

ACP-ACTAE Project Agroecological Crop Protection



Minutes of the ACP Workshop

Nay Pyi Taw, Myanmar
(3 - 4 May 2017)





Acknowledgments

Many thanks to The Ministry of Ministry of Agriculture, Livestock and Irrigation that hosted this Workshop. Special thanks to Dr Thin Nwe Htwe and Dr Kyin Kyin Win and her colleagues, who locally organized the Workshop in Nay Pyi Taw, Myanmar.

Thanks to ACTAE project and AFD (French Agency for Development) for having funded local charges during the Workshop and travel costs and accommodation of some participants.

Thanks also to CIRAD (UMR PVBMT) that contributed to the organization and funding of this Workshop.

Dr Jean-Philippe Deguine (Cirad), coordinator of the ACP-ACTAE Project





1 Background

In South-East Asia in general and especially in Myanmar, agriculture faces a wide range of constraints, including the rapidly changing demand for agricultural production (quantity, quality and safety), the impacts of climate change, the impacts of inputs on health and the environment. Crop Protection has relied for a long time on agrochemicals but is now at a defining moment. Although pesticides have been condemned for many years, the problems encountered with this type of Crop Protection are becoming more frequent and acute: inefficiency in many situations; resistance to pesticides; soil, water, and air pollution; hazards to human health; and loss in biodiversity.

In this context, the challenge of agronomic research is: ii) now to move from this chemical-based approach to that of pest prevention with more balanced and sustainable agroecosystems; ii) to answer both the current questions (in particular to improve the socio-economic viability of the stakeholders) and those of tomorrow (in particular to design and implement ecologically sustainable agroecosystems). Agroecology appears to be an appropriate and relevant way to respond to this challenge.

2 Agroecological Crop Protection

Agroecological Crop Protection (ACP) is the declension of Agroecology to Crop Protection and it is at the crossroad of Agroecology and Crop Protection. It aims at “replacing” chemicals, which have negative effects on the environment and on human health, by the services offered by functional biodiversity above and below soil surface. By focusing on preventive measures, it aims at establishing a bioecological balance between plant and animal communities within an agroecosystem in order to prevent or reduce the risk of infections or outbreaks of pests’ outbreaks. ACP is based on 2 axes: i) enhance biodiversity (vegetal/animal) and ii) soil health. It is therefore very consistent

and complementary to Conservation Agriculture, devoted to agroecosystem soil management. ACP is another field of agroecosystem field study and management, devoted to prevention and management of pests. It is now well documented.

The three pillars of implementation of ACP are sanitation, habitat management and biological control. New scales of intervention are considered, both in terms of space and time in accordance with participatory, global and systemic approaches. The implementation of the ACP principles to the field reality have shown good results in different parts of the world and some success stories have been described, for example in horticultural crops or fruit crops. Keys of agroecological transition are now available and can be adapted to different contexts, for example SEA context.

3 ACP-ACTAE project

ACTAE is a regional project, funded by AFD (French Agency for Development) and Cirad, aimed at promoting agro-ecological principles and practices in Cambodia, Loa PDR, Myanmar and Vietnam. The overall objective of ACTAE project is to build sustainable and effective mechanisms to facilitate synergies among initiatives contributing to an agroecological transition in South East Asia between Research, Extension and Farmers.

The overall object of the “Agroecological Crop Protection (ACP)” under ACTAE project is, by starting and promoting activities in a new field of Agroecology, to contribute to the global development of Agroecology in SEA through 3 specific purposes: i) Making a state of the art of Crop Protection in the zone and identifying the priority issues of Crop Protection that must be taken into account; ii) Training and information exchanging on ACP for stakeholders (including training sessions and the organization of a regional Summer Scientist School); iii) Building the foundation of a ACP medium term project, integrating research, training, education and extension support (including already identified



deliverables) with CANSEA partners.

We have to consider this project as a framework to start basic activities (survey, exchange of information, training) and as a leverage to build a medium term ACP research project for CANSEA (2020-2024), the platform on research and education on Agroecology in South East Asia, with current and new technical and financial partners.

Meetings and seminars planned in this proposal are destined to all ACTAE countries (Vietnam, Myanmar, Laos, Cambodia), such as workshops and Summer School (see below). But, taking into account the limited amount of the requested budget, this ACP proposal will particularly focus on developing partnership with two countries: Vietnam and Myanmar.

4 ACP Workshop (Nay Pyi Taw, Myanmar (03-04 May 2017))

This workshop is dedicated to gathering partners on the same level of information, both

on the current working research axes in Crop Protection and on the knowledge of ACP and its ins and outs. It is made up of training on ACP (around the following questions: What is ACP? What are the experiences available? What are the keys of the agroecological transition?), exchange of information on the status of Crop Protection priorities and local research axis, discussion on the progress of the collective paper, and contribution to the identification of the possible future orientations and area of work for a medium term collaborations. The workshop is performed jointly by local partners (researchers and teachers) and by CIRAD, in charge of the coordination of the ACP-ACTAE project.

The financial charges of the WS have been supported by the different partners. ACP-ACTAE project supports logistical charges of the Workshop, lunch (3rd and 4th, travel and accommodation of some participants coming from Inlay or other places than Nay Pyi Taw. ●



Workshop agenda

Day1. Wednesday 3rd May 2017. State of the art. Current situation (i.e. where we are)

8:30-9:00. Registration

9:00-9:30. Opening session

Opening remarks by Deputy Director General of Department of Agriculture, Ministry of Agriculture, Livestock and Irrigation

Introduction Remarks by Representative of Actae

9:30-10:00. Coffee Break, Group Photography

Presentation of ACTAE Project (Dr Cao Van, Cirad)

10:00-12:00. Presentations on specific topics

Agroecological Crop Protection: concepts (Cirad, JP Deguine)

Status of Crop Protection in Myanmar (PPD-DOA, Kyin Kyin Win)

Fruit and Vegetable Crop Protection in Myanmar (Horticulture, DOA, Hla Hla Myint)

12:00-13:00. Collective Lunch

13:00-16:30. Presentations on specific topics (continued)

Status of Academic Teaching in Crop Protection in Myanmar (Yu Yu Min, Yezin Agricultural University)

Research results in Crop Protection and transfer of knowledge in Myanmar (New New Yin, DAR)

Priorities for Research and Training in Crop Protection (Extension, DOA, San San Yee)

Status of Organic Agriculture in Myanmar (Thin Nwe Htwe, Land Use, DOA)

Research on improvement of the health of the soil (Land Use, DOA, Khin Myat Soe)

Proposals relevant with Agroecological Crop Protection (NGO, Than Than Sein)



Day 2. Thursday 4th May 2017. Deliverables & Perspectives (i.e. where we want to go, what do we want to do)

9:00-12:30. Actions of ACO-ACTAE project

Action 1. ACP Collective paper: structure and repartition of activities

Action 2. ACP Brochures & Flyers (English & Birman)

Action 3. ACP WS. Minutes of the 1st ACP WS; Organization of the 3rd WS in South Vietnam

Action 4. ACP-SEA-Summer School 18'

Action 5. Final Seminar of ACP-ACTAE project

12:30-13:30. Collective lunch

13:30-15:30. Agroecology in practice: experiences on Agroecological Crop Protection (JP Deguine, Cirad)

15:30-15:45. Workshop Conclusion and perspectives

15:45-16:00. Closing session

Opening Session

Moali (Ministry of Agriculture, Livestock and Irrigation) hosts the Workshop. Everybody greatly thanks for the welcome and the kindness of the organizers. Special thanks to Dr Kyin Kyin Win (PPD-DOA) and Dr Thin Nwe Htwe (Land Use, DOA) for the coordination of this organization. Dr Cao Van (Cirad, ACTAE project leader) thanks MOALI representative for the welcome and the people and the staff in charge of this organization. He gives some words on ACTAE project (see presentation).

40 participants attended the Workshop (Annex 1). The repartition of the participants and the represented institutions are given in the Table 1.



Institution / Department	Participants
Department of Agriculture DOA (DG, DYDG)	5
Land Use, DOA	5
Plant Protection Department, DOA	5
Yezin Agriculture University	3
Department of Agricultural Research (DAR)	3
DOA, Inlay Lake District	6
DOA, Extension Department	3
NGO	1
CIRAD	2
Other participants	7
Total	40

Table 1. Number of participants and institutions and departments represented

Presentations on Specific topics

This s After the Opening session, Dr Deguine presents the program of the WS and also thanks the local organizers. The presentation Session started by a presentation of the ACTAE project by Dr Cao Van (Cirad). Then presentation Session continued by presentation on scientific and technical topics on Crop Protection.

A CD-Rom was given to each participant at the end of the Workshop, including all the presentation files. To complete the content of this CD-ROM, the manuscripts of the available presentations are given in Annex 2. Below are the titles of the presentations, with the name of the presenters, and some quick and non-exhaustive comments.



1 Agroecological Crop Protection: concepts (JP Deguine, CIRAD)

- the way is not easy to take, but the sooner we start, the sooner we get results;
- permaculture: another way to the same goal, sustainable systems
- 100 % agroecology, when the agroecosystems is ecologically sustainable (the real aim), note when we suppress pesticides (a positive consequence)
- period de transition



2 Status of Crop Protection in Myanmar (PPD-DOA, Kyin Kyin Win)

- 22000 tons of pesticides imported in 2015 ; exponential trend last years; no production of pesticides in Myanmar; main concern with illegal pesticides
- IPM avec FFS, different components, including biological control, cultural practices, physical techniques.
- contribution to follow and assess pesticide residues and GAP.

3 Research results in Crop Protection and transfer of knowledge in Myanmar (New New Yin, DAR)

- food security and nutrition with the impact of innovative advanced crop variety and production technology research.
- Entomology Research Section: insect pest resistant varieties (rice, cotton, groundnut...); investing pest control methods; using botanical insecticides
- Plant Pathology Research Section
- transfer of technology: crop cultivation practices; education & training of PP-safe & efficient use of pesticides; farmers' education activities; 515 farmers trained in 2016-2017 on crop Protection
- national and International collaboration.
- an original tool: the "farmer channel studio" in collaboration with different departments. Local preparations of the videos and send them to the national channel.

4 Research on improvement of the health of the soil (Land Use, DOA, Khin Myat Soe)

- degradation of the soil: erosion, loss of organic matter, contamination, compaction, increased salinity, acidification, soil structure decline, other harms.
- Myanmar: soil degradation on 0.96 million ha (8% of total cultivable land stock)
- soil health: capacity of soil to function as a living system; maintain a diverse community of soil organism control plant disease, insect and weed pests; form beneficial association with plant roots, recycle essential plant nutrients, improve soil structure for soil water and nutrient holding capacity; not pollute environment; rich diversity of its biota
- example of symbiotic biological fixation with Bradyrhizobia and application of fertilizer: increase of yield for soybean and good nodulation
- example of green manure application: with *Gliricidia sepium* in low-land rice cropping systems
- Lime application on acid soils:
- Issue to bring together specialists of soil and specialists of crop protection; experiments can be carried out on the same places and on a long-term scale.

5 Status of Organic Agriculture in Myanmar (Thin Nwe Htwe, Land Use, DOA)

- Myanmar: one of the least developed countries in SEA (AusAID, 2013)
- challenges: land degradation (17% of the total area in Myanmar); land productivity decline
- different supporting technologies, and among them: organic agriculture
- Myanmar Organic Agriculture Group (MOAG) since 2006. It has its own standards and guidelines equivalent to internal standards and
- today: preparation of Myanmar Organic Standard
- activities to develop OF: training, certification, collaboration with INGO, NGOs
- now private sector is involved in OA
- some needs: establish Myanmar national standards by Government and establishment of infrastructure and certification process in the country; capacity building; assist/create to get Certain market access for organic products.
- GAP certificates waiting for Organic Agriculture certificate (next year?)



- International Conference on Organic Agriculture in the Tropics (Indonesia, August 2017)

6 Status of Academic Teaching in Crop Protection in Myanmar (Yu Yu Min, Yezin Agricultural University)

- YAU: education, research, extension; the only one University in Agriculture in Myanmar, 7 Departments; Major Agronomic subjects for Bachelors (entomology and Pathology);
- Plant Pathology: plant disease management, biology of plant microbe interactions
- Zoology & Entomology: to increase the crop productivity and farmers' income through the proposer pest management
- some priorities: rice, pulses, sesame; precise information (forecasting and management practices)
- budget: 38% YAU (and other partners)
- extension activities: short term training; providing information through farmer channel media.
- future perspective; existing curriculum and syllabus of crop protection will be revised (ecology courses would be more visible from outside); more training about molecular technology for identification; establish society of a plant protection journal (in 2 years)

7 Fruit and Vegetable Crop Protection in Myanmar (Horticulture, DOA, Hla Hla Myint)

- review of the main fruit (mango, citrus, grape, watermelon) and vegetable crops in Myanmar. Export market mango.
- main issues: unawareness for food security (use of pesticide), loss in quantity and quality, hazards of contamination by pesticides at different levels
- GAP (Good Agricultural Practices): important way developed in Myanmar for Fruits; in order to reduce the risk of hazards occurring during the different phases (production, harvesting, post harvesting,...) and to improve the quality of the production; publication of the GAP Myanmar National Guidelines in 2014; lot of activities and regulations to develop GAP in Myanmar; rational management of chemicals; reasoning along the chain farmer consumer; today about 80 farms with GAP certificates for mango; for tomato in Inlay lake, more difficult because more pesticides are used.

8 Priorities for Research and Training in Crop Protection (Extension, DOA, San San Yee)

- Agriculture and allied sectors still contributes about 32% of country's GDP (including crops (23%), livestock & fisheries (8%) and forestry (1%))
- 61% of Labor Force, 28.1% of Export Earnings (crops (16.6%), livestock & fisheries (4.9%) and forestry (6.8%)) (2015-2016)
- diverse agroecosystems: cereals, pulses, horticulture, vegetable & fruits, livestock and fish (65 > crops can grow successfully & economically); food baskets
- Large working age (15-64) population (46M out of 51M)-labor bonus
- Huge market potential (BGD, CHN, IND, LAOS, THA), 3000M Peoples- agriculture: 32% of country GDP (crops, 23%; livestock & fisheries, 8%; forestry 1%); 61% labor force
- diverse climatic conditions as different ecological zones; some disasters in different regions in Myanmar with climate change (erosion, flood, drought, degradation of soils)
- others: research for GAP with IPM; Organic Agriculture;
- training and education: in MAOLI, 15 institutions concerned by Research and Training; ToT (training of Trainers); Discussions & Education (staffs and Farmers); Demonstrations & Trials; Call Center, flyers, journals, FM radio.
- 5572 people devoted to extension in the districts in 2016 (666 camps).
- issues and suggestions: training on impacts of pesticides on environment and health and sustainability.



9 Proposals relevant with Agroecological Crop Protection (NGO, Than Than Sein)

- composting with agriculture waste; organic Fertilizer Making to Farmers; agroforestry Initiatives with Bamboo growing (Wood Trees); Organic Model Farm establishment; record Keeping for farmers; System of Rice Intensification (SRI); Integrated farming (Specific Animals); Bio-control agent (Trichoderma and IPM); Bee Keeping; Local Seed Maintenance and self-production; Bio-diversity Festival

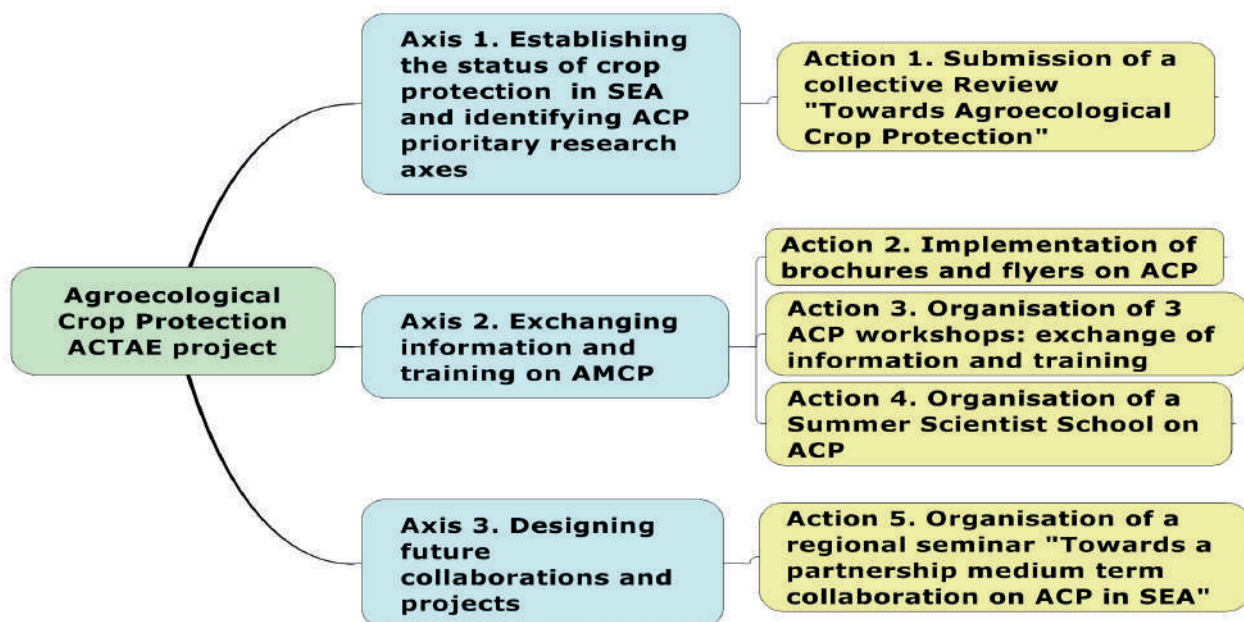
10 Agroecology in practice: experiences on Agroecological Crop Protection (JP Deguine, Cirad)

- the good performances and results obtained in these Reunion experiences do not mean that it will be the same thing everywhere; but it shows that it is relevant to try to apply and to study the ACP strategy in farm conditions.

- the concepts and the strategy of implementation in the field are generic, but it is needed to take into account the specificities and the local context to adapt the strategy.

Deliverables and perspectives

The three axis of the ACP-ACTAE project result from the three specific objectives listed above and give 5 actions.





ACP-ACTAE project / Action1. Collective paper

During the Workshop, participants agreed on a proposed structure of a paper untitled «Crop Protection in Myanmar: from Agrochemistry to Agroecology?» The plan of the paper is given in Annex 3. For each chapter, there are one or two coordinators, and several contributors (Table 2). Each coordinator has in charge the coordination of his chapter and the aim is to submit a first draft of the chapters for the 15 August 2017. The coordinator has to take contact with the contributors to write the chapter (see Table 3 for email addresses). Please be free to include data, figures and illustrations.

Chapter of the paper	Coordinators	Contributors*
Introduction	Philippe Cao Van, Cirad	
1. An expected evolution from Green Revolution to Agroecology	San San Yi, Extension, DOA	Than Than Sein, NGO Khin Myat Soe, LUD, DOA Jean-Philippe Deguine, Cirad Aung Zaw Moe, LUD, Shan
2. Chemical Crop Protection and impact	Kyin Kyin Win, PP, DOA	Khin Mya Mya Lwin; PP; DOA Daisy Myint, LUD Khin Su Yee, DOA, San San Lwin, PP, DOA Nilar Moe Swe, Planning, DOA
3. IPM and IPM related experiences and limits	Nwe Nwe Yin, DAR	Si Si Myint, DAR Ni Ni Htein, PP, DOA Yu Yu Min, YAU Moe Hnin Phu, YAU Khin Myat Soe, LUD Jean-Philippe Deguine, Cirad
4. Basis of ACP and perspectives in Myanmar	Jean-Philippe Deguine, Cirad	Thin Nwe Htwe, LUD, DOA Khin Hnin Yu, LUD, DOA Kyin Kyin Win, PP, DOA
Conclusion	Philippe Cao Van, Cirad	

* Everybody is welcome to add his name and to contribute to a part. He has to contact the coordinator.

Table 2. Coordination and contribution for the collective paper «Crop Protection in Myanmar: from Agrochemistry to Agroecology?»



No.	Name	Institution	Email
1	Dr. Than Than Sein	NGO	thanthansein@gmail.com
2	Dr. Kyin Kyin Win	PP, DOA	kyinkyinwin@gmail.com
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20	Thin Nwe Htwe	LUD, DOA	nwe.thirimon@gmail.com
21	Dr Cao Van Philippe	Cirad	philippe.cao-van@cirad.fr
22	Dr Deguine Jean-Philippe	Cirad	jean-philippe.deguine@cirad.fr

Table 3. Email addresses of the coordinators and contributors to the collective paper

Participants also agreed on the relevance to use the final collective paper (submission proposed at the beginning of 2018) for a declension to a booklet, that can be useful for policy makers, trainers, professionals,



ACP-ACTAE project / Action 2. Brochure and flyers

An example of a brochure on ACP in English was presented, proposed and agreed by the participants. The next step is to share this example of brochure by email, to modify it and to adapt to the Myanmar context (because the example is adapted to the Reunion context), to valid it, and to translate it in Birman. The first page of this brochure is given in Annex 4. There is no copyright or permission to get to adapt this brochure at the Myanmar context in Myanmar language.

In addition, some flyers can also be designed and implemented. An example is the project to implement a Guide for recognizing Fruit Flies in SEA. Dr New New Yin (Director of the Biotechnology, Plant Genetic Resources and Plant Protection Division, DAR) would be happy to be involved in this project. She will be the focal contact for the Myanmar part for this guide.

ACP-ACTAE project / Action 3. Workshops

After the 1st Workshop held in Hanoi, the 2nd current one is held in Nay Pyi Taw (Myanmar) on the 3rd and 4th May 2017.

The 3rd Workshop will be an International Workshop and it will be organized in the South Vietnam on the 29th, 30th and 31st August 2017. Participants from Myanmar, Laos, and Cambodia will attend the Workshop. In addition, some Vietnamese colleagues from the other parts of Vietnam than the South will also attend this 3rd Workshop. Some institutions (SOFRI, Nong Lam University, Can Tho University) proposed to host this Workshop. Dr Cao Van, head of the ACTAE project, will give soon the final decision.

ACP-ACTAE project / Action 4. ACP-SEA-SS18' (Agroecological Crop Protection – South East Asia – Summer School 2018)

An International Summer School on Agroecological Crop Protection (ACP) will take place from 12 to 16 March 2018 in South-East Asia. Can Tho University proposed to host this event. The general objectives of the summer school are to know about and jointly exchange the principles of ACP and to understand the concepts, methods and tools for their implementation. Specific sub-objectives are to:

- Acquire the scientific principles of agroecology and ACP;
- Share practical experiences of ACP implementations and identify subsequent generic recommendations adaptable to different crops under various production situations;
- Adapt and prepare for the necessary changes in the profession of researcher: areas of knowledge to invest or to deepen; have a good command of tools (notably modelling); multidisciplinary approaches to adopt
- Engage in a collective dynamic of ACP and develop collaborations and research projects, with eventual deliverables - videos, articles, and training resources - consistent with this dynamic.

The programme of ACP-SEA-SS18' (12-16 March 2018) is the following (the detailed program will be available soon):

Day 1: introduction and ACP principles

Day 2: modelling for ACP

Day 3: experiences and case studies - agroecological field trip

Day 4: development of research in ACP

Day 5: ACP-SEA-SS18' wrap-up and follow-up



ACP-ACTAE project / Action5. Final Seminar

Finally, a regional final seminar will be organized at the beginning of 2018, the week after the ACP-SEA-SS18' (in order to reduce the costs), with 2 to 3 representatives per country and representatives from international organizations (about 14 participants) in order to identify perspectives of collaboration and structure of a medium term. This Seminar will be held in South Vietnam from the 19th to the 21st March 2018.

Workshop Conclusion and main perspectives

Dr Deguine (Cirad) gives some conclusions of the Workshop.

1) the presenters have to send "ppt" and "doc" files of their presentations before the 18th of May, even if the "ppt" files have already available on a CD given to each participant at the end of the Workshop.

2) The workshop was useful and fruitful. The quality of the presentations was very good. Some were pedagogic (on general issues: soil, agroecology, crop protection, impacts of pesticides ...). A lot of data concerning the Myanmar situation of Agriculture and Crop Protection were given and are now available. In addition, the Workshop was also very pleasant and it has been held in a very nice atmosphere.

3) Soil health has emerged as a major concern common to Crop Protection, Soil management and agronomist research topics. A lot of scientific knowledge is available today on this subject, and nowadays an important issue is to integrate this knowledge to answer the development challenges (soil degradation, loss of fertility, erosion, etc.). Another challenge is to make pedologists and crop protection specialists work together on the same subject, with shared objectives.

4) The presentations also highlighted the importance of restoring biodiversity in agroecosystems, both for pest management and for soil management. Optimizing the interactions between plant communities and animal communities represents a major challenge for research and academic education.

5) Soil health and biodiversity are the two axes of PAEC. This shows the coherence and the complementarity between the different actions and orientations discussed during the workshop: ACP, Conservation Agriculture, Organic Agriculture, Soil management, etc. We have to keep in mind that the implementation of these two axes is difficult and time consuming. It requires humility and sincerity, to make a good diagnosis and to take the right road. But it is necessary if we recall that the current agroecosystems are not ecologically sustainable and that we have in mind the negative impacts of pesticides on health and the environment. The development of ACP, in the actions of research, academic teaching, education, and training are indispensable, alongside the public policies and regulations that must also be worked. The challenge is major, since it is on one hand a question of answering the current challenges of development, mainly socio-economic and environmental, and on the other hand a challenge of preparing the answers to the questions of tomorrow, which will also be focused on the ecological sustainability of agroecosystems and human health. It is reasonable to assume that pesticides will be banned in the future.

6) The ACP-ACTAE project was designed to share information and to get the same level of knowledge on ACP. This was the objective of this workshop. We have to go not too fast and to take the time for these discussions, because they are necessary before considering concrete actions in the fields. However, we now do have a plan of action, with collaborations already initiated on ACP on a scientific level (scientific collective paper, summer school, ...) and also in order to contribute to the sharing and transfer of knowledge (brochures, workshops, booklets) to help policy makers become aware of the need to integrate agroecology into tomorrow's agriculture in Myanmar.



7) Finally, thanks were expressed to the Moali for hosting and organizing this workshop. Thanks to all participants for their active contribution and their interest in the ACP subject. Thanks to the staff who perfectly organized the workshop, with a special mention to the Dr Dr. Kyin Kyin Win and Dr Thin Nwe Htwe. Finally, thanks to all for the welcome and the kindness. Beyond the scientific and technical interest of this workshop, sharing these two days was a pleasure.

Closing session

Dr. Kyin Kyin Win (PP, DOA) closes the Workshop. She thanks everybody for participation and active and positive contribution. She also thanks the representatives of Cirad for having providing very new and useful information on Agroecology and Agroecological Crop Protection. She finally stresses on the quality of the exchange of information and the motivation of the participants during with Workshop.

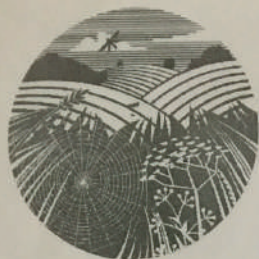


Group photography and presentation session





Annex 1. List of participants (ACP-ACTAE Workshop, Nay Pyi Taw, Myanmar, 03-04 May 2017) (1/4)



ACP-ACTAE Project Agroecological Crop Protection



Action 3. Workshop on Agroecological Crop Protection

Nay Pyi Taw (May, 3-4, 2017)
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List of participants (1)

Name, Surname	Institution	Email address	Signature 3.5.2017	Signature 4.5.2017
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12. Daw May Oo Khin	Deputy assistant staff officer	mayoohkin-3333@gmail.com	<i>May</i>	<i>May</i>
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14.				



Annex 1. List of participants (ACP-ACTAE Workshop, Nay Pyi Taw, Myanmar, 03-04 May 2017) (2/4)



ACP-ACTAE Project

**Agroecological
Crop Protection**



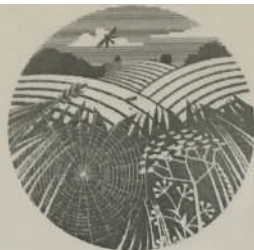
Action 3. Workshop on Agroecological Crop Protection
Nay Pyi Taw (May, 3-4, 2017)
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List of participants (2)

Name, Surname	Institution	Email address	Signature 3.5.2017	Signature 4.5.2017
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Annex 1. List of participants (ACP-ACTAE Workshop, Nay Pyi Taw, Myanmar, 03-04 May 2017) (3/4)



ACP-ACTAE Project

Agroecological Crop Protection



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Action 3. Workshop on Agroecological Crop Protection

Nay Pyi Taw (May, 3-4, 2017)

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Annex 1. List of participants (ACP-ACTAE Workshop, Nay Pyi Taw, Myanmar, 03-04 May 2017) (4/4)



ACP-ACTAE Project Agroecological Crop Protection



Action 3. Workshop on Agroecological Crop Protection

Nay Pyi Taw (May, 3-4, 2017)

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Annex 2. Some presentations of the ACP-ACTAE Workshop (Nay Pyi Taw, 3-4 May 17)

"Agroecological Crop Protection: concepts" (JP Deguine, CIRAD)

Applying Agroecology principles to Crop Protection

The evolution of crop protection has been described by many authors; it has relied on different concepts, the most emblematic of which is certainly that of IPM. Since the last decades of the 20th century, researchers and practitioners have reduced the use of chemical pesticides in particular because of its economic, health and environmental costs (decreased efficacy, toxicity to producers and consumers, environmental pollution). This reduction in use of agro-pharmaceutical products has been accompanied by the development of so-called agroecological solutions based on ecology.

The agroecological design of an agroecosystem rests on two main guidelines: maintaining local biodiversity and soil health. These two key elements ensure the ecological dynamics of the agroecosystem and thus its sustainability. The basic principles of agroecology allow this sustainable approach. Human activity (agriculture) is considered a necessary disturbance of the natural ecosystem. A concerted and reflective agroecological action aims to minimize the impact of this disturbance by preserving or restoring the biodynamic balances that govern the sustainability of the agroecosystem.

Taking up these two main thrusts of agroecology, the application of agroecology to the protection of crops has been addressed since the early 2000s by various authors. It is based on two axes of management:

- incorporation of plant diversity in time and space (in the form of habitat management);
- improvement of soil quality (organic matter, biological function), through ecologically sustainable cropping practices unfavorable to pest development.

ACP Definition and Implementation Strategy

Deguine et al. (2009) define agroecological crop protection as a system of crop protection founded on the science of agroecology. By favoring preventive measures, it establishes bioecological balances between animal and plant communities within an agroecosystem with the aim of preventing or reducing infestations or outbreaks of pests. ACP covers all pests (insects, pathogens, weeds). It emphasizes (among the classical techniques mobilized within the framework of integrated pest management) optimization of cropping practices and management of plant populations to favor the maintenance or creation of habitats favorable to the useful indigenous fauna and / or unfavorable to crop pests. Agroecological protection, besides management of plant populations (crops and non-crop plants in the vicinity of plots, in the agroecosystem as a whole), also includes management of other organism populations, mainly arthropods such as pests, diverse natural enemies and pollinators and other soil invertebrates such as earthworms and collembola, as well as pathogen agents. It is known that diversified agroecosystems have fewer pests and more natural enemies.

ACP involves concerted action between relevant professionals including farmers and other land managers. The use of curative techniques can only be considered as a last resort and only in the case of absolute necessity, as long as it does not disturb functional biological groups providing



ecological services. The future of pesticides seems to be limited, at least in their present form; many are already subject to environmental and toxicological restrictions. Sanitation, through cropping management, habitat management and biological control, are the main effective components of crop protection.

IPM is a combination of techniques, and ACP uses the scientific understanding of agroecology (Gliessman, 1997), in particular knowledge of biology and ecology and integrating this knowledge into practices (taking account, at different spatial and temporal scales, of functional biodiversity, the ecological function of agroecosystems). In operational terms, this agroecological methodology results in a systemic and orderly approach.

Based on this agroecological approach, Deguine et al. (2009) propose a phytosanitary strategy adapted to the sustainable management of agroecosystems. In this approach, the essential stage, chronologically following on from regulatory measures and before considering curative approaches, is the priority implementation of preventive measures through the management of plant populations (cultivated or uncultivated):

- cultivate healthy plants and ensure good soil health, via sanitation, the use of adapted varieties, crop succession and crop rotation, technical itineraries such as direct seeding mulch-based cropping systems with minimal tillage, management of grass cover, fertilization, irrigation and organic amendments;
- reduce pest populations and increase natural enemy populations (at the scale of the plot, its surroundings, the farm and the whole agroecosystem) through crops or trap plants, refuge zones, associations and intercropping, push-pull techniques, field border management, development of ecological compensation structures (corridors, hedges, herbaceous and flower strips), techniques to promote plant diversity;
- encourage concerted practices, both in time and space, within agroecosystems.

In addition, ACP is systematically studied at different spatial and temporal scales, ranging from local agronomic practices to integration into the landscape, bringing it closer to the area-wide pest management concept which is strongly linked to landscape ecology. This is one of the reasons why its effectiveness must be measured in a farming environment, on small or large areas depending on the situation and on significant timescales. Figure 1.9 shows the seven main features of ACP.

Conservation Biological Control

The IOBC (International Organization for Biological Control) defines biological control as the use of living organisms to prevent or reduce crop loss or damage caused by pests. Biological means available include, for example, living organisms (mites, insects, nematodes, bacteria, fungi and viruses). There are three types of biological control:

- classical biological control (or introduction / acclimation), which includes identification of indigenous and exotic natural enemies, introduction and acclimatization of exotic natural natural enemies, use of natural enemies to eliminate crop pests;
- augmentation biological control, including raising and releasing natural enemies (as many times as necessary), to eliminate pests when a natural enemy is present but its number insufficient to ensure elimination (three components: inoculation, augmentation, flooding);
- conservation biological control, including all measures taken to conserve indigenous natural enemies, preventing their destruction by other practices and increasing their effectiveness, in particular through habitat management. Intermediary measures or use of a mixture of the types of biological control are also possible (e.g. autocid control).

Long underused and less studied than augmentation biological control in agricultural environments (introduction and release of natural enemies), conservation biological control has become



an essential component of biological control. It is based on the management of plant populations (management of arthropod habitats) in the same way that conservation biology is based (in natural environments) on the management of habitats or animal species to be protected or promoted. These two approaches can thus be brought together and the boundaries of biodiversity management in space can be reduced. Thus, agronomists protect crops, ecologists manage protected species, and hunters manage game populations and together they lead a concerted action in the management of habitats.

The implementation of conservation biological control relies on three techniques:

- eliminating or significantly reducing insecticide treatments on crops and herbicides in agroecosystems;
- introducing plant biodiversity into agroecosystems by creating unfavorable habitats for pests and / or favorable habitats for natural enemies, e.g. permanent ground cover, trap plants, refuge plants for natural enemies;
- adapting cropping practices for crop management and management of new habitats.

These examples focus on pest management, but it is important to note that ACP takes into account all crop pests and also targets weeds and pathogens responsible for different diseases.

Promoting population management through sustainable organization of habitats, biological control is based on new agroecological ideas likely to increase its efficiency and reliability (Landis et al., 2000; Nicholls and Altieri, 2004). This approach also supports the traditional methods of introduction-acclimatization or biological treatment, favoring the implantation of artificially introduced natural enemies in agroecosystems. It is likely to provide an operational response to the demand for the preservation of biological diversity and is respectful of the environment and valorizes landscapes. It requires a significant change in agricultural practices including uncultivated areas. The role of agronomists is thus determined by an adaptation of cropping systems and technical itineraries.

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“Status of Crop Protection in Myanmar” (PPD-DOA, Kyin Kyin Win)

Plant Protection Division is one of the Divisions under Department of Agriculture under Ministry of Agriculture, Livestock and Irrigation established in 1979 with technical and financial assistance from FAO/UNDP. Plant Protection Division maintained its working atmosphere by its own effort. Strict enforcement of Laws regarding in the field of plant protection, the pest incidences and marketing of pesticides were under controlled.

Actually objectives of department of agriculture are prior to fulfill the needs of local consumption, export of more surpluses of agricultural products for the increase of foreign exchange earnings and assistance to rural development through agricultural development.

Main Export Commodities and Countries in Myanmar are pulses (Green Gram & Black Gram), sesame, peanut, maize, rice, onion, rubber and timber. Main Export Countries are Korea, Japan, Vietnam, Malaysia, Indonesia, Thailand, UAE, India, China and Pakistan.

Pesticide Imported in Myanmar were 4704.24 metric tons in 2005-06 and 22019.24 metric tons in 2015-16. Pesticide Imported in Myanmar increase year by year. Farmers used a lot of pesticide because of it is easy to use and nearby them.

Plant Protection Division has adopted the following policies so that plant protection measures would be carried out in an economically justifiable and ecologically sound manner.

Plant Protection Division give plant protection recommendations that are in line with Integrated Pest Management concepts and supporting sustainability of good agriculture practice to crop production, monitor and ensure that pesticides use in food crop production for local consumption are in accordance with the international food safety standards, ensure that plant protection chemicals having minimum adverse effect to human health and the environment, are judiciously used.

Up to date, Plant Protection Division preserves and maintains, as far as possible, the present conditions of agriculture system, which are in favor of IPM concept.

IPM is the coordinated use of pest and environment information with available control methods and to prevent unacceptable levels of pest damage by the most economical means and with the least possible hazard to people, property, and the environment.

Activities of IPM in PPD

- To educate the farmers to use the IPM package
- To establish the Farmer Field School in each region and state within crop season
- To experiment and transfer of plant protection technology appropriate for specific cropping system, crops and agronomic practices.
- To monitor, safe and efficient use of pesticides,
- To Organize capacity building training on plant protection technologies, IPM with GAP
- To share the knowledge of project to Growers



Table.1. Established Farmer Field School in Myanmar

Sr	Year	Division	Name of Crops	Farmers
1	2000-2001	3	Rice	212
2	2001-2002	3	Rice	90
3	2002-2003	2	Rice	64
4	2003-2004	4	Rice, Pulses	113
5	2004-2005	4	Rice, Pulses ,Autumn crops	194
6	2005-2006	3	Rice, Pulses ,Oil Seed Crops	135
7	2006-2007	7	Rice, Pulses ,Oil Seed Crops ,Vegetables	298
8	2007-2008	7	Rice, Pulses ,Oil Seed Crops ,Vegetables ,Horticulture Crops	183
9	2008-2009	11	Rice, Pulses, Vegetables ,Horticulture Crops	400
10	2009-2010	16	Rice, Pulses, Vegetables ,Horticulture Crops	803
11	2010-2011	17	Rice, Pulses, Vegetables ,Horticulture Crops	948
12	2011-2012	28	Rice	882
13	2012-2013	18	Rice, Pulses, Monson Sesame	862
14	2013-2014	13	Monson Rice, Summer Rice	469
15	2014-2015	24	Monson Rice,Summer Rice,Pulses,Vegetables,Monson Sesame	818
16	2015-2016	6	Monson Rice	271
			Total	6742

Before using of chemical by people especially farmers, agro –dealers and growers need to take the training is Certified Pesticide Applicator Training on Safe and Effective use of Pesticide in PPD. Plant Protection Division organized the training on safe and effective use of pesticide to user, farmers and dealers for being qualified in the use of highly toxic chemicals in the whole country.



Table .2. Number of frequencies and Trainee Yearly

Sr	Year	Frequency	Trainee		
			User , Dealer	Government Service	Total
1	1993-2004	60	3280	685	3965
2	2005	3	291	22	313
3	2006	8	901	57	958
4	2007	12	2039	147	2186
5	2008	5	867	55	922
6	2009	11	1154	71	1225
7	2010	9	605	81	686
8	2011	6	859	72	931
9	2012	7	854	62	916
10	2013	4	421	61	482
11	2014	12	1485	134	1619
	Total	137	12756	1447	14203

PPD Needs for strengthening capacity building with following the requirements.

- short/long term training for identification of plant pests and diseases, weed to Staff
- short/long term training for IPM package
- Need to new technology to production of bio agent & Botanical product
- Need to open FFS in each regions & States



“Research results in Crop Protection and transfer of knowledge in Myanmar” (New New Yin, DAR)

Myanmar is an agro-based country and agriculture sector is the back bone of its economy. There are many crops cultivation in Myanmar. Department of Agricultural Research (DAR) is one of the Departments under Ministry of Agriculture, Livestock and Irrigation. DAR is a main agricultural research department in Myanmar. The objectives of DAR are to develop high yielding improved varieties and hybrids with good quality and good regional adaptation, to generate profitable cropping system and production technology, to develop crop varieties and production technologies resilience to climate change and global warming, to develop agricultural technologies and biotechnology, to disseminate research finding through Farmer Channel. Many agricultural researches on major crops and technologies are being conducted at DAR. Pests and Diseases are one of the main constraints to obtain the high yields for agricultural crops. For this reason, Plant Protection is very important in agriculture. Integrated pest and disease management researches are being implemented for the safety of consumers and environment. In DAR, there are two Sections for plant protection, Entomology Research Section and Plant Pathology Research Section which are being conducted for Plant Protection researches.

Insect pest control researches are being implemented at Entomology Research Section. Entomology Research Section has been carried out research activities to find out insect pest resistant varieties, to investigate the effective pest control methods and to observe the effectiveness of botanical insecticide and bio-pesticide. Therefore, screening of major pest resistant varieties and investigating the effective pest control methods for important crops in Myanmar including rice, groundnut, chickpea, pigeon pea and cotton are being conducted at Entomology Research Section.

Achievements of Insect Pest Resistant Varieties		
Crop	Pest	Resistant Varieties
Rice	Brown Plant Hopper (BPH)	Shwe Thwe Yin, Sin Thwe Latt, Thee Htut Yin, Yadanar Toe, Shwe War Tun
	White-backed Plant Hopper (WBPH)	Kyaw Zay Ya, Nga Kywe Hmwe, Shwe Myanmar, Shwe Thwe Yin, Thee Htut Yin, Shwe War Tun, Inn Ma Ye Baw, Sin Shwe Thwe
Crop	Pest	Resistant Varieties
Rice	Yellow Stem Borer	Shwe Thwe Yin, Thee Htut Yin, Shwe War Tun, Inn Ma Ye Baw, Sin Shwe Thwe, Nanaw Ha Ri
	Rice Gallmidge	Sion Kalhar, Sein Ta Lay, Ye Net-5, Nga Kyawe Hmwe, Yar-1, Yar-3, Yar-4, Yar-6
Groundnut	Leaf Miner and Binder	Sinpadathar 5
Chickpea	Pod Borer	ICCV-8302, ICCV-8201, ICCV- 31, ICCV- 4935, ICCV-5264, ICCL-86105, ICCL-86106, ICCX-7320244
Pigeonpea	Pod Borer	ICPL-265, ICPL-332, ICPL-88034, ICPL-187-1-1, ICPL-84060, ICPL-87089, ICP-87119, ICP-7194-E1 Yezin-4, Yezin-7 and Yezin-12
Cotton	Sucking Pests	Line 66, Line 67

Cultural control is an effective way and environmental save methods, therefore, by adjust time of sowing that can escape the pest infestation. Therefore, research on effects of time of sowing on pest infestation and disease infection are also studies from Plant Pathology Section



such as Mungbean Yellow Mosaic Virus Disease (YMV) and recommended that the sowing time of greengram and blackgram is early not later than November last week can escape the YMV disease occurrence.

Moreover, Yellow Sticky Board can be used as a pest management tool. That is effective and easy way to make it. The sticky material can be as simple as a thin layer of cooking oil, other oils, a mixture of mineral oil and petroleum jelly, or commercially prepared materials such as Sticky Stuff that can catch winged aphids, leaf miner adults, thrips, white flies, fungus gnats, and shore flies (among others, but these are the main pests) and therefore, that can be used to monitor and or reduce populations of certain insect pests.

In Myanmar, not only the major crops such as Rice, Maize, Pulses and Oilseed crops, Ornamental crops and fruit trees are also important. Integrated Pest Management (IPM) on major crops is being demonstrated in the farmers' field. Oriental Fruit Fly *Bactrocera dorsalis* (HENDEL) is an important pest on mango in Myanmar. The toxicity of the selected insecticides to Oriental Fruit Fly *B. dorsalis* (HENDEL) was conducted and the results indicated that among the insecticides tested, Chlorpyrifos was found to be the most effective contact insecticide for the control of oriental fruit flies followed in descending order by Deltamethrin, Dimethoate and Malathion under the laboratory conditions of 26-30°C and 75-78% relative humidity. The availability of Chlorpyrifos in Myanmar offers a good opportunity for farmers to obtain better control of oriental fruit fly. However, as these chemical insecticides are, in general, detrimental to natural enemies, their use should be considered and to use only when absolutely necessary (Nwe Nwe Yin et al., 2016).

Rodents are one kind of major pest not only at growing season but also at storage duration. Therefore, researchers from Entomology Section conducted research to find out rodent population and rodent species in four villages near by DAR by using trap barrier system (TBS) in 2005 (Mu Mu Kyaw et al., 2015).

The research objectives of the Plant Pathology Research Section are to evaluate disease resistant varieties, to find out appropriate control measures for plant diseases and to produce the ability of effective microorganism and bio-fertilizer production.

Growing of disease resistant varieties is one of the effective ways to escape the disease infestation. Therefore, screening of disease resistant varieties is being conducted for serious diseases of major crops in Myanmar such as Rice, Maize, Sesame, Chickpea, Greengram and Sugarcane. As far as research achievement of screening of disease resistant varieties are as follows:

Achievement of Disease Resistant Varieties		
Crop	Disease	Resistant Varieties
Rice	Bacterial Leaf Blight (BLB)	Sinthukha, Shwe Myanmar
	Bacterial Leaf Streak (BLS)	Manawthukha
	Blast	Yadanar Toe, Yar-1 and Yar-8
	Sheath Blight (ShBlight)	Manawthukha and Shwe Myanmar
Sesame	Black Stem	Sinyadanar-6
Greengram	<i>Cercospora</i> Leaf Spot	Yezin-4, Yezin-7 and Yezin-12
	Yellow Mosaic Virus	Yezin-11, Yezin-14
Sugarcane	Red Rot	DAR-4, Kyaukseine, VMC-74/527

Moreover, to prevent disease development and to minimize yield losses due to the disease, research on disease management practices for serious diseases of major crops in Myanmar are being conducted approaching Integrated Disease Management (IDM) at Plant Pathology Section of DAR. Those disease management researches including chemical control (fungicidal effects), cultural practices including different fertilizer rates, time of sowing and plant populations, mechanical practices and biological control have been carried out in both laboratory and under



filed conditions.

Based on the results, the recommendation from DAR for the rice growers are additional applications of Potash fertilizer into the rice field at the rate of 56 lb ac⁻¹ together with Mencozeb that can reduce BLB disease and also together with Fungiking that can reduce the BLS disease of rice. Fugi One is the most effective fungicide to control the Rice Blast Disease.

Banded Leaf and Sheath Blight of Maize is an important disease in Myanmar especially in Hilly Regions. To control this disease, IDM, i.e., by manually de-leafing and application of both Trichoderma and Benomyl can reduce the Banded Leaf and Sheath Blight of Maize. Trichoderma together with Carbendazim can control black stem disease of sesame. Moreover, they recommended that using Carbendazim alone can reduce the Collar Rot disease of Groundnut, however, by combination with Carbendazim and Trichoderma can decrease the infestation of Black Stem of Sesame and Dry Root Rot of Greengram.

Plant diseases can prevent and/or control by both direct and indirect way. By promoting plant growth and plant immune system, that can also protect the soil-borne diseases infection. For that case, Trichoderma spp. can use for that purpose. Moreover, Trichoderma spp. can be used as decomposer for compost. Plant Pathology Research Section of DAR have being conducted the research on plant growth promoting and biological control of Mycoparasite, *T. harzianum* for many crop diseases including Rice, Tomato, and Maize. *T. harzianum* inoculants are being produced from Plant Pathology Research Section of DAR since 1993-94.

Moreover, research on N-fixing bacteria Rhizobium are also conducted and Rhizobium inoculants for 7 different legumes including Groundnut, Chickpea, Blackgram, Greengram, Soybean, Pigeon pea and Cowpea are being produced since 1978-79 from DAR for legume growers. That can help to fix the nitrogen for the legume crops and promote the plant growth as healthy plants and soil improvement.

Normally, DAR directly distributes and transfers the results, information and knowledge to farmers and also indirectly transfers the information through Department of Agriculture (DOA) which is the main linkage Department with farmers. Therefore, DAR invite DOA officials and delegates to DAR meeting and workshop for technology transfer and to discuss concerning about farmers' requirements to add research activities in DAR regular research program.

Transfer of technology to farmers through agricultural extension regarding crop cultivation practices; appropriate cropping patterns; provision and proper utilization of agricultural inputs; and systematic plant protection practices are being undertaken. Educating and conducting trainings of plant protection to the farmers for safe and efficient use of pesticides, showing the demonstration research trials, field days, training, meeting and workshop. Farmers' education activities include use of mass media (newspaper, radio, television, journals); distribution of education pamphlets; training and visit to farmer fields in group and individually. Ten times of plant protection farmers' trainings are implemented to 515 farmers in 2016-2017.

Another way that DAR transferred the knowledge and technology is from Farmer Channel. Farmer Channel Studio is situated at DAR and there are many programs which were produced from DAR concerning about research activities, new released varieties, and recommended technologies and up to date information. Those programs are broadcasting from Myanmar Radio and Television (MRTV) as Farmer Channel. Broadcasting can cover most of the areas; however, it cannot cover the whole Myanmar as there is some limitation. The farmers who can watch that channel can know about the up to date agricultural information.

Plant Protection Division of DAR collaborates with national (Yezin Agricultural University (YAU) and Department of Agriculture (DOA); international (FAO, IRRI, ICRISAT and IAEA) and non-government organization (JICA, KOICA, ACIAR and AFACI).

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Presentation 4. "Research on improvement of the health of the soil"
Dr. Khin Myat Soe, Deputy Staff Officer, Biofertilizer Laboratory, Land Use Division (LUD), Department of Agriculture (DOA),
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Myanmar is one of the agriculture based countries and agriculture sector is the back bone of our country economy. Myanmar's current population is 53.90 million - 70 % live in rural areas and engage primarily in agriculture. Agriculture plays a vital role in the country's economy. The main crops are cereals (rice, maize, and wheat), pulses, and oilseed crops (sesame, peanut, and sunflower). Department of Agriculture (DOA) is one of the Departments under Ministry of Agriculture, Livestock and Irrigation. Land Use Division (LUD) is one of the important divisions under DOA. The LUD laid down the following objectives: Soil classification, Cropping recommendation based upon soil types of different agro- ecological zones, Recommendation on fertilizer management for each type of crops and soil, Recommendation on irrigation frequencies for different crops based upon physical characteristics of the soil and meteorological conditions and Undertaking soil conservation and reclamation measures. As ongoing tasks of LUD, Survey and Mapping, Demonstration of Soil conservation practices, Demonstration of Amelioration on problem soil, Soil fertility improvement, Research on Soil and Fertilizer correlation, Fertilizer Registration and Enforcement of Law and Regulation, Soil, water and fertilizer analysis and Training and Education.

Soil is fundamental to crop production. Without soil, no food could be produced on a large scale, nor would livestock be fed. Because it is finite and fragile, soil is a precious resource that requires special care from its users. Many of today's soil and crop management systems are unsustainable. At one extreme, overuse of fertilizer has led, in the European Union, to nitrogen (N) deposition that threatens the sustainability of an estimated 70 percent of nature. At the other extreme, in most parts of sub-Saharan Africa, the under-use of fertilizer means that soil nutrients exported with crops are not being replenished, leading to soil degradation and declining yields. The evidence for widespread degradation of agricultural soils in the form of erosion, loss of organic matter, contamination, compaction, increased salinity, acidification, soil structure decline and other harms (European Commission 2002).

In Myanmar, problem soils occupy an area of about 0.96 million ha representing about 7.81% of total cultivable land stock of 12 million ha. Out of the problem soils area, about 0.66 million ha is occupied by the saline and alkaline soils, most of which are currently underutilization. The remaining problem soils area of about 0.3 million ha are occupied by acid sulphate soils, degraded soils, peat soils and swampy soils. Hence soil and water quality degradation can be thought of as symptoms of poor soil health. For this reason, research has been directed to devising measures of the health of soil, which could be used to monitor its condition and inform its management so that degradation is avoided. The challenge for management of agricultural soils is to develop production systems that not only prevent soil degradation but also enhance soil health.

Soil health is the capacity of soil to function as a living system. Healthy soils maintain a diverse community of soil organisms that help to control plant disease, insect and weed pests, and form beneficial symbiotic associations with plant roots, recycle essential plant nutrients, improve soil structure with positive repercussions for soil water and nutrient holding capacity, and ultimately improve crop production. An ecosystem perspective: A healthy soil does not pollute the environment; rather, it contributes to mitigating climate change by maintaining or increasing



its carbon content. Two crucial characteristics of a healthy soil are the rich diversity of its biota and the high content of soil organic matter. If the soil will be healthy, the soil has the following properties: protected soil surface and low erosion rates, high soil organic matter, high biological activity and biological diversity, high available moisture storage capacity, favourable soil pH, deep root zone, balanced stores of available nutrients, resilient and stable soil structure, adequate internal drainage, favourable soil strength and aeration, favourable soil temperature, low levels of soil born pathogens and low levels of toxic substances.

There are some indicators for soil physical, chemical and biological properties. As the indicators of Soil Physical Properties, the soil has Aggregate Stability, Soil Structure, Soil Porosity, Bulk Density, Water Infiltration, Water Holding Capacity, Soil Available Water, etc. As the indicators of Soil Chemical Properties, it will be good Cation Exchange Capacity, Organic and Inorganic N, Organic and Inorganic P, Organic and Inorganic K and Soil pH. As the Soil Chemical Properties like availability of Earthworms, Soil Microorganisms, Particulate Organic Matter, Soil Respiration and Soil Enzymes.

There are some players under Ministry of Agriculture, Livestock and Irrigation (MOALI). They are Land Use Division (LUD), Department of Agriculture (DOA) and Vegetable, Fruits Research and Training Center (VFRTC), DOA. Soil Science, Water Utilization and Agricultural Engineering Division, Department of Agricultural Research (DAR), Agricultural Microbiology Section, Department of Agricultural Research (DAR), some NGO, INGO and Private Sector are involved in the improvement of soil health. Land Use Division (LUD), Department of Agriculture (DOA) and Soil Science, Water Utilization and Agricultural Engineering Division, Department of Agricultural Research (DAR) are key players for the improvement of soil health in Myanmar.

The key players of the improvement of soil health are doing the related researches for soil improvement. They are Biofertilizer application (eg. *Rhizobium*, *Streptomyces griseoflavus*, etc.), Green Manure application (Gliricidia, Sunnhemp, Dain cha (*Sesbania*), Rice bean (*Phaseolus*), Black gram, Green gram, Soybean, etc.), Lime application, Compost application (rice straw, Palm pallet, etc.) Gypsum application, Balance Fertilization in Upland Soil, Site-Specific Nutrient Management, and Soil Conservation, etc.

As an example of the research on the improvement of soil biological property, the research title of Coinoculation of Myanmar *Bradyrhizobium yuanmingense* MAS34 and *Streptomyces griseoflavus* P4 to growth and seed yield of different soybean cultivars are carried by Biofertilizer Laboratory; Department of Agriculture (DOA) was carried out. Leguminous crops are one of the important cash crops and increasing demand for domestic consumption and export in Myanmar and standing as a leading country in ASEAN (DOP, 2016). Leguminous crops can assimilate nitrogen from the atmosphere through symbiotic biological N₂ fixation (BNF) with *Bradyrhizobia*. Root nodule bacterial inoculants substitute the nitrogenous fertilizers. Indigenous rhizobium strains have adapted to local environmental conditions. Endophytic actinomycetes have to improve and promote growth of host plants as well as to reduce disease symptoms caused by plant pathogens and/or various environmental stresses. The results that we found were the single inoculation of *Bradyrhizobium yuanmingense* MAS34 improved growth and yield of CM-6 soybean variety. Synergistic effects of P4 coinoculation with *Bradyrhizobium yuanmingense* MAS34 was found in Yezin-12 soybean variety. Although the effect of P4 was not uniform on different soybean varieties, P4 is better in dry biomass and yield than control. The improvement of soil properties were achieved after doing the research. Furthermore, Rhizobium inoculation with the application of 56 - 112 lb/ ac P₂O₅ and 28 – 56 lb/ac K₂O should be applied for good nodulation and maxi-



imum yield in soybean and mungbean cultivation. Rhizobium inoculation with the application of 60 Kg P₂O₅/ha {1 bag (50 kg) T- super/ac} treatment should be applied for good nodulation and maximum yield in mungbean cultivation through the researches carried out by the Agricultural Microbiology Section, Department of Agricultural Research (DAR).

As an example of the improvement of soil physical property, the research title of *Gliricidia* (*Gliricidia sepium*) as a Promising Green Manure Source for Lowland Rice in Rice-Rice Cropping System was carried out by the purpose of to conduct the effect of *Gliricidia* (*Gliricidia sepium*) as a Promising Green Manure Source for Lowland Rice in Rice-Rice Cropping System and increasing the property of soil. The experiment was carried out to find out the usage of *Gliricidia* not only for green manure but also for fire wood beginning from 2012 wet season. In this experiment the effect of *Gliricidia* green manure was evaluated by comparing the effect of cowpea and sunnhemp green manures and FYM. According to the analysis result, cowpea and sunnhemp green manure contain 1.5-2.5% N and *Gliricidia* leaf contain 2.5-3.5% N. So, *Gliricidia* can be said N-rich plant. The highest yield was observer in *Gliricidia* green manure added block. As much as 11-24% grain yield increased over FYM added block was observed from the plot with *Gliricidia*. When compared to without fertilizer application treatment, 15-56 basket/acre yield increase could be expected from *Gliricidia* a treatment. 13-34 % grain yield increased over cowpea added block and 21-33% yield increased over sunnhemp were also observed from *Gliricidia* added block. Moreover, we also get 1 ton of firewood when we apply 2 ton of *Gliricidia* green manure.

Another example of the improvement of soil chemical property, the research on lime application research were carried so that to reduce acidic condition, to get desirable pH To become better soil structure, phosphorus and soil microbes, to reduce toxic elements for plants: Al, Fe and Mn. The application rate of NPK+ Lime = 112: 56: 28 lb/ac + 560 lb/ac and NPK = 112: 56: 28 lb/ac for control on different rice cultivars in 10 states and region in total 92 acres of land by using simple trials. The responded yields were depended upon the state ant region but all have been greater yield than control.

We would like to give as key messages as follows: Healthy agricultural soils are those used within their capability to enhance production without being degraded or degrading their environment. The biological, physical and chemical properties of healthy soils enable them to function with resilience to disturbances from agricultural practices and with minimum external inputs. To maintain and improve soil health, it is necessary to plan for the long term and integrate best practice for erosion control, soil organic matter management, water and nutrient management, and pest and disease management into the production system. There needs to be more effective communication of soil health management.



“Status of Organic Agriculture in Myanmar”
ThinNwe Htwe
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Department of Agriculture
Ministry of Agriculture, Livestock and Irrigation

Introduction

Myanmar is basically an agricultural country with about 73 percent of the population residing in rural areas, of which 36% are below the poverty line (ADB, 2013). The agriculture sector provides about 70 percent of the total labour force and contributes 36 percent GDP and 25-30 percent of total foreign export earnings (ADB, 2013). Myanmar is one of the least developed countries in SE Asia (AusAID, 2013).

The country's geographical location, topography and climatic conditions provide a setting for different agro-ecological zones and make it feasible to grow tropical, sub-tropical and temperate crops. Crops grown in the country can be classified into seven main groups, namely- cereals, oilseeds, food legumes, industrial crops, food crops, plantation crops and miscellaneous crops.

Land Utilization in Myanmar (2014-2015)

2014-2015	Million hectare	(%)
Net Sown Area	11.95	17.7
Fallow land	0.44	0.7
Cultivable Waste land	5.26	7.8
Reserved Forests	18.62	27.5
Other Forests	14.73	21.8
Other land	16.65	24.6
Total	67.66	100

Source: Myanmar Agriculture in Brief 2015

The Ministry of Agriculture, Livestock and Irrigation (MOALI) has laid down the following guidelines for agricultural development:

- (a) To permit agriculture production freely;
- (b) To expand the area under agriculture while safeguarding the rights of farmers;
- (c) To permit the private sector to engage in the production of industrial crops, fruit trees and perennial crops;
- (d) To encourage the participation of the private sector in the production of agricultural machinery and inputs.



Area Contribution of Crop Groups (2013-2014)

Sr. No.	Crops	Sown area		Production (000 MT)
		(000 ha)	%	
1	Cereal crops	8360	40	29624
2	Oil seed crops	3414	16	2916
3	Pulses	4449	21	4785
4	Industrial crops	1018	5	10197
5	Culinary crops	341	2	2052
6	Other crops	3465	16	446288
	Total	21047	100	495862

Yield of Major Crops in Myanmar (2013-2014)

No	Name of crop	Yield (ton/ha)
1	Paddy	3.90
2	Maize	3.70
3	Groundnut	1.00
4	Sesame	0.57
5	Sunflower	0.96
6	Black gram	1.43
7	Green gram	1.29
8	Pigeon pea	1.33
9	Sugarcane	61.83
10	Cotton	1.70

The government has designated agriculture as the main pillar of the economy and tremendous efforts are being made to achieve greater progress in the agricultural sector. Gross area is estimated to have increased from 11.01 million hectares in 1992/93 to 12.88 million hectares in 1995/96. Among the crops grown, paddy takes up the largest portion, occupying about 48 percent of the total area, followed by oil seeds at 16 percent, food legumes at 16 per cent and industrial crops at 5 per cent. The area under paddy continued to increase steadily, and for 1995/96, covered 6 million hectares due to the introduction of summer rice programs on a large scale and rice price increases which have encouraged farmers to cultivate more land. There was an increase of 22 per cent of land cultivated between 1991/92 and 1994/1995. Although paddy area and production have grown steadily, yields have remained low, with an average of 3.9 tons per hectare in irrigated land and 1.0 to 2.0 ton per hectare in rainfed area of upland region.

In order to discourage the monoculture of paddy, the Government promoted a policy to diversify agricultural production. Although production of crops other than paddy decreased after 1987/88, current statistics show that production, especially of pulses, wheat and sesame has recovered.



Soil Types in Myanmar

No.	FAO Classification	Area (000 ha)	(%)
1	Acrisol	4130	6.1
2	Andosol	46	0.1
3	Arenosol	244	0.4
4	Cambisol	16517	24.3
5	Ferralsol	18922	28
6	Fluvisol	736	1.1
7	Gleysol	6105	9
8	Lithosol	531	0.8
9	Luvisol	1781	2.6
10	Vertisol	482	0.7
11	Nitosol	42	0.1
12	Not suitable for crop	18123	26.8
	Total	67659	100

The main challenges in Myanmar, population was increasing year by year. Because of population increased, deforestation, shifting cultivation, intensive agriculture and unsustainable agriculture became increasing year by year. These factors caused soil erosion and soil fertility depletion as well as because of climate change. These erosion and soil fertility depletion are leading to land degradation in surrounding areas and also decline land productivity. Decrease in productivity of agricultural land is very important issue, and the proper conservation and improvement of degraded land needs an immediate action.

In Myanmar, land degradation is a serious environmental problem that threatens food security, livelihood and ecosystem services. Land degradation covers 17% of the total area of Myanmar (ADB/GEF/UNEP, 2006). Land degradation is caused by forest degradation, water erosion, wind erosion, soil fertility depletion, salinization, alkalinization, and water logging and so on. The total vulnerable farming areas of 4.8 million acres were observed in Myanmar (Forest Department, RS/GIS Data, 1998). In upland areas and dry zone, soil erosion is common form of land degradation which is primarily a natural process but aggravated by human interventions such as excessive forest harvesting, mono-cropping practice and shifting cultivation.

Research and Training Section to cope with the impact of climate change and land degradation

As it is aware the fact that the yields of agricultural crops cannot increase if the soil is by no means fertile although the crop yields depend upon other factors, for instance, climate, variety, pest control and mechanization and so on. Due to diverse climatic constraints, the soil types differ from place to place. As a result, the problem soils occur with varying degree. The problem soils do not occur due to nature alone, mismanagement of agricultural practices leads to soil problems and soil fertility deterioration. Now the problem soils occupy an area of about 0.96 million hectare (about 7.81% of total cultivable land area). Among problem soils, about 0.66 million hectare are saline and alkaline soils and about 0.33 million hectare are acid surphate soils, degraded soils, peat soils and swampy soils. For the purposes of this, researches are ever needed to be conducted in the following areas: (1) how to minimize and /or prevent soil problems (2) how to ameliorate problem soils at the current situation (3) how to achieve and maintain soil fertility (4) fertilizer ma-



agement for the yield increase from the efficient and balanced utilization and economical point of views. In addition, soil health care must be taken with regard to hazards of the utilization of the chemical fertilizers on environments. Moreover, Soil reclamation such as gypsum application on saline soils and alkaline soils, lime application on acid soils and loamy soil application on some soils should do in the problem soils. Soil improvement through manuring play a prominent role in increase of crop of production. On the one hand, control of erosions, amelioration of the soil problems and to prevent soil degradation shouldn't be neglect. Conducting training is of great importance to enable for sustenance agriculture and not to have negative impact on environment.

Besides, proper soil management such as zero tillage, mulching and manure application, crop-residues management should be practiced to conserve ecosystems. Water management such as water harvesting, efficient water utilization and intermittent irrigation plays the crucial roles for promoting crop in environmentally friendly manner as well as watershed management focus on physical features: land, forests, water, dams, parks, communication, infrastructure, biodiversity, etc, and economical features: agriculture, industries, tourism, commercial & trade, waste, etc, and social features: human settlement, population growth, health, pollution, historical sites, etc. After assessment of climate change, adapted varieties: early, drought tolerant and pest and disease resistant based on different agro-ecology zones, region-wise proper cropping patterns, agro-forestry and diversification of crops should be practiced in maximizing crop production.

DOA is one of the technical supporting sections under Ministry of Agriculture, Livestock and Irrigation. Therefore, we are going to support Technology to cope with the Impact of Climate Change and degraded land with these above agricultural technologies and practices. Some farmers are adopted these practices in their farms but mostly are still using their traditional farming systems. So, now we are going to transition of organic farming system in Myanmar.

Status of Organic Agriculture in Myanmar

Myanmar Organic Agriculture Group (MOAG), INGO is established in Myanmar since 2006 based on the voluntary statement, not for mandatory. MOAG has own standards and guidelines which are equivalent to internationally accepted standards, (EEC 834/2007 and EEC 1235/2008 and also with ISO 65).

MOALI discussed and did workshop with ASEAN, KOICA, FAO and MFVPEA started from year 2005 to present.

Myanmar Organic Standards have been prepared based on the following factors;

- International Federation of Organic Agriculture Movement (IFOAM) standard,
- National Organic Program (NOP)
- Organic Agriculture Certification Thailand (ACT) standard

Now MOALI and MOAG have been together prepared to set up the Myanmar National Organic Standards and third draft of its interpretative guide is nearly adopted the IFOAM standard.



Advisory committee for Organic Certification includes Department of Planning, Department of Agriculture (Different Division-Extension, Horticulture and Plant Biotechnology, Plant Protection, Land Use and other related Division), Department of Agriculture Research and Yezin Agricultural University.

MOALI are doing some activities such as training, certification and collaboration with INGOs and NGOs to development organic farming in Myanmar. Department of Agriculture (DOA) has initiated to develop Myanmar organic farming collaboration with other projects; JICA, KOICA, FAO, private companies, etc. DOA has being implemented Project for Farmers Participatory Grantee System (PGS), Climate Friendly Agriculture (CFA), Nitrogen Cycle Management (NCM), Nitrogen Use Efficiency (NUE) and Green Water Management Project in Myanmar (2014-2018) with TA-REG 8163: ADB- GMS, Phase II.

Staff from MOAI, Ministry of Commence, private companies and growers from MFVPEA and farmers have achieved by attending **Organic Inspector Training** by Korea expert at CARTC (2010). Moreover, DOA staffs have attended oversea trainings and workshops at China, Korea, Thailand, Malaysia, Japan, and Vietnam and so on.

Organic Farming had been demonstrated about 100 acres (nearly 40.48 ha) in Dagon International Co. Ltd at Nay Pyi Taw (2011) by Thailand expert.

Ongoing to Organic Agriculture, we are also introduced with Good Agriculture Practices (GAP) to farmers to adapt GAP and transit to Organic Farming Systems.

Brief overview in GAP

- ASEAN and ASEAN GAP- Initially development as an activity under the AADCP project, Quality Assurance System for ASEAN Fruit and Vegetables (QASAFV-37703), 2004 implemented during phase III of the ASEAN – Australia Economic Cooperation Programme (AAECP).
- A recognised standard in ASEAN adopted by the 10 ministers of Agriculture of the member countries at the Twenty-Eight Meeting of the ASEAN Ministers on Agriculture and Forestry (28th AMAF) held in Singapore, 16 November 2006 ([http:// www. aseansec. org/ 21366.htm](http://www.aseansec.org/21366.htm)).
- Covers the production, harvesting, post harvest handling of fruit and vegetables on farm and also they are handled to sale.
- Publications of Myanmar National GAP Guideline in 2014 and already distributed 1300 books and many pamphlets to staff from MOAI and line Ministries and other related growers and stakeholders.
- Totally Myanmar Standard, 45- kind of fruit and vegetable due to ASEAN Std. were translated into national language and to be submitted to the focal of standardization, Ministry of Science.

Therefore, the government still needs to do the following processes to improve current organic farming for getting the International Organic Standards level.

- ▶ Establish Myanmar National Organic Standards by Government and establishment of infrastructure and certification process in the country
- ▶ Resource Persons, Technical skill, Management and Certified Processes
- ▶ Education programs and awareness trainings to farmers, fruit and vegetable growers and consumers about the importance and benefits of organic agriculture
- ▶ Capacity building for government staff as well as private sector
- ▶ Try for issuing organic certificates to organic growers, and
- ▶ Assist/create to get CERTAIN MARKET ACCESS for organic products.



Annex 3. Structure shared and agreed of the collective paper (ACP-ACTAE Workshop, Nay Pyi Taw, Myanmar, 03-04 May 2017)

«Crop Protection in Myanmar: from Agrochemistry to Agroecology?»

Introduction

- * intensive agriculture
 - increasing then decreasing yields
 - negative impacts
 - unsustainability

- * necessity to change
 - passing Green Revolution
 - towards AE
 - for actors
 - in cluding consumers

- * In Crop Protection
 - excessive use of pesticides
 - impacts: flora, fauna, environment, water, human

- * it's the case in MM
 - it's the case in SEA
 - MM is not the largest user of pesticides
 - officially
 - but consumption increases
 - reglementation
 - not well known by farmers
 - illegal pesticides
 - réglementation ?
 - lot of impacts
 - references
 - issue to move
 - Status of policies in MM
 - cf Peeters et al 2014

- * objective of the review
 - to make a status of the situation in Crop Protection in MM
 - to review the evolution of Crop Protection in the recent years or decades
 - to list the main limits of current protection
 - to appropriate the need to change in the aims, in the concepts, in the practices
 - from an unstainable agriculture to a sustainable one
 - with good performances for socio-economical, environmental criteria



- and also taking into account health and ecology
- ecology=NEW concern
- and limiting the use of pesticides
- to identify the keys of the transition period that can help policy makers

- * announcement of the plan
 - evolution of crop protection
 - chemical CP and impacts
 - IPM and limits
 - ACP and perspectives

Chapter 1. Evolution of Crop Protection in the recent decades

- *In the world, in SEA
 - in Asia, evolution of the demand
 - high increase of the demand
 - high increase for
 - cereals
 - fruits and vegetables
 - cf Muniappan et al 2012
 - production losses by pests
 - en particulier en ASE

- *evolution and status of CP
 - excessive use of pesticides
 - SCHREINEMACHERS et al 2015
 - for a long time: Thailand, VN
 - exponential increase in Cam, Lao, MM
 - in quantity and in quality
 - negative impacts
 - promotion of IPM, training, FFS, but during projects and in some experiences
 - today: IPM is the reference, but limits in considering and practicing
 - unsustainable AES
 - questioning the use of pesticides
 - everywhere
 - ONU
 - not only FAO
 - but also for Human rights

- *promotion of AE and AE in CP
 - promotion AE
 - ONU de Schutter
 - FAO Rome 2014
 - FAO bangkok 2015
 - ONU human rights 2017
 - 4 for 1000 initiative
 - in CP



IPM presented as a way belonging to AE (FAO 2015; Pretty et al 2014)
because it could reduce pesticides
but unsustainable AES in most of the cases (false IPM, low IPM)
ACP Deguine et al 2009 and 2016
declension of AE to PC

Chapter 2. Current Chemical Crop Protection and impacts

*worldwide and dominant

- in developing countries and in developed countries (de Bon Africa)

*status of the situation in SEA and MM

- study of GRET on pesticides used in SEA
- data
 - evolution of the quantities used during the last 10 years
Peeters, DOA
 - data of use, country per country in SEA
available in literature
 - situation per crop
 - what are the main problems and what are the way to answer
 - which research axes are implemented?
- Ccl : evolution
 - increasing
 - cf China production and consumption

*farmers are OK with pesticides because

- no tax on misuse or excessive use
- biopesticides non available or expensive
- low knowledge on IPM and on ecology
- IPM programs relie on projects and funders
 - stop after the project
- no or few assessment on pesticide risks and no or few studies

*negative risks and impacts

- impacts: flora, fauna, environment, water, human
- cf litterarture
 - references ?

*need to significantly reduce pesticides

- some experiences show it is possible
 - IPM Pretty
- way of OA
 - some experiences in SEA (Thailand,
in MM
 - see presentation ACP WS



Chapter 3. IPM and IPM related experiences and limits

*FAO bangkok 2015

IPM = 1 of the 6 AE approaches
because it can reduce pesticides
but limits
cf sustainability

*IPM in SEA and MM

a lot of papers
Pretty et al 2014
developed in Asia in the 80s
ie Indonesia (FFS)
in MM

description of success stories (rice?)

*IPM limits

- paradigm of CP for 60 years
harmonise CC & BC
- today
 - promoted in the words
but often forgotten in practices
false IPM
 - CC easier and cheaper
- low adoption
 - in North and South Parsa et al 2014
 - in SEA like elsewhere
- numerous definitions
 - more than 100: confusions of understanding & implementing
Intelligent Pesticide Management
no Management of populations
- in the practices : chemicals
Deguine et al 2016
chemical = basis of IPM in the fields
there is a threshold of reduction that we cannot reach
ESR

Chapter 4. Basis of ACP and perspectives in MM

*aim: declension of AE in CP

- to take into account the Sustainable Development criteria
 - but also two other issues
 - health
 - cf ONU
 - ecology
- AGROECOLOGY!

*description of ACP

- ordered approach and systemic strategy in the field
- possibility to use pesticides but only on a last resort and carefully



- *positive impacts
 - for health, sustainability, environment, socioeconomy
 - high reduction of pesticides
 - to do our best to not use them
 - but possibility at the end

- *what are the priorities or the proposals for ACP in MM?
 - crops ?
 - areas?
 - cropping systems?
 - partners?

- * other practices
 - GAP
 - Organic Agriculture

- *what are the difficulties and the keys of the transition?
 - research into questions?
 - new perimeters
 - new fields
 - new tools, new approaches,
 - training and teaching
 - public support, policies and reglementation

Conclusion

- *need to include AE in CP
 - to improve sustainability of AES
 - to reduce pesticides
 - ESR
 - to reduce negative impacts
 - AE is in process, including AE in CP

- *generic keys to move
 - cf book

- *proposals in MM
 - priorities
 - to test the principles in the fields
 - to manage the transition period
 - concrete proposals

- *regulation and implementation could be more efficient
 - si better education and training of farmers, extensionists and salers
 - if there was alternative to chemicals
 - what are we waiting for?
 - issue to move to agroecology



Agro-ecology >> Using functional biodiversity to boost agrosystem performance



Agro-ecological crop protection

Applying the principles of agro-ecology to crop protection



Diversinervus sp., a parasitoid of *Saissetia hemispherica* on custard apple
© A Franck/CIRAD

Agro-ecological crop protection (ACP) is an innovative, ordered approach that stems directly from applying the principles of agro-ecology to crop protection, in which ecological aspects are truly centre-stage. ACP aims to reconcile efficient crop protection against pests and diseases with the socioeconomic, ecological, environmental and sanitary sustainability of agro-ecosystems. It is also intended to make a substantial contribution to the switch from agrochemical-based practices to agro-ecological practices within cropping systems.

>> Crop protection lies at a crossroad

In the field of crop protection Integrated Pest Management (IPM) has been the prevailing paradigm since the 1950s, based on a concept devised by Californian entomologists. IPM has contributed to the positive changes in crop protection since the 1950s. However, without questioning the reasoning behind the concept, it is now appropriate to wonder about the coherence between current concerns about crop protection, notably with a view to promoting the principles of agro-ecology, and current practice in the field, which often centres on using agrochemicals, in both North and South.

Agro-ecological crop protection (ACP) lies at the crossroads between several research and management concepts and fields:

- agro-ecology, which can be seen as both a scientific discipline in its own right (it involves integrative studies relating to agronomy, ecology, sociology and economics, on various scales) and an agro-ecosystem management method;
- integrated crop protection, which has meant pooling the efforts of researchers and practitioners for the past 50 years or more, but which is now showing its limitations in the field;
- biodiversity management within agro-ecosystems, which for both research and management purposes draws on conservation biology within natural ecosystems.

ACP-ACTAE Project