO, ADB, ITC) and on different topics. This has been an asset for conducting this assessment, since the consultant was already familiar with the context, and already knew most of the project stakeholders.

There was therefore no conflict of interest for the expert in undertaking this assessment.

2. Assessment Methodology

2.1 Assessment Techniques and Procedures

The assessment was conducted following the STDF Project Evaluation Guidelines. The assessment process was structured, beginning with an analysis of documentation and the creation of a comprehensive Assessment Matrix, which was presented to APAARI at the onset of the assessment and is included in Annex 2.

The assessment adopted a participatory and consultative approach to foster stakeholder ownership of the findings, recommendations, and the learning opportunity provided by the assessment.

2.2. Steps in the Assessment

The assessment process was carried out in the following sequential steps:

1. **Identification of available documentation and information source:** The documentation provided by the implementing agency (APAARI), and the documents already in the possession of the consultant were reviewed. The collection of documents consulted was comprehensive and included the project design document, progress reports, implementation reports from all partners, training material, protocols, steering committee meeting material and other materials developed under the project. Three main documents and frameworks guided the assessment approach and methodology: (1) The terms of reference for the assessment; (2) The guidelines for evaluation of STDF-funded projects; and (3) The STDF Monitoring Evaluation and Learning Framework – MEL.

2. **Identification of stakeholders:** Based on a preliminary list provided by APAARI, a list of 27 stakeholders involved in project implementation (or indirectly concerned by the project but whose opinion could be relevant for the assessment) was established. The stakeholders were classified into two categories: (a) Implementing agency and associated international partners; and (b) National partners and beneficiaries (Public sector and Civil society and private sector). The detailed list of stakeholders including their role in implementation, type of benefits received and contact persons, is provided in Annex 3. This assessment step was not subject to any specific challenge or difficulty.

3. **Desk study:** The documentation collected was analysed to extract the elements that would be relevant for the assessment. A key issue at this stage was that the field trials had not been completed at the time of the desk study and reporting was not available when the first draft was submitted to APAARI and STDF. The sustainability plan was also not drafted at the time of this assessment.

4. **Interviews with stakeholders**: It was initially envisaged that this assessment step could take place both remotely and physically; most of the interviews were to be held remotely with field trips to Malaysia, Thailand and Cambodia. However, given the timing of the closing workshop, this provided an opportunity, either, pre, post, or during the -workshop, to have face-to-face interviews with most of the technical team, management team and each of the country counterparts. A total of 25 face-to-face interviews, supplemented with ZOOM calls, were completed to clarify specific points. Based on the assessment matrix, detailed guiding questions were developed for each category of stakeholders; they are presented in

Annex 4. The timing of the project closing workshop supported this phase of the assessment as all key persons were available in Thailand for interviews.

5. **Preliminary analysis**: The substantial amount of information, data, opinions and evidence gathered during the desk study and interview phases was then collated and analysed. The main tool used for this analysis was the assessment matrix, with specific questions for each criterion. For the detailed report with data. Bangladesh, Cambodia, Indonesia, Thailand and Vietnam reported significant reduction in residue levels in the final harvest after introduction of biopesticides incase of conventional pesticide as last spray. In Malaysia, the crop failed due to thrips infestations. Loas and Sri Lanka. inconclusive results were obtained. (Annex 9C of End of the project report).
6. **Validation of preliminary analysis:** Preliminary findings were shared with APAARI and STDF. This provided an opportunity to confirm and validate most of the preliminary findings, clarify pending issues and fill information gaps. The provided written comments have been considered and, where relevant, included in the present final report.
7. **Final analysis**: The present final analysis is based on the preliminary draft report revised in light of the complementary information gathered during the above phase.

2.3 Introduction to Assessment Scoring

In the process of this project assessment, each Evaluation Question (EQ) was assessed and assigned a score. It is important to underscore that these scores are inherently subjective, serving as a directional guide to signify the degree of accomplishment of each assessment question. The scoring system employed in this assessment is structured as follows, descending from the highest to the lowest:

- Very High
- High
- Satisfactory
- Poor

3. Findings and analysis

This section provides the answers to the Evaluation Questions (EQs) that were set out in the Assessment Matrix (Annex 2).

3.1 Relevance: did the project do the right things?

Overall judgement on relevance

The project's **relevance** is rated **very-high** due to its alignment with the institutional priorities and needs of the participating countries during the design and implementation phases. These needs included the identified need to address SPS issues relating to non-conforming pesticide residues and the desire to expand export markets. The assessment of relevance is further detailed in the following four questions.

1. To what extent did the objectives and design of the project respond to the SPS-related needs, policies and priorities of the beneficiaries, as well as other stakeholders involved (public and/or private sector, regional/international organizations, etc.)?

The project was strategically designed and effectively implemented to address the specific needs of the participating countries. The project's primary focus was on ensuring compliance with pesticide residue

Maximum Residue Limits (MRLs) in harvested products, which aligned well with the needs of the partner countries who were actively considering, or implementing, Sanitary and Phytosanitary (SPS) control measures aimed at pesticide compliance issues affecting trade. Additionally, the project successfully developed tools for monitoring pesticide residues, thereby enhancing the technical capacity of the participants to effectively address trade constraints and SPS issues related to pesticide residue limits in both domestic and international markets.

It is worth noting that most countries involved in the project were actively exploring the adoption of sustainable agriculture practices, including the use of biopesticides. Supporting these initiatives, the countries were at various stages of developing, or adopting, strategies or policies to promote the adoption of biopesticides by farmers and the private sector. The strategies and policies encompassed approaches to streamline the registration process, facilitate biopesticide manufacture, and encourage the widespread use of biopesticides. However, they faced challenges associated with commercializing and streamlining the biopesticide registration process.

One of the project's unique strengths lies in its innovative strategy to address the lack of MRLs for minor crops and the resulting low residue requirements. This strategy directly tackles the significant constraints faced by many Asian countries, as they encounter difficulties in acquiring, maintaining, or operating the advanced analytical equipment necessary to detect such low residue levels. Remarkably, even more advanced economies in Asia also struggle with this issue.

Overall, the project's design and implementation effectively aligned with the identified needs and policies of the partner countries, contributing to their efforts in implementing SPS control policies and reducing pesticide use. The project's focus on biopesticides and the development of tools for monitoring pesticide residues significantly enhanced the technical capacity of the participants, enabling them to address trade constraints and SPS issues related to restrictive pesticide residue limits.

2. To what extent were there differences and/or trade-offs between different priorities or needs?

At the country level, the assessment found that there were no trade-offs between different priorities and needs. This was due to the robust identification of these priorities during project identification (STDF PPG 634) and project design which remained relevant throughout the implementation phase. The project's tools and knowledge were successfully applied across all countries, despite the varying levels of capacity among them.

At the project level, some minor trade-offs were necessary. Initially, countries provided a priority-ranked list of pesticide/crop combinations for the study. However, due to certain constraints, it was not always possible to include the top-priority pair. The two main reasons for this were that the selected pesticide was not registered in the country and the project's effort to streamline the number of different crops for smoother implementation. Additionally, while the project utilized neem as a biopesticide, some countries expressed a preference for other biopesticides they believed would be more effective in their specific contexts.

3. How were local contexts, ownership, processes and stakeholders taken into account in the design and implementation of the project?

The assessment findings indicate that the project was designed and implemented with careful consideration of local contexts, partners' needs, and processes. The active engagement of government authorities in identifying specific residue problems resulted in the submission of 218 issues. These issues were then ranked based on their importance, potential for regional cooperation, and facility capabilities.

Project partners selected a residue mitigation option as the project's basis and were further consulted to identify and list potential pesticides and crops for study. The final selection of pesticides and crops took into account each country's mandate and identified problems, even if they were not their top priority.

The project included a wide range of countries, from the least developed to more technologically advanced economies within the ASEAN and South Asia regions. The technical demands of the project highlighted noticeable disparities in capacity and resources among the participating countries. Countries with a strong export history, such as Thailand, were well-equipped to handle the project's technical demands. Conversely, the least developed countries encountered significant hurdles due to their limited ability to acquire, maintain, or operate the high-tech analytical equipment needed for detecting low residue levels. These countries also faced a deficit in soft skills, either due to a lack of trained personnel or experience. To mitigate these challenges, the project implementation phase incorporated planning meetings and bespoke training sessions, tailored to the unique needs and priorities of each participating country. The project also ensured that the pesticides used for analysis were registered in the respective study countries and that the necessary analytical equipment was readily available. This strategy enabled the countries to focus on building their capacity and knowledge of Good Laboratory Practices.

The project demonstrated flexibility by accommodating individual country needs for changes or additional support. For example, Laos requested technical support from Thailand for field trials, and the project was able to provide the necessary assistance.

To enhance the integration of biopesticide use by farmers, the project collaborated with the Asian Farmer Association (AFA). The AFA organized national webinars in local languages to enhance farmers' capacity to integrate biopesticides. It should be noted that in the original project document, this role was assigned to FAO, who subsequently withdrew from the project. The reasons for the departure of FAO remain unclear.

However, it is worth noting that there were a few issues during the early stages of the project. In some countries, collaborating partners had been selected and included in the project but correct procedures had not been followed. In Vietnam for example, projects of this nature must be assigned to an agency by the Ministry. With several of the countries, the signing of MOUs was also problematic. The issues were resolved by APAARI, but significant time was lost while mutually aggregable solutions could be found.

The project demonstrated a comprehensive approach to addressing residue problems, engaging stakeholders, and building ownership in participating countries.

4. To what extent did the project remain relevant, even if the circumstances changed over the course of implementation?

The project consistently addressed the persistent issue of hindered access to export markets due to a lack of strategies to comply with existing MRL trade requirements, ensuring its relevance throughout implementation. Despite varying capacities at the country level, the project also maintained its relevance to all participating countries, albeit for different reasons.

3.2 Coherence: how well did the project fit?

Overall judgement on coherence

The project's coherence is rated **high** for its alignment with other national and donor-funded interventions and its focus on addressing the gap between national policies aimed at reducing pesticide use and promoting biopesticides and a lack of mechanism for their implementation. The project complemented other interventions by filling a significant gap without duplicating efforts.

The assessment of coherence is further detailed in the following four questions.

5. How well did the project fit vis-a-vis other interventions (led by the implementing organization, government authorities, donors, etc.) in the particular context (country/region, sector, etc.)? To what extent did the project add value, while avoiding duplication of efforts?

Overall, the project assessment findings indicate that the project was an excellent fit with other interventions and added value without duplication.

The evaluated project was built upon the foundation of STDF's regional MRL project in ASEAN (STDF/PG/337). The project extended the work supported by various programs and projects, including FAO's Asia Regional IPM program, Germany's biopesticides and pheromones project in South Asia, FAO's ASEAN project on food safety standards, and GIZ's project on Biological Control Agents regulation. The involvement of APAARI in the FAO/EU project on Capacity Development for Agricultural Innovation System (CDAIS) was also beneficial.

During the design and implementation of the project, no partner governments had initiatives in this technical area, and policies promoting biopesticide use were not linked with nationally funded research.

The STDF project addressed a significant gap in the field by providing a technical justification for using biopesticides to replace the final spray. It is worth noting that other projects involving biopesticides did not include research or investigation of the impact of biopesticide use on pesticide residues, while STDF/PG/337 did not focus on biopesticides in its research. This project filled this gap and added value without duplicating efforts.

6. To what extent did other interventions (including policies) support or undermine the project, and vice versa?

The assessment findings indicate that the national policies promoting reduced pesticide use and the adoption of biopesticides have been instrumental in creating a positive environment for the project. Governments in the partner countries have shown strong commitment to these policies.

Before the project formulation and during the implementation period of the project, participating governments already had or prepared policies aimed at reducing chemical pesticide use and promoting sustainable agriculture. These initiatives were driven by the national governments and independent of the STDF project. For example, Bangladesh implemented the "safe crop programme" and Malaysia introduced the "MyOrganic" scheme to reduce chemical pesticide use. Similarly, Thailand and Vietnam implemented policies to promote the use of biopesticides, such as Thailand's "production and promotion of biopesticides of lower cost" and Vietnam's "incentives to promote use of biopesticides". These policies have contributed to the supportive environment for the project, with countries actively adopting biopesticides and amending their policies accordingly.

Furthermore, in 2014, the Association of South East Asian Nations (ASEAN) with the support of BMZ published harmonized guidelines on the regulatory review of bio-control agents, including biopesticides[8]. This regional collaboration further supported the project by providing a framework for the regulation and use of biopesticides.

[8]https://asean.org/wp-content/uploads/2021/08/ASEAN-Guidelines-on-the-Regulation-Use-and-Trade-of-Biological-Control-Agents-BCA.pdf

7. What were the synergies and interlinkages between the project and other interventions carried out by the same institution/government?

The assessment has identified a significant gap in national interventions specifically addressing the technical aspects essential for residue monitoring and promoting the use of biopesticides. Similarly, efforts towards implementing existing biopesticide policies appear to be sporadic and insufficient. The project addressed, in part, the gaps between policy and implementation and the need for a technical basis.

While exposure to Good Laboratory Practice (GLP) training by some of the partners was noted, a clear understanding of how to apply this training to generate pesticide residue data for Maximum Residue Limit (MRL) considerations was weak.

Based on interviews and review of workshop/training material it is apparent that there are, for some of the countries, supportive policies for biopesticide usage at the governmental level. However, there seems to be a lack of targeted initiatives to encourage the adoption and application of biopesticides. Noteworthy is Bangladesh. The government of Bangladesh has funded a project aimed at research and extension activities for the development of biopesticide-based technologies. This project has led to the successful development of 30 product "technology packages", already implemented across 14 districts. The initial phase of the initiative predates the STDF project, the second phase is planned building on previous work, including the STDF project. It is important to note, however, that these initiatives did not factor in data on residue decline. The lack of consideration for such data implies that there remains room for substantial value addition in this area.

The project was able to build on strong synergies with activities of USDA, specifically in Pakistan who despite not being an STDF beneficiary, was able to join the project because USDA was funding a similar project there.

8. To what extent was the project complementary to and/or coordinated with relevant interventions supported by other actors in the same context, including how did it add value while avoiding duplication of effort?

The project was a substantial addition to the agricultural trade development initiatives in the region, co-existing with donor efforts on Sanitary and Phytosanitary (SPS) matters, agricultural development, and sustainable food systems. Key contributors to these integrated efforts included the ASEAN Regional Integration Support from the European Union (ARISE+), projects from the Asian Development Bank and the World Bank, initiatives from USAID, as well as projects from the Food and Agriculture Organization and International Fund for Agricultural Development. The examples of other initiatives are USDA/USAID funded projects implemented bu CABi in Pakistan and APAARI in Bangladesh.

The key aspect of the project was to support the novel approach with the provision of a scientific rationale favouring the use of biopesticides as a replacement for the final spray. This filled an important void in regional agricultural practices without redundantly overlapping with other existing efforts. Throughout the project's lifespan, no other donor activities were focusing on the provision of a scientific rationale favouring the use of biopesticides and no other SPS-oriented interventions could produce the particular data and understanding required to advocate the use of biopesticides. **This unique attribute has positioned the project as a pivotal contribution to the agricultural sector in the region.**

3.3. Effectiveness: did the project achieve its objectives?

Overall judgement on the effectiveness

The project's effectiveness is deemed **satisfactory-high.** Notwithstanding the early-stage hurdles which led to delays, a majority of the project outputs were successfully achieved.

At this time, the goal and some of the outcomes have not yet been achieved and the key output, linked to the activities of residue analysis, was not wholly accomplished due to a variety of factors. Consequently, this resulted in data that was not entirely definitive. However, it is important to note that the trends observed infer that the final application of biopesticides in the spraying process may lead to a reduction in residues found in the harvested product, while simultaneously managing pest control effectively.

Additional outcomes, notably the augmentation of regional collaboration and the ability to generate and critically evaluate data related to pesticide residue, and most of the activities, were successfully met.

The key determinants of the project's success encompassed the dedication and persistence of the technical and national teams involved, the efficacious composition and management of the team, the central coordination provided by APAARI, the implementation of a specialized Good Laboratory Practice (GLP) training program, and the outstanding technical assistance provided during field trials and laboratory analysis.

The assessment of effectiveness is further detailed in the following three questions.

9. To what extent were the project objectives achieved or are likely to be achieved (based on the indicators for expected outputs and outcomes identified in the project's logframe)?

Achievement of project goal, outcome and outputs

A review of the logframe was deemed necessary in March 2023 when it was decided to upload this ongoing project to STDF's platform Logalto. It should be noted that the "outcome level" did not exist in the original/approved logframe, nor did the related indicators. This might partially explain why some indicators were partially achieved (see below). For the sake of clarity, the revised version of the logframe is summarised below with details on the attainment of the project's goals and outcomes as well as their indicators.

Overall goal	Indicators	Achievement against indicators
Improved compliance in participating ASEAN and SAARC member states with pesticide MRLs of Codex and trading partners.	1.1 - 10% increase in exports of targeted crops from participating ASEAN and SAARC countries within five years of project completion	**Not yet achieved:** the field trials, with a limited number of farmers, were only completed at the end of 2023.
	1.2 - 50% increase in the percent of produce grown under a residue mitigation system to comply with MRLs	**Not yet achieved**: the field trials, with a limited number of farmers, were only completed at the end of 2023.
	1.3 - Evidence of uptake and application of good practices and knowledge products produced by STDF to inform and support SPS capacity development led by global / regional / national bodies	**Not yet achieved**: the field trials were only completed at the end of 2023 and knowledge products were still being developed in early 2024.
	1.4 - Evidence of adaptation, replication, scaling of STDF approaches	**Not yet achieved:** the field trials were only completed at the end of 2023. In general governments of the project countries are now more aware of the benefits of biopesticides and are planning / approving access to funding to continue this work.
	1.5 - #, type of collaborative networks, relationships, initiatives at global, regional	**Partially achieved:** regional collaboration through the

	and/or national level that support the delivery of change in SPS systems, including attention to partnerships addressing climate change, environment, gender and inclusion	creation of WhatsApp and email groups. Although relatively informal has fostered a regional work-sharing framework that allows for the identification of regional pesticide residue concerns for key export crops.
Long-term outcome	**Indicators**	**Achievement against indicators**
Increased regional collaboration and capacity to generate and evaluate pesticide residue data (that combines conventional pesticides with biopesticides) to resolve trade concerns due to MRLs	1.1 - Decline residue data	**Achieved:** Residue data with the use of biopesticides generated with participating countries. The project showcased a substantial reduction of 50% in pesticide MRL values conducted through residue mitigation studies (18). More details on the results are added with the final report.
	1.2 - Increased understanding among regulatory authorities of how time, IPM production practices and end of season mitigation impact residues	**Achieved:** Project partners had gained an increase in their understanding on how time, end of season mitigation and IPM impacted residues.
	1.3 - Regional work-sharing framework for the identification of regional pesticide residue concerns for key export crops	**Achieved:** A work-sharing framework was in place
	1.4 - Government authorities in targeted countries have a regulatory system in place specific for biopesticides	**Partially achieved:** Indonesia, Malaysia, Thailand and Vietnam are aligned with the 2014 ASEAN Guidelines on the Regulation, Use and Trade of Biological Control Agents. Countries like Sri Lanka, Bangladesh, and Pakistan are not ASEAN members. Sri Lanka does not have biopesticide regulations, while Bangladesh is finalizing revised guidelines proposed through APAARI's collaboration with the USDA Phytosanitary Project. In Pakistan, biopesticide regulations have been approved following a USDA and STDF project implemented by CABI.

Regarding the achievement of the project's primary objectives, it is important to clarify that the intended goal has not been fully realized. Nevertheless, this does not inherently signify a project failure, which is further elucidated in the subsequent section on the project's impact. The project's primary aim was to Improve compliance in participating ASEAN and SAARC member states with pesticide MRLs of Codex and trading partners, an objective that has been successfully fulfilled. As it stands today, a robust foundation has been established, and notable improvements have been made in terms of technical capacity and awareness of a potential model to control pesticide residues in harvested products. These are valuable assets to which the project has made significant contributions.

In terms of long-term outcomes, the project has achieved partial success. Residue decline data was generated and post-activity evaluation reveals an enhanced understanding among regulatory authorities regarding the effects of time and end-of-season mitigation on residue levels.

The project's success can also be observed in its facilitation of regional collaboration through the creation of WhatsApp and email groups. Although relatively informal, this has fostered a regional work-sharing framework that allows for the identification of regional pesticide residue concerns for key export crops. However, no additional regulatory systems were in place at the end of the project.

There was no specific functional capacity (soft skill) training built into the project design as relevant topics were integrated into the technical activities. There were also no specific quantifiable indicators related to the development of functional capacity, therefore based on the observation that the outcomes of the technical training were achieved, by extension it can be surmised that functional capacities were also developed.

Achievement of outputs

The table below refers to results against indicators.

Desired Results Areas	Indicators 2015	Outputs/Results Achieved
Output 1: New MRL data and improved knowledge to interpret this data on the use of biopesticides (combined with conventional pesticides) to mitigate pesticide residues	**Indicator 1.1:** Up to 15 field residue mitigation studies on specific pesticides / commodities	**Achieved:** 18 residue studies in 9 countries for 4 crops (chili pepper, basil, dragon fruit, cabbage) completed replacing the chemical pesticide with neem in the final spray application were completed.
	Indicator 1.2: Increase in knowledge of participants attending training workshops	**Achieved:** Pre- and post-training surveys indicate the increase in knowledge of the participants attending training workshops. A total of 36 responses were received after the training from the participants confirming the increase in knowledge obtained from the training. A detailed report is added in Annex 10_Feedback on MRL training and KAP evaluation report
	Indicator 1.3: Assessment by technical director of country's preparedness to initiate field trials	**Achieved:** A checklist of supplies and capacity assessment was made by the study director (SD) with the support of the project manager. Once the country's performance is assessed, a virtual call is arranged to finalize protocol and initiate the study in the countries.
	Indicator 1.4: Improved SOPs	**Achieved:** SD drafted a protocol for each of the participating countries, including the amendment for biopesticide trials. Protocols on supervised pesticide residue trials were conducted for the crop + chemical identified in the phase 1. In

		total, 18 protocols have been produced including Pakistan – one for phase 1 and one for phase 2 for all the countries.
Output 2: Increased knowledge and skills on improved practices to manufacture microbial pesticides	**Indicator 2.1:** 20% average increase in production efficiency of manufacture of microbial pesticides in participating countries	**Not achieved:** While the workshop successfully achieved its goal of increasing capacity (knowledge and skills), the target of a 20% increase in production efficiency of microbial pesticides in participating countries was not met. This specific indicator could not be directly controlled or measured within the project's timeframe due to the need for long-term commitments from governments, industries, and farmers. A more accurate assessment of the project's impact on production efficiency will be possible through post-project evaluations and impact studies conducted 3-5 years after project completion.
	Indicator 2.2: List and type of biopesticides produced and registered in participating countries	**Achieved:** A list of the types of biopesticides produced and registered in participating countries was generated. Number of biopesticides registered in countries: Bangladesh 74; Cambodia 32; Indonesia 21; Lao PDR 4; Malaysia 37; Pakistan 4; Sri Lanka 9; Thailand 9; Vietnam 190 (Annex 15_List of Biopesticides registered in participating countries)
Output 3: Enhanced capacities for regulatory harmonization	**Indicator 3.1:** Network developed to facilitate dialogue between government authorities and other regional bodies on the harmonization of their systems	**Achieved:** A digital based communications network has been developed to facilitate discussion related to regulatory harmonization on a regional basis, greater engagement of biopesticide registrants in pursuing registrations in participating countries. A WhatsApp group and email group was created for the regulators to exchange information and use the platform.
	Indicator 3.2: Project facilitated cooperation with CropLife Asia on a USDA-ASEAN CropLife sponsored program	A workshop was organized in April 2023 with USDA and CropLife's participation to understand the status of Biopesticide regulatory guideline implementation and adoption in the countries.
	Indicator 3.3:	

	One workshop organised on biopesticide regulatory harmonization	**Achieved:**. 2 major workshops focused on biopesticide regulatory harmonization across Southeast Asian countries (one online in March 2022 and one face-to-face in April 2023) were conducted. Indonesia, Malaysia, Thailand and Vietnam are aligned with the 2014 ASEAN Guidelines on the Regulation, Use and Trade of Biological Control Agents. Countries like Sri Lanka, Bangladesh, and Pakistan are not ASEAN members. Sri Lanka does not have biopesticide regulations, while Bangladesh is finalizing revised guidelines proposed through APAARI's collaboration with the USDA Phytosanitary Project. In Pakistan, biopesticide regulations have been approved following a USDA and STDF project implemented by CABI. Formal approval of updated biopesticide regulations in July 2023 after updates were prepared and translated by November 2022.
Output 4: Extension and outreach activities facilitated for creating awareness on and dissemination of project outputs	**Indicator 4.1:** Number of people trained on GLP (disaggregated by sector and gender) **Indicator 4.2:** Number of people trained on microbial pesticides manufacturing (disaggregated by sector and gender) **Indicator 4.3:** Online media briefings facilitated by the project **Indicator 4.4:** Number of knowledge products developed by the project	**Achieved:** A total of 71 laboratory officials have been trained on GLP, including 37 female and 34 male participants. 174 people trained – 71 females and 103 males in GLP training. **Achieved:** 19 people trained – 12 females and 7 males in microbial biopesticide manufacturing training.. No online media briefing was conducted by the project. Instead, the project team prepared and issued two press release. **Achieved:** 45 knowledge instruments were produced including - protocol for Field trials, regulatory status report, field training synthesis, laboratory training synthesis and YouTube videos. **3 April 2023:** Asian biopesticide and pesticide regulation officers meet in Bangkok to strengthen their capacity in streamlining regulatory processes in their countries

		1 Policy Brief, 1 Background Policy Paper, 11 infographics, 1 regularly updated web page devoted to the project, 3 videos, Regulatory status – 1, Field training synthesis – 1, Lab training synthesis – 1, 12 web/newsletter articles and 13 Social Media posts **Infographics developed for project insights:** Infographics **Project page:** Asia Pesticide Residue Mitigation through the Promotion of Biopesticides and Enhancement of Trade Opportunities **Videos:** **Microbial Biopesticide Production in Detail:** Microbial Biopesticide Production in Detail M**icrobial biopesticides manufacturing - Part 1:** Microbial biopesticides manufacturing - Part 1 | APAARI, STDF **Microbial biopesticides manufacturing - Part 2:** Microbial biopesticides manufacturing - Part 2 | APAARI, STDF **Pre-inception webinar synthesis– 1** Pre-Inception Webinar: Asia Pesticide Residue Mitigation through the Promotion of Biopesticides and for Enhancement of Trade **Field training synthesis - 1** https://apaari.org/web/wp-content/uploads/downloads/2020/Field_Training-Synthesis-Final-_APRMP.pdf **Lab training synthesis - 1** Synthesis of the Lab Training Workshop, 10-14 August 2020 **Web articles:** 1. APAARI successfully delivers Training of Trainers on Strengthening Agricultural Innovation Systems for Biopesticide Development in Africa through Capacity Enhancement

		2. Pre-Inception Webinar: Asia Pesticide Residue Mitigation through the Promotion of Biopesticides and for Enhancement of Trade Opportunities 3. Virtual Inception Workshop for Asia Pesticide Residue Mitigation through the Promotion of Biopesticides and Enhancement of Trade Opportunities 4. Training on Good Laboratory Practices in the context of pesticide mitigation successfully delivered online 5. Field training workshop on Asia pesticide residue mitigation 6. First Biopesticide Regulatory Workshop, 16 March 2022 7. Asian biopesticide and pesticide regulation officers meet in Bangkok to strengthen their capacity in streamlining regulatory processes in their countries 8. Building Sustainable Solutions: Hands-On Training on Microbial Biopesticide Production in Vietnam 9. APAARI Conducts Successful Good Laboratory Practices Training in Singapore for Agricultural Researchers 10. APAARI Successfully Organized a Webinar on Effective Risk Communication Strategies for Agricultural Trade and Food Safety 11. APAARI's Biopesticide Project Concludes with a Successful Closing Workshop in Bangkok 12. The Evolving Status of Biopesticide Regulation in Asia – Asia-Pacific Association of Agricultural Research Institutions (APAARI) **Social Media posts:** 1. https://www.linkedin.com/feed/update/urn:li:activity:7106899638602903552 2. https://www.linkedin.com/feed/update/urn:li:activity:7102891441168773120

		3. https://www.linkedin.com/feed/update/urn:li:activity:7092792412225306625 4. https://www.linkedin.com/feed/update/urn:li:activity:7089851120906379265 5. https://www.linkedin.com/feed/update/urn:li:activity:7061596803892150272 6. https://www.linkedin.com/feed/update/urn:li:activity:7056913534512762882 7. https://www.linkedin.com/feed/update/urn:li:activity:7026155253284675584/ 8. https://www.linkedin.com/posts/apaari-community_stdf-safetrade-biopesticides-activity-7158576792725839872-zcCm/ 9. https://www.linkedin.com/posts/apaari-community_stdf-pg634-biopesticide-activity-7003621224584998912-oJRL 10. https://www.linkedin.com/posts/apaari-community_apaari-stdf-usda-activity-6999212133343219712-as86 11. https://www.linkedin.com/posts/apaari-community_apaari-basil-stdf-activity-6998940359556780032-fliO 12. https://www.linkedin.com/posts/apaari-asia-pacific-association-of-agricultural-research-institutions_stdf-agriculture-training-activity-6959755753557504000-wukh 13. https://www.linkedin.com/feed/update/urn:li:activity:6907569334739189760/

Upon evaluation, it is observed that the project largely attained its outputs. These include the generation of pesticide residue information, coupled with an enhanced understanding to interpret such data concerning the use of biopesticides. This achievement aligns well with the initial project document.

A significant improvement in knowledge and skills concerning the production practices of microbial pesticides was achieved. This capacity building is indicative of the success of the project's key objectives. Complementing this, regulatory harmonization capacities were strengthened, further enhancing the project's output spectrum.

The project also succeeded in its extension and outreach initiatives, thereby facilitating the creation and dissemination of awareness about the project outputs. This played a pivotal role in promoting the project's visibility and application across relevant stakeholder groups.

Contribution to STDF's higher-level objectives

The extent to which the project has contributed to STDF goals and outcomes was also assessed:

1. Project contribution to STDF goal "increased and sustainable SPS capacity"

The contribution of the project to STDF's goal is assessed has not been fully realised and more time will be needed before a clear assessment can be made. This pilot project has, successfully, tested a novel approach to improving compliance with pesticide MRLs of Codex and trading partners. This was achieved and a robust foundation has been established, and notable improvements have been made in terms of technical capacity and awareness of a potential model to control pesticide residues in harvested products. These are valuable contributions towards the STDF goal.

2. Project contribution to STDF Outcome 1: "More synergies and collaboration driving catalytic SPS improvements "

This is a key contribution of the project towards STDF outcomes. The project has facilitated regional collaboration through the creation of digital groups, which have fostered a regional work-sharing framework that allows for the identification of regional pesticide residue concerns for key export crops.

3. Project contribution to STDF Outcome 2: "greater access to, and use of good practices and knowledge products"

On this aspect, the project has made a partial contribution. The project had a knowledge management strategy and dedicated resources.Capacities on GLP practices were enhanced. Skills of conducting residue experiments were acquired by the member countries and the learning lessons are documented in the report (Under lessons learnt section .End of product report Page No 35).

10. What were the major factors influencing the achievement or non-achievement of the project objectives, outcomes and outputs?

The project's success was largely influenced by a robust and adaptable management team, a skilled technical team, effective activity sequencing, and a strong dedication to training.

Three training methods were employed. (i) Traditional workshops, covering topics such as biopesticide production and harmonisation, were well-received and effective according to the evaluations and 6-month follow-up assessment. The methodology was similar for all these workshops, with usually plenary presentations by experts, followed by group work for appropriation, and self-evaluation.; (ii) Online training, while accessible to more participants, was less impactful and had certain shortcomings; and (iii) Hands-on laboratory and field training, though resource-intensive, was highly impactful and tailored to specific needs.

Positive influences on project achievement also included a clear point of contact, a knowledgeable technical team, networking opportunities, alignment with national mandates, effective communication, and sufficient funding.

Conversely, obstacles to project achievement included country-specific crises (e.g., Sri Lanka's pesticide ban, economic and fuel crises) and bureaucratic hurdles, for example, the MOU process was a key factor as it took over 2 years to have the document signed with some of the countries. Other hurdles, included issues in engaging with regulators, rushed field trials due to time constraints, and changes in national project teams.

11. To what extent were horizontal issues (particularly related to gender and environment) adequately addressed in the project?

The project's contribution to crosscutting issues, notably gender and environment, was minimal, largely due to their brief inclusion in the initial project strategy without specific targets or activities. This project was designed at a time when those issues were not as high in the development agenda as they are today.

Regarding gender, the project did not explicitly cater to women's inclusion, and there was no specific indicator of women's participation. However, gender balance was promoted in training, and women scientists equally conducted the residue data generation study. In terms of the end-beneficiaries, in the project countries, minor-use crops tended to involve small-sized farms. Women tend to share in the farm duties, so whatever benefits accrue (e.g., better protection habits, lower-risk pesticides, higher incomes due to greater demand for their products, etc) farm women and families are likely to benefit. In addition to technical capacities related to the project objectives, women's functional capacities (soft skills) were developed to enable them to harness and manage their newly acquired knowledge and build and maintain partnerships as described in section of Lessons learnt in the End of the project report(Page no.35).

In terms of environmental protection, the project indirectly contributed despite the lack of specific mention in the project design. A method called the Environmental Impact Quotient (EIQ) determines the environmental impact of the most commonly used pesticides (insecticides, fungicides, and herbicides) in agriculture. The values obtained from these calculations can be used to compare the environmental impact of different pesticides and pest management programs. The final project report presents the environmental impact quotient (EIQ) analysis of the results and the chemical formulations used in the protocol and field application by the countries. In general, the overall EIQ for neem was 12.10, compared with a range of 59.53 for profenofos to 26.85 for chlorpyrifos (higher numbers have a greater environmental impact).

National study teams adhered to Good Laboratory Practices (GLP) training for proper disposal of analytical chemicals. The project also built capacities for reduced use of chemical pesticides and promoted non-toxic biopesticides and Integrated Pest Management (IPM) systems, contributing to environmental protection. No project activities were found to negatively impact the environment.

3.4 Efficiency: how well were resources used?

Overall judgement on efficiency

The project's efficiency is rated as **high**. Despite delays primarily due to the COVID-19 pandemic, changes in the technical team, and external bureaucratic factors, all planned activities were implemented. The project adeptly adapted to these challenges, notably through the project extensions. The assessment of efficiency is further detailed in the following four questions.

12. To what extent did the project deliver results in an economic and timely way, based on the project document?

Compliance of activities and outputs delivery with to the project plans and budget

The project delivered results in an economical and timely manner, albeit with significant delays. Delays in implementation are explained elsewhere.

Activities were fully implemented as per the project plans, with a few exceptions (See annex 5). Almost all activities were implemented as per the plans, notable exceptions being:

- Thailand was involved in the "train the trainer" model for laboratory training but for only one country. Following the transition to the new technical team, the Study Director analysed the technical status and availability of resources for each of the participating countries. It was apparent that Thailand had a strong capacity and high level of resources compared with the other countries. Given the capacity level of Thailand, language similarities and mutual interest from both countries, it was decided that Thai expertise should be used to support the training of the Laos counterparts. Singapore also provided technical support by facilitating laboratory training for all of the participants. Oversight was provided by the Study Director from AgAligned Global who replaced the IR-4 team.
- Malaysia did not provide field trial oversight to the less developed countries (Bangladesh, Cambodia, Indonesia, Laos, and Sri Lanka) as per the project document. Because of the significant delay caused by the COVID-19 pandemic, the field support/field trial oversight intervention was redesigned, resulting in a reduced involvement of Malaysia. The reorganisation resulted in the AgAligned Global Team providing field trial oversight, and Malaysia providing only online training before the start of the field trials. Taking advantage of the new team structure, and being conscious of the delays, oversight was provided directly by the Study Director who visited the facilities to train the countries and adapt the protocols to suit the countries' capacities. All the trainings were provided by members of the technical team.
- There were some slight deviations in the sequence of actions detailed in the project document. Due to the COVID-19 pandemic, initial laboratory training was conducted virtually. Field activities were started before the group training. Thailand trained Laos in laboratory analysis before the experimental analysis started. Cambodia wanted a few additional trainings as they were undertaking the trails for the first time. In Bangladesh, a hybrid set-up with an Indian trainer in Bangladesh and a technical team joining virtually.
- There were no changes in the sequence of the field trials, but there were significant delays due to weather conditions and some documentation issues.

Based on direct requests from Laos and Cambodia, an early decision that samples from these two countries be analysed in Thailand was reversed when the project started again. The two countries had requested that they use their facilities.

In terms of conformity to financial plans, the total STDF Contribution of USD 899,586 was utilized at an average annual rate of 23.5%, amounting to an annual expenditure of USD 211,402.7 over 4.25 years from February 2020 to March 2024.

Generally, the budget allocated for activities including staff costs, consultant fees, workshops, training, missions, etc., was disbursed according to the plan outlined in the budget. Although there were slight deviations in budget lines, as the financial expenditure related to activities (workshops training, missions) was below the planned rate, while consulting fees were slightly higher. Following guidance from the steering and advisory Committees, the budget was revised, granting flexibility to APAARI to enhance productivity amidst the challenges posed by the COVID-19 situation and the need for repeated trials due to weather conditions. Additional costs incurred for technical consultations resulting from changes in the technical support described elsewhere in the report were managed through contingency funds and savings from project activities.

13. What changes and risks, if any, occurred during project implementation, and how was the project able to adapt to these changes and manage risks?

The Log Frame only identified assumptions which were restricted to the Goal and Outcome levels. These four assumptions occurred or partially occurred. However, this did not affect significantly the achievement of outputs. One of the reasons for this is that these assumptions are actually of a higher level and prevent outputs from being translated into the expected outcome, but do not affect the implementation of activities.

The project document also lists four potential risks (Table 3). Two of the risks did not materialise ("even with mitigation, the residues do not fall below MRLs" and "the biopesticides are not effective in controlling the pest at the end of the season") as the residues did fall below the MRLs and, on the whole, the biopesticide was effective in controlling pests during the late stage. It is too early to assess the remaining two risks ("biopesticides are too expensive and growers will not want to use them" and "uptake/adoption of project outputs by the national authorities due to lack of political will or proper compliance by project partners") as the field trials were only completed at the end of 2023.

Other risks, not anticipated:

- The main risk that occurred was the COVID-19 pandemic, which had a profound impact on the timing and implementation of the project. The unprecedented COVID-19 pandemic was impossible to anticipate and prevented crucial in-person training and guidance for relevant stakeholders. The project was able to adapt to the challenge by holding online meetings and delivering practical virtual training by experts. This form of training was impacted by technical (connectivity) and language issues. Feedback from participants suggests that online training does not effectively replace in-person training.
- Another key risk identified during the assessment was the major shift in technical support following the sudden exit of the technical expert from IR-4. The subsequent change in personnel significantly strained the project's budget, as the role of IR-4's technical expert had to be filled by five distinct individuals. Substantial time was also lost due to an inadequately managed transition process. The handover from IR-4's technical expert to the newly constituted technical team and APAARI was poorly executed, causing a considerable delay. This delay, in turn, compelled the team to accelerate field trials, which unfortunately introduced further complications to the project. The fact that APAARI was not able to meet with the national implementing partners during the project formulation stage is identified as another significant issue. This missed connection resulted in lost opportunities for partnership development and consolidation. Ideally, a validation workshop involving all participating entities should have taken place to mitigate such an issue. Furthermore, the lack of comprehensive handover documentation compounded the problems for APAARI and the new technical team. The absence of these notes meant that the incoming team spent considerable time attempting to comprehend the project's status quo. Communication challenges also surfaced as APAARI had not been properly introduced to the rest of the partners. Consequently, some initial communications were overlooked, and a lack of mailing lists further exacerbated this issue.
- Nepal was initially a part of the project application. However, from the outset, there was limited interest from Nepal to get engaged. This lack of interest could be partially attributed to the transfer of a key contact from Nepal who had connections with APAARI. Despite APAARI and STDF's attempts to involve various Nepalese departments and ministries in the project, their efforts were met with silence. The cause behind this sudden shift in commitment was not provided. The project's start coincided with the advent of the COVID-19 pandemic in early 2019. As a result of the ensuing travel restrictions, FAO was unable to assume responsibility for the Integrated Pest Management (IPM) related activities. Once travel resumed, it was clear that FAO's commitment to the project had diminished, as evidenced by their absence from Steering Committee meetings. A discussion with FAO on the matter could not be made by the Consultant.
- In terms of effective communication and delivery of training, language was a challenging issue as not all countries and the people involved had a good level of English.

At a national level, risks included:

- Preparing national staff to the high degree of documentation and precision required for GLP research.
- Transfers or absences of key project personnel which led to delays and lost continuity
- Need to repeat trials and analyses in Thailand and Malaysia

- Changing political environment and focus, created issues in some countries, most notably Sri Lanka, which endured a nationwide ban on the sale of chemical pesticides and economic and fuel crises.
- Poor climatic conditions during the field trials – an issue which was exacerbated because of the limited time available for the trials.
- The need to complete the field trials during the "wrong season"; again a legacy of the limited time available for this activity.

In most cases, solutions were found, and with considerable persistence, patience and commitment, the project was completed.

It is important to underscore the commitment of APAARI, particularly in terms of staff allocation which surpassed the initial estimates. The project demanded a significant allocation of resources, primarily due to the need for mentoring, monitoring, and follow-up with the eight countries involved in the project.

To ensure effective communication with partners, it was essential to identify and utilize a variety of communication tools, including WhatsApp, Line, Telegram, and Email. The pressure on resources was further intensified by delays in the project timeline and initially low response rates from partners.

These experiences indicate that when planning for future multi-country projects, these considerations should be factored into the planning process.

14. Was the project a cost-effective contribution to addressing the needs of the beneficiary?

The project demonstrated a high degree of efficiency, achieving a significant portion of its intended outputs in a relatively short timeframe, and generating cost savings, mainly due to the switch to online activities, which were used to support the unforeseen costs related to contracting AgAligned Global (AAG). STDF's financial contribution to the project was USD 899,586, which was allocated across the participating countries, resulting in a low per-country cost.

One of the project's strengths was APAARI's ability to utilize external resources strategically. Savings were achieved through strategic measures such as leveraging online platforms, maximizing existing laboratory and field resources of institutions, and securing cost-effective hotel and meal packages. National governments and local institutions covered unanticipated shortfalls in funding. Examples included unexpected transport costs due to field trial relocations. The field trials were completed in all the countries, they were economically managed with countries receiving USD 10-20,000 in support.

The project's systematic and participatory approach towards achieving its desired outputs was one of its key successes and a key reason for its cost-effectiveness.

The project's selection of crops, such as chilli, was strategically carried out through multi-country studies, resulting in robust data without overburdening the resources of a single country. Efforts were made to harmonize practices and standards, thereby optimizing resource utilization and increasing registration efficiency. The selection of crops also addressed broader residue problems on chili, greens, basil, and dragon fruit, thereby extending the project's relevance across all ASEAN and SAARC countries.

The project was designed to optimally address SPS needs cost-effectively. The project team explored various options during the design stage, eventually settling on a mitigation approach as the most economical strategy. By targeting the restrictive MRLs, not only were CODEX MRLs met, but the project also ensured the unrestricted trade of crops across a set of diverse MRLs from different regulatory bodies.

15. How well was the project managed?

At the start of the project, as detailed in the project document, APAARI was the lead agency in implementing the project, in close collaboration with the U.S. Interregional Research Project (IR-4), which provided a technical person to provide expertise and coordination. The USDA Foreign Agricultural Service (USDA/FAS) also provided technical advice (in-kind). Following the complete departure of IR-4's technical expert and the reorganisation of the project, the project management structure was changed.

APAARI designated one of its staff to be the Project Manager who was responsible for routine communication with the partners and operational matters. In addition, the Project Manager organized the various workshops and capacity-building actions, applied a knowledge management strategy for stakeholders, and kept track of the progress. The Project Manager also kept in close contact with the technical team regularly informed about the progress and sought technical and managerial advice regularly. This allowed the key technical players to remain well-informed and allowed them to play their technical and advisory roles in a much more efficient manner.

APAARI were the project implementer with responsibility for the management, logistics and financial aspects of the project. They also had responsibility for the Knowledge Management strategy.

For field trial work, the project staff made funding transfers to the relevant, participating country agencies or institutions. The transferred funds were used for the purchase of materials and supplies, the establishment of contracts, and other necessary reimbursements.

Technical aspects were coordinated and managed by the technical team. The structure and composition of the technical team changed with the departure of IR-4's technical expert in 2020 (see annex 7).

Despite the apparent complexity in implementation arrangements, it should be highlighted that the implementing agency was efficient in coordinating, planning and synchronizing activities carried out by various partners, including by mobilizing external partners.

The project implementers met the reporting deadlines, and their communications and management were described by virtually all beneficiaries as 'proactive problem-solving, expert guidance, quick feedback, cooperative, good communication, flexible'. The project was therefore well managed, with sufficient oversight. Throughout implementation, the project remained focused on key priorities, refining approaches and tools to focus them more clearly on the objectives.

The STDF effectively met its obligations by promptly processing payments upon receipt of an invoice/memo from APAARI.

The project's success was largely due to the open lines of communication and the collaborative approach of the STDF team in addressing issues with APAARI. Other factors that positively influenced the project's outcome included the regular and timely guidance offered, along with the understanding and adaptability demonstrated in the face of challenges, including those associated with mid-term modifications in plans and budgets.

33.5 Impact – what difference did the project make?

Overall judgement on impact

Assessing the impact of this STDF pilot project is complex. The project's potential influence on improved compliance in participating ASEAN and SAARC member states with pesticide MRL of codex and trading partners was evaluated, with the impact **rated as satisfactory**. Although the project has not significantly influenced compliance and biopesticide use yet, it has laid a solid foundation for future impact. The field trials, involving a limited number of farmers, were only completed at the end of 2023 and knowledge material was developed in early 2024, therefore there has not been sufficient time for the project to have impacted exports or the

proportion of products complying with MRLs. The national partners also need time to work with their governments to drive further uptake of this approach.

The project has notably heightened awareness among officials and beneficiaries, leading to additional financial and technical support for biopesticide activities, showcasing a notable spill-over effect. The assessment of impact is further detailed in the following three questions.

16. To what extent did the project generate, or is expected to generate, significant positive or negative, intended or unintended, higher-level effects (for instance improved domestic and/or regional SPS situation, measurable impact on trade, contribution to sustainable economic growth, poverty reduction and food security)?

The project's contribution to the STDF's overarching goals is yet to be definitively determined. While it has created a solid foundation for improving trade, particularly by introducing a potential solution for pesticide residue compliance in export markets, this has not yet translated into improved market access.

The project's role was to support the creation of favourable conditions for improving compliance with pesticide MRLs and thus promote exports, not to initiate them - a task largely falling to the private sector. The project's mitigation approach effectively addresses even the most stringent EU-adopted MRL (0.01mg/kg (Limit of Detection, LOD). However, it's premature to evaluate its trade impact. It is anticipated that improved market access will stimulate additional cultivation, positively affecting rural development and poverty reduction.

The project has fostered awareness and expertise in pesticide residue field trials and GLP, which can be integrated into the registration and MRL setting process of conventional pesticides, crucial for improving SPS management and monitoring for local and imported goods, as well as exports. Joint activities and regional event participation have enhanced team spirit among regional SPS institutions, leading to positive outcomes such as improved dialogue on biopesticide harmonisation and strengthened regional participation. The training and experience gained have empowered national teams to provide more science-based information to decision-makers.

The project has also bolstered confidence in supply safety among partners such as Singapore and Malaysia, potentially leading to reduced risk assessment and fewer inspections. This unanticipated positive impact was not included in the project's original LogFrame.

17. What real difference (expected and/or unexpected) has the project made, or is likely to have, on the final beneficiaries including on people's well-being, gender equality and the environment?

The STDF project has demonstrated a potential for impacting the 'minor use' crop value chain, with both anticipated and unanticipated outcomes. It has strengthened the execution of the WTO SPS Agreement through capacity building, tools, and upgrading analytical capacity. The project has also promoted regional collaboration and knowledge sharing, expected to enhance national adoption of biopesticides and regional harmonisation.

For each of the participating countries, the project has enhanced the technical capacity of approximately 10 technical staff; a further 20 staff were also trained as national teams developed their support staff to conduct residue trials and monitor pesticide residues. Primary target groups, field and laboratory researchers, report a better understanding of GLP requirements and a more disciplined approach to field trials, analyses, and documentation. However, they stress the need for ongoing work, including new projects.

The project offered training and support to 19 scientists and officials on improved practices for microbial pesticide production. This training was well received, with 68% of the 19 participants finding it highly relevant, and 89% reporting improved knowledge six months later (event evaluations re. This was further supported by a series of online videos.

A total of 20 regulators benefited from a workshop on enhancing biopesticide regulatory processes, which strengthened regional relationships, provided strategic technical advice, and addressed regional harmonization and capacity-building needs. Participants reported retained enhanced capacities for regulatory harmonization six months later. A pre-workshop survey identified gaps in adopting the ASEAN guidelines.

Unexpectedly, through communication by study teams to upper-level management, the project has prompted national funding and inclusion in some countries' annual work plans (see below). However, the full impact on people's well-being, gender equality, and the environment remains to be seen.

18. How did the project catalyse any other action or change, for instance raising awareness on SPS challenges and/or mobilizing additional resources for SPS capacity development?

With the communication by study teams to upper-level management, the project has significantly contributed to heightened awareness of senior management regarding the potential benefits of biopesticides, a change that was not anticipated at the project's inception. This substantial shift, although not explicitly outlined in the logframe, aligns with the STDF strategy of catalysing and influencing change, marking it as a major success.

3.6 Sustainability: will the benefits last?

Overall judgement on sustainability

The sustainability of the project is rated as **satisfactory.** The project's primary outcomes have the potential for longevity beyond the project's conclusion. However, the sustainability of these outcomes may be at risk due to insufficient resources, particularly core national resources, for implementing SPS measures. The assessment of sustainability is further detailed in the following four questions.

19. To what extent are the benefits of the project continuing, or are likely to continue over the longer term, after the end of STDF funding?

The benefits of the STDF project are likely to persist over the long term, albeit with varying degrees of durability. The heightened awareness of biopesticides' benefits among officials, which is crucial for future investments, is expected to endure, bolstered by ongoing initiatives and growing supportive data.

The capacities developed by the project are also likely to continue, although they will need updating due to high turnover in public administrations. This necessitates future refresher courses and initial training for newcomers, which should be supported by other development partners in the SPS domain, as STDF funding will not be available for these.

Post-project, several follow-up activities are planned by implementing agencies, international partners, and governments to sustain the project's results (discussed in the project sustainability plan). For instance, study teams' communication with upper management has led to improved access to national funding in countries such as Indonesia and Sri Lanka. While funding at this time is modest, it is expected that with stronger data more funding will accrue. Malaysia is building on the project's momentum and has secured government funding to expand research into other crop/pesticide pairs.

Moreover, the project has fostered further synergies and collaborations, identifying several new related projects such as the STDF projects in the SADC Region (STDF/PG/694) and Latin America (STDF/PG/753), various USDA-funded projects in Bangladesh, Thailand, Philippines, Vietnam, Pakistan, and the CDLP project in Sri Lanka.

20. To what extent was sustainability addressed at the design stage and during the project, and what are the major factors (including risks) influencing sustainability?

Sustainability considerations were present in the project's design and implementation, albeit not explicitly as a continuity objective. The project documents referenced enhanced participation in international pesticide residue forums and the potential for involvement in further projects. However, they lacked specific national follow-up activities such as verification of results and regular needs assessments.

From the outset, the project emphasized the dissemination of results, ongoing awareness building, and knowledge sharing. It recognized the need for both technical and functional skills to achieve long-term development outcomes (see section 1.3). A particular focus was placed on capacity retention, acknowledging the challenge of maintaining capacity in most Asian countries due to frequent personnel changes.

Key factors influencing the project's sustainability include:

- The project's inclusive design and implementation, and national ownership; it was based on national demand and priorities.
- The presence of other programs and initiatives, national or donor funded, that could continue or build on the project outputs.
- Effective knowledge management and functional skills integrated into the project, which will be useful for future activities.
- The active support from relevant partners, including APAARI and government agencies responsible for SPS management. APAARI is expected to continue networking with project partnering countries even after the end of the project period.

Note on private sector engagement: The implementation of the residue mitigation strategy tested in this pilot project, coupled with the growth of functional capacities, has the potential to provide a solution for mitigating Maximum Residue Limit (MRL) However, a limitation of the project was the less active involvement of the private sector, except for CropLife, Dragonberry Produce Inc, and Jagro (Pvt) Ltd, Sri Lanka. This otherwise cold have enhanced the progression of Public-Private Partnerships (PPP) or other beneficial collaborations. The project also experienced limited engagement from regional universities and national extension services due to challenges of Covid 19 during the implementation phase. To ensure the project's future sustainability, it is vital to foster increased participation from the private sector and to utilize potential local university research in this domain. It is equally crucial to eventually devise strategies for national extension services that support scalability, as this is also a key element for sustainability.

21. Are the necessary capacities and systems (financial, social, institutional, etc.) in place to sustain the project results over time?

The partner countries have made progress in generating pesticide residue data and enhancing technical capacity for biopesticide use.

The necessity to adapt the training and intensity of inputs to each country's specific needs was evident. Countries with a history of similar projects, including Thailand, Malaysia, and Vietnam, showed commendable performance with minimal supervision, notwithstanding minor adjustments and errors identified by the study

director during the trials. These adjustments related to aspects such as documentation, sampling, and updating the Study Director.

In contrast, countries with less exposure initially faced difficulties in comprehending the project. However, the study director's efforts in providing both group and individual training led to an enhanced understanding among the national teams. Consequently, they were able to actively engage in project activities, even those that were technically demanding such as field trials.

Particularly, the Least Developed Countries (LDCs) encountered challenges in their capacity to absorb due to pre-existing workloads and other commitments, which detracted their focus from the project. The technical team's persistent follow-ups proved beneficial in identifying issues and providing the necessary support. This support ranged from resolving issues, and identifying equipment problems, to supplying necessary chemicals to the team.

Further support is needed to solidify these skills and disseminate them. The project's results are expected to be sustainable in the short-medium term given the capacities of the partners and tools generated in this project. To extend sustainability it will be necessary to further strengthen skills through continued skill transfer and further research. Governments' commitment suggests this is feasible.

Significant expansion in biopesticide use will require solid connections with farmers and other value chain actors, increased private sector commitment to biopesticides, and engagement of other institutions such as universities.

4. Conclusions and recommendations

4.1 Main conclusions based on the findings and analysis of the assessment

In conclusion, the assessment reveals that this pilot project has successfully demonstrated a novel approach to address the challenge of Maximum Residue Limits (MRLs) for minor crops, particularly benefiting nations lacking sophisticated analytical equipment. The project's primary focus was on ensuring MRL compliance in harvested produce through the application of biopesticides in the final spraying stage.

An additional advantage was the provision of tools for participants to monitor pesticide residues, thereby strengthening their technical capabilities to tackle trade restrictions and Sanitary and Phytosanitary (SPS) issues associated with pesticide residue limits in both local and international markets.

The pilot project's concept holds promise for impacting the 'minor use' crop value chain. However, it necessitates continued support and commitment from donors and national governments to establish the necessary infrastructure, enabling the approach to become a standard farming practice and thereby achieving the project's long-term objectives.

The project's **relevance** was confirmed, based on the assessment of key questions, as aligning well with the institutional priorities and needs of the participating countries, which remained consistent throughout the project. This highlights the project's strength in its design and implementation, with a strong focus on taking into account local contexts, stakeholders, and processes.

The project's focus on addressing pesticide residues was **coherent** with other country-level interventions aimed at reducing reliance on chemical pesticides and promoting sustainable food systems. The project has served as a bridge between government policies and a practical model, filling a significant gap and adding value without duplicating efforts.

The project was **effective** in paving the way towards improving compliance with pesticide MRLs of Codex and trading partners in participating ASEAN and SAARC member states. Project outcomes were largely achieved, accompanied by an increase in knowledge and skills in several areas.

Despite significant delays mainly due to the COVID pandemic and changes in the technical team, the project was delivered **efficiently**, with results produced economically and in a timely manner. The project and national

partners encountered risks, but in most instances, solutions were identified, and the project was completed with considerable persistence, patience, and commitment.

The project's success can be attributed to a robust and adaptable management team, a skilled technical team, effective activity sequencing, and a strong commitment to training. The approach to control product MRLs was a cost-effective solution to this specific SPS need.

The project's achievements have had a significant **impact** on the participating countries by enhancing their technical capacity to conduct residue trials and monitor pesticide residues. The project has also fostered a team spirit among regional SPS institutions through joint activities and regional event participation, leading to positive outcomes such as biopesticide harmonisation and improved confidence in supply safety among partners.

The capacities developed by the project are likely to be **sustainable,** although they will require long-term support. This project has set a precedent for future initiatives in this field, demonstrating the potential for significant impact and sustainable change.

4.2 Clear and actionable recommendations targeted at relevant stakeholders in the specific country/region

Design phase - project designers, managers, partners and STDF:

Recommendation 1: Define key roles and responsibilities

For the optimal success of new initiatives, it is recommended to allocate resources towards the identification of key national decision-makers and stakeholders. This identification process should be grounded in the necessity of predefined roles that are integral to the success of the project. These roles must be delineated, and strategies must be formulated to engage these key players at crucial junctures throughout the project lifecycle. It is also suggested to devise methods for involving senior government officials.

The roles and responsibilities of each team member, whether they are part of the management, technical, or national team, should be precisely and clearly defined. This not only enhances communication efficiency but also promotes mutual understanding, aligns individual contributions with overarching project goals, and fosters a sense of ownership and accountability among team members.

In the interest of preparedness for unforeseen circumstances, such as the departure of a key team member, it is recommended to assign a backup individual for each critical role within the team. This strategy not only ensures continuity but also promotes the distribution of knowledge and skills across the team, thereby bolstering overall team resilience.

Recommendation 2: Future projects would benefit from a more thorough planning and review process

In the interest of enhancing the success rate of forthcoming projects, it is advised to adopt a more exhaustive planning and review methodology. This should encompass comprehensive needs analysis, risk evaluations, contingency planning, and ongoing scrutiny. Such a systematic approach will not only facilitate the identification of prospective challenges but also provide the team with robust strategies to effectively overcome these hurdles.

Recommendation 3: Address project sustainability in the initial design

For the sustainability and meaningful impact of future projects, it is recommended to embed sustainability considerations into the initial design phase. This can be achieved by linking sustainability to specific activities within the Log Frame, and by setting clear targets and indicators. The identification and implementation of suitable follow-up mechanisms at both the overall and individual output levels is also recommended.

Determining the best practices to consolidate the knowledge and outcomes acquired during and after the project is also an important consideration.

In addition, it is suggested that key partners and relevant ministries establish their institutional commitment to the sustainability of key outputs in writing at the outset. This would require a more specific commitment than the current system. This commitment should be integrated into the letter of support, which is part of the current application process.

Recommendation 4: Future projects, donor or national government driven, on the generation of pesticide residue data in support of biopesticide use should be based on the model piloted in this project.

It is advised that future initiatives, whether they are funded by donors or driven by national governments, which aim to generate pesticide residue data to support the use of biopesticides, should adopt the model that was successfully implemented in this project. This suggestion is based on the premise that the model will be adapted to suit the unique infrastructure, conditions, and resources of the participating countries, incorporating insights from the experiences gained during this project and STDF/ PG/ 694 and STDF/PG/753.

The structure of the national teams in this project has demonstrated its effectiveness and is therefore recommended for duplication where possible. The team composition should ideally consist of a national focal point, team coordinator, field research lead, laboratory analysis lead, biopesticide/efficacy research lead, biopesticide regulatory lead and functional capacity building. The role of the focal point should be assigned to a senior-level individual, equipped with the necessary authority to make critical decisions. Furthermore, this individual should be able to allocate adequate time to the project to ensure its successful completion.

Recommendation 5: Establish feasible timelines

It is recommended to carefully determine and define project timelines, taking into account the necessity for contingency strategies and subsequent actions. The calculation of these timelines should incorporate the duration needed to foster trust and team cohesion, navigate bureaucratic procedures (as evidenced by the up to 2-year gap before the signing of some MOUs), and address specific national processes. An integral part of this procedure should be a pragmatic evaluation of the partners' capacity, as this will significantly influence the completion time of specific actions. Furthermore, it is advised to incorporate a mid-term review within this timeline. This review will serve as a platform to evaluate project progression and propose any requisite enhancements to the methodology.

Recommendation 6: Only identify project indicators after careful and through assessment of their feasibility

It is strongly advised that projects meticulously evaluate potential risks and success factors before the establishment of indicators for goals, outcomes, and outputs. This is particularly crucial when these indicators are reliant on third-party entities rather than the implementing partner. To illustrate, consider Output 3, Indicator 3.2: “The project has successfully facilitated a collaboration with CropLife Asia as part of a USDA-ASEAN CropLife sponsored program”, which was not achieved because of external factors.

Furthermore, it is recommended that indicators be pragmatic and assigned a quantifiable value to facilitate more efficient progress monitoring, to illustrate consider the lack of quantifiable indicators for the development of function capacity (soft skills). It is also essential to generate and specify baseline data at the project's inception.

Project implementation - project managers, trainers and partner country institutions:

Recommendation 7: Periodically assess activity implementation

Upon the successful delivery of each significant output, it is advised to convene debriefing sessions at both national and regional levels. These sessions should encompass all stakeholders and any parties expressing

interest. The primary objective of these meetings would be to disseminate the achieved results, deliberate on acquired insights, and formulate strategies to enhance the planning and execution of forthcoming activities.

Recommendation 8: Generate records relevant to the project implementation and keep backup copies of the records and relevant communications

One of the significant risks identified during the assessment of the project was the unexpected exit of a pivotal technical team member. This event led to a considerable loss of time due to a poorly managed transition phase, leaving the implementation and the newly assembled technical teams in a challenging position. The absence of handover notes, lack of mailing lists, and the missed opportunity for the implementing entity to engage with project partners during the design phase were notable issues. This situation further exacerbated time loss as partners were slow to recognize the staff and role of APAARI.

For future projects, it is strongly recommended that work plans be updated regularly, supplemented by situational notes as needed. The creation of mailing lists and logging of key communications should be mandatory. All such information should be centrally stored and made accessible to all relevant project implementers.

Additionally, the practice of appointing a backup individual should be considered essential, as highlighted in recommendation 1.

Recommendation 9: Diversify training methodologies

Subject to resource availability, it is recommended to explore and implement a variety of capacity enhancement methodologies. The continuation of traditional training methods such as classroom/group sessions, on-the-job training, and train-the-trainer programs is encouraged. However, the integration of online training into the existing mix could prove beneficial. Despite its perceived inefficiency compared to traditional methods, online training offers the advantage of wider reach, making it a valuable tool for awareness building.

While online training cannot fully substitute in-person sessions, if conducted before traditional training, it can serve as a platform to familiarize participants with the training scope, setting, and key terminologies. This can help participants to better focus during the traditional training sessions.

Participation in training courses and study teams should be dependent on adequate technical knowledge and language proficiency to ensure maximum benefit. Given the frequent staff turnover in most organizations, trained individuals must transfer their knowledge to their peers. This can be facilitated by trainers through the provision of training materials made available on cloud storage, which was the case with the biopesticide manufacturing component in this project. This form of storage is proposed as the material can be continuously updated.

Furthermore, incorporating case studies related to issues that have previously caused delays in training activities can help draw attention to common problem areas and promote proactive problem-solving.

Recommendation 10: Enhance private sector engagement

The incorporation of a private sector viewpoint is instrumental in providing practical insights and ensuring project sustainability. The consensus from interviews underscores the necessity for strategic engagement of the private sector to actualize the adoption of biopesticides. Future initiatives should strive to devise innovative strategies to bolster private sector involvement in areas that stand to gain from their expertise. Potential private sector collaborators could encompass pertinent agricultural and export trade and industry associations, particularly if the project can investigate their potential contributions to project outcomes through the dissemination of information on progress, results, lessons learned, and opportunities to their members. The Ministry of Commerce, export promotion agencies, and other relevant entities could be engaged and motivated to collaborate with these associations to assist farmers and food exporters in capitalizing on the emerging opportunities presented by the lower-risk model that has been tested.

Recommendation 11: Enhance identification of concurrent projects and research undertaken by other donors and academic Institutions

It is important to recognize the potential contributions of universities and research institutions in the field of biopesticide research. The government officials, however, seem to lack awareness of these potential collaborations. Similarly, the technical team has expressed a lack of comprehensive knowledge regarding the activities of other donors.

For future projects, it is recommended to allocate resources towards the identification of the relevant activities of other donors and academic institutes and pertinent research activities within the country is also advised.

Furthermore, it is suggested to devise strategies on the most effective methods of obtaining this information and integrating it with the project. This will ensure a more coordinated and efficient approach towards achieving the project's objectives.

Recommendation 12: Remain updated on changes in the political or work environment of the project countries

In projects characterized by diverse national political and commercial interests, it is important to conduct a comprehensive evaluation of the political climate and work environment taking into consideration challenges and risks. This should be considered at the initial design phase and consistently throughout the implementation phase. This approach facilitates the management and adjustment of expectations and anticipated outcomes. It is highly recommended to incorporate these analyses in the annual planning process and to provide updates in the biannual progress reports.

5. Lessons learned

This section shares the key lessons learned and practical suggestions that are applicable to wider use and future programme development. Lessons learnt include:

- Identify and budget for travel to conduct the field trials - Several of the field trial sites were far from the researchers. Future projects should include larger budgets for site travel. In addition, it is critical to identify several alternative field study sites in case problems develop at the initially planned site.
- Ensure the continuity of the participants during the whole process, and if necessary, add new participants at different points, while maintaining intact the core group that was there from the beginning.
- In complex projects such as this, communication and coordination are key to success. The implementing entity must be prepared to make sure they have the staff and resources to fulfil this need.
- While the project documents are shared with partners before they commit. It is also important to share the scope of the research protocol with the national partner implementing this part of the project as this gives them time to arrange internal budgets and resources.
- Stressing the key role of the technical trainers not as conveyors of knowledge and information but as facilitators that create, promote and maintain supportive conditions necessary for learning to take place.
- Ensuring that PPTs are not monotonous – integrating reflection questions in PPT to relate to participants' own experience e.g. "What is your experience with PRA?" Not just theory but using experience as a primary learning resource for addressing issue. Participants' experiences enrich the learning process.
- Developing clear objectives for each technical session - Communicate the benefits of the project training to the participants beforehand, knowing why the subject matter is useful can be a highly motivating factor.
- Agreeing on facilitation techniques (knowledge-sharing and learning) that encourage engagement and respond to each session objective to deliver desired learning outcomes.

- Integrating small group discussions that fit the technical agenda whenever possible to enable all participants to express their perspectives, knowledge based on experience, and concerns, leading to practical outcomes.
- Focusing the training content on its practical use – It is fundamental to present competencies, knowledge and abilities in one package – not just the theory but problem orientation.
- Mentoring to reinforce learning, address key concerns, and learn about progress and knowledge application (e.g. through Whatsapp group, online discussions, follow-up webinars)
- Documenting technical (dealing with technical challenges) and functional accomplishments (innovative ways of dealing with institutional constraints, reaching out to different stakeholder groups, adopting innovative processes that led to change) – using various planned project activities for this opportunity.

Annexes

Annex 1: Assessment TOR

Annex 2: Assessment Matrix

Annex 3: List of people interviewed

Annex 4: Evaluation questions

Annex 5: Final LogFrame

Annex 6: Key Personnel Involved in the Project Activities