S AND T TECHNOLOGY TRANSFER MODALITY IN MANAGING CROPS PESTS

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The Philippines

Location - Southeastern Asia, archipelago between the Philippine Sea and the South China Sea, east of Vietnam

Total Area - 300,000 km²
  Land — 298,170 km²
  Water — 1,830 km²

Agricultural land area — 9.67 million ha

Population — 88.57 M

Popn. Density — 296 p/ km²
More Information

**GNP** – US$ 48.72 Billion

**GDP** – US$ 46.39 Billion

Share of agriculture -- 18%

**GVA in agriculture by sub-sector**—

- Crops—50%
- Banana—5%

**Total Agri export** --US$ 3.17 B

- Coconut oil 21%
- Banana fresh 11%
- Pineapple & products 7%

**Total Imports** —US$ 4.92B

- Rice (Vietnam)—76%
- Milk & cream----43%
The Philippine Horticulture Industry

- accounts for 44% of the total volume of food crops, with fruits and vegetables estimated to be worth PhP74B (US$1.54B)
- able to meet local demand
- post-harvest losses
  - 28% and 42% in fruits and vegetables
  - Caused by short shelf-life, adverse conditions in the existing post-harvest environment, and poor post-harvest handling and practices particularly in the case of small farmers and traders
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Vegetables

- mainly grown in mountainous areas with poor roads, steep slope, irregular topography and few transport and cold storage systems.

Tropical fruits

- highly perishable
- post-harvest losses 15 – 35%
- losses are due to unfavorable climate, pests and diseases, cultural practices, poor harvesting and packing, poor storage conditions, and inadequate handling during transport.
# Fruit Crops: Area, Volume, & Yield (2008)

<table>
<thead>
<tr>
<th>Fruit Crops</th>
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<th>Volume (MT)</th>
<th>Yield /ha (MT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Banana</td>
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<td>19.81</td>
</tr>
<tr>
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### Vegetables: Area, Volume, & Yield/ha (2008)

<table>
<thead>
<tr>
<th>Crop</th>
<th>Area (Hectares)</th>
<th>Volume (000 MT)</th>
<th>Yield per hectare (MT)</th>
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<td><strong>MAJOR:</strong></td>
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<td>Peanut</td>
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<td>Cabbage</td>
<td>8,593</td>
<td>128,863.01</td>
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<td>Eggplant</td>
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<td>Tomato</td>
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S&T Agenda related to Horticulture sector

Anchored on the 4 banner programs of PCARRD:
- knowledge and technology generation
- utilization of the generated R&D results
- policy formulation and advocacy program
- capability building and governance.

Focused on 5 thematic areas:
- poverty reduction and food security,
- competitiveness
- frontier and cutting-edge science
- sustainable development
- R&D support to public sector/services
# National/Regional STA for Fruits and Vegetables

<table>
<thead>
<tr>
<th>INDUSTRY CLUSTER</th>
<th>COMMODITY</th>
<th>REGION 1</th>
<th>REGION 2</th>
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<tr>
<td>TROPICAL FRUITS</td>
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<td>VEGETABLES</td>
<td>Conventional Vegetables</td>
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<td>Organic Vegetables</td>
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</table>

- **Major Commodity** (National priority)
- **Minor commodity** (Regional priority)
R&D Agenda for Fruits & Vegetables

1. Increasing yield/productivity based on scientific knowledge

2. Developing production systems towards sustainable productivity and good environment

3. Improving income and livelihood of farmers
R&D Areas for Major Fruit Crops

1. Increasing yield/productivity
   - Germplasm conservation and use
   - Development of quality varieties

2. Developing production systems for sustainable productivity
   - Development of improved production systems
   - Pest and disease management
   - Improvement of nutrient and water management
INTRODUCTION

- Green revolution in the last five decades brought technological advancement and development of modern approaches in agriculture to increase production efficiency.
However, after years of massive campaign, a remarkable effect on the landscape of the agro-ecosystems and concomitantly on the diversity of species
• Paradigm shift in the agricultural system has been initiated towards sustainable agriculture

• IPM strategy for maintaining the balance of the agro-ecosystem.
IPM PROGRAM

• May 3, 1993, launching of the National IPM program known as ‘KASAKALIKASAN’

• Philippine Government Commitment to Agenda 21 to UNICEF

• Focused on Rice, Corn and Vegetables
• Empower the farmers to become more effective managers and decision-makers

• Focus is about IPM by farmers and not IPM for farmers

• Biological control and ecological approaches are the founding principles
• The practice of IPM was achieved through the direct or hands-on training in season-long FFS

• Carries out a program of training and research activities to strengthen capacity and capability of LGUs, NGOs and farmers’ group
Biological control – a major component of IPM program for crop production.

Earwig (Euborellia annulata) -
- an effective biological control agent, predatory on many phytophagous, lepidopterous and coleopterous insect pests.

- can control up to 23% Asian Corn Borer (Ostrinia furnacalis) infestation through augmentative release.
On green corn “Asukar” variety, farmers realized an increase of 69% in farmers’ net income due to earwigs over that of using insecticides.

For the “Lagkitan” variety, net income increased by 87% and 61% when using earwigs over the untreated control and complete reliance on insecticide respectively.
Merits of earwig utilization

❖ Decreases the cost of insecticide application by 94%.

❖ Promotes an ecologically-sound pest management strategy which minimizes insecticide application, thus reducing the adverse effect in the environment such as contamination.

❖ Conserves the population of other natural enemies which will enhance pest control.
BIOLOGICAL AGENTS UTILIZED

for other pests of important crops

• *Trichogramma* species for lepidopterous pests
• *Diadegma semiclauseum* and
• *Cotesia plutellae* for DBM
• NPV for cutworm and earworm
• *B. bassiana* for leafhoppers, rhinoceros beetles, rice black bug
Enhancement of Technology Uptake

Techno-Gabay Program (TGP) which is one of PCARRD’s banner programs which aims to bring the science-based information and technology services in AFNR sectors
R&D Results Utilization

Techno-Gabay Program (TGP)
- FITS centers
- Magsasaka-siyentista
- ICT
- IEC
Fig 1. S&T-Based Farm Framework

**PROCESS FLOW**
- Farmer-Cooperator (FC) Farm
- Existing Farm Practices
- S&T Interventions Packaged (with partial budget analysis or cost & return analysis)
- Enhanced FC S&T-based farm

**ACTIVITIES**
- Gap analysis/supply chain analysis
- Documentation of FC practices
- Identification of S&T interventions
- Packaging of S&T interventions
- Provision of technical assistance and support for adoption of interventions

**IMPORTANT PLAYERS**
- Farmer-Cooperator (FC)
- Project Implementing Team
- PhilRice Technical Experts
- LGUs
Magsasaka farms or Farmer Scientist’ farms that showcase the effectiveness of S and T in improving productivity and income of farmers. The farms/enterprises highlight S and T based livelihood and business opportunities for particular focus commodity/product in a community.
Techno Gabay Program (TGP)

• Establishment of S&T-based farms
• Packaging and dissemination of content and services of Farmers Information Technology Services (FITS) Centers and Magsasaka Siyentista (MS) Program in the regions

Technology packaging (TP)

• Packaging of Investment Portfolios
• Technology Profitability Analysis
• Technology Assessment
S&T-based Farms on Fruits and Vegetables

- Vegetable
- Strawberry
- Mini-citrus
- Cauliflower
- White potato
- Cashew
- Banana
- Lanzones
- Pili
- Pineapple
- Mango
- Jackfruit
- Vegetable
- Banana
- Peanut
- Papaya
- Mango
- Lanzones
- Cassava
- Mango
- Banana
- Latundan
- Mandarin
- Tomato
- Lakatan
- Pineapple
- Pummelo
- Mango
- Banana
Technology Transfer

Techno-Gabay Program

16 sites in Regions 2, 3, 4, 7, 11 & 12 (3 completed; 13 ongoing)

- Saba/Cardaba—9
- Latundan ------ 1
- Lakatan ------- 5
- Cavendish ------ 1
Technology interventions introduced in the STBF for Lakatan

• Use of disease-free tissue-cultured planting materials
• Field management technologies for TC plantlets
  - pest & disease mgt
  - nutrient & water mgt
  - sanitation, desuckering, bagging
Comparative yield performance of producing Saba & Lakatan under MS Farm

<table>
<thead>
<tr>
<th>STBF Established</th>
<th># of cycles</th>
<th>Computed Yield (t /ha)</th>
<th></th>
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<tr>
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<td>Existing Practice</td>
<td>With Intervention</td>
<td>National</td>
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<td>STBF on Saba</td>
<td>3</td>
<td>14.94</td>
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<td>Production in Dingalan, Aurora</td>
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<tr>
<td>STBF on Lakatan</td>
<td>2</td>
<td>13.30</td>
<td>26</td>
<td>19.81</td>
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<td>Production in Diffun, Quirino</td>
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• PCARRD S&T Agenda 2006-2010 identified the priority commodities for research and development activities

• PCARRD Banner Priority Programs
  – Knowledge and Technology Generation
  – Technology Transfer and Utilization
  – Policy Advocacy
  – Capacity Building and Governance
Knowledge and Technology Generation

New Knowledge / information on different crop pests for utilization through S and T based farms
National Banana Program
(Lakatan, Latundan & Saba)
In 2008

- 438,593 ha planted with banana
- 8.7M metric tons
- Cavendish – 49.83% of total production
- Mindanao (regions IX to XIII) produced 81.10% of total production
- Top 3 producing provinces:
  - Davao del Norte
  - Compostela Valley
  - Bukidnon
**R&D Agenda/Areas**

**Increasing yield/productivity**
- Germplasm conservation and use
- Development of quality varieties

**Developing production systems for sustainable productivity**
- Development of improved production systems
  - Pest and disease management
- Improvement of nutrient and water management

**Improving income and livelihood of farmers**
- Supply chain improvement
- Development of postharvest, processing and machineries
PRODUCTION CONSTRAINTS

- DISEASES: BBTV, FUSARIUM WILT, MOKO, SIGATOKA

- INSECTS: MEALYBUGS, APHIDS
Survey conducted on fruits of Saba banana showed predatory earwigs preying on mealy bugs
3 SPECIES OF MEALY BUGS

- **Dysmicoccus neobrevipes**, Beardsly
- **Rastrococcus invadens**, Williams
- **Pseudococcus jackbeardsleyi**

*Use of existing natural agents like predatory bugs, predatory ascid and phytoseeid mites are being explored*
Survey was further conducted to determine the species of mealy bugs

• 2 spp *Dysmicoccus*
• 1 species *Planococcus*
• 1 species *Nipaecoccus*

• During the survey, a predatory earwig was collected, *Chelisoches morio*
• Functional response study revealed that the predator feeds on all active stages of mealybugs, *D. Neobrevipes*.
• Consumption was greater on 1st instar.
• Consumes > 1400 individuals of 1st instar within 83 days life cycle.
• Mass rearing protocol was developed.
Mealybug in Lakatan
Different developmental stages of *Chelisoches morio*, a potential biological control for mealybugs
Regional R&D Program for Jackfruit

Towards Globally Competitive and Sustainable Jackfruit Industry in Eastern Visayas
Conceptual Framework for the Regional Jackfruit R&D Program

- 2 NSIC registered varieties being commercialized
- Asexual propagation through cleft grafting
- Foundation and scion groves of jackfruit established
- Improved protocol for nursery management
- Package of production technology available
- Processed products of jackfruit developed

R&D Intervention (2008-2011)

Research Components
- Nutrient management
- Pest management
- Process improvement

Promotion & Commercialization
- Information needs assessment
- IEC materials
- Promotional activities

Supply Chain Analysis
- Regional baseline data
- Distribution channels
- Processing Facilities

Input
- Production Cost Efficiency

Process
- Factors of Production (Type & Quality)

Output
- Quantity & quality of products produced
  - Fresh Fruit
  - Processed pulp
  - Grafted seedlings

Outcome
- Locally sufficient
- Import/Export Competitiveness

Output Market

Support Services
- Plant Now-Pay Later, Germplasm/Seed System Programs, Techno-Demo Farms, Village Level Production, STBF

Policies
Integrated Pest Management of Jackfruit

SP1 - Identification, Pathogenicity and Evaluation of Management Strategies Against the Wilt-causing Microorganisms in Jackfruit

SP2 - Etiology of Fruit Bronzing and Its Management in Jackfruit

**SP3 - Biological Control of Jackfruit Fruit Borer in Region 8**

<table>
<thead>
<tr>
<th><strong>Objective</strong></th>
<th><strong>Expected Output</strong></th>
<th><strong>Activities</strong></th>
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</thead>
<tbody>
<tr>
<td>To develop an integrated pest management scheme for jackfruit</td>
<td>▪ IPM scheme</td>
<td>▪ Evaluation of fruit bronzing syndrome</td>
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<td>▪ Evaluation of fungicides &amp; antagonists against wilt syndrome</td>
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<td>▪ Evaluation of biocontrol agents for borer</td>
</tr>
</tbody>
</table>

![Images of jackfruit and pests]
Preliminary results

- Identified biocontrol agents against jackfruit pests
  - *Gliocladium* sp. & *Aspergillus* sp. vs. *Phytophthora* wilt
  - *Metarhizium anisopliae* vs. jackfruit fruit borer
  - *Trichogramma evanescens* & *Apanteles* sp. vs. jackfruit crambid fruit borer
Rearing of jackfruit pest and bio-control agents
National Vegetable R&D Program

‘safe and quality vegetables for a healthy nation’
few alternatives to chemical pesticide; high cost of inputs
indiscriminate use of pesticides, seasonal production; high cost of production
mishandling and improper storage; high postharvest losses; exposure to microbial contaminants
mishandling and improper storage; high postharvest losses; exposure to microbial contaminants; high cost of transport; inefficient chains; lack of proper promotion
FOOD SAFETY CONCERNS
IRREGULAR SUPPLY
HIGH PERISHABILITY
HIGH PRICES
LOW PREFERENCE
40kg (2003)
## Details: Pest Management Products– Projects 2.1 to 2.3

<table>
<thead>
<tr>
<th>CROPS</th>
<th>PESTS &amp; DISEASES</th>
<th>PRODUCTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bell pepper</td>
<td><em>Fusarium</em> wilt, bacterial wilt</td>
<td>Disease-resistant rootstock varieties</td>
</tr>
</tbody>
</table>
| Bitter gourd | *Fusarium* wilt  
bacterial wilt  
downy mildew, namamarako  
aphid -transmitting namamarako luteovirus | Disease-resistant rootstock varieties, varieties  
Chemical inducers varieties |
| Cabbage    | Cutworm                                                   | BCA                                           |
| Carrot     | mole cricket, powdery mildew, root knot nematode           | BCA                                           |
| Cucumber   | *Fusarium* wilt, bacterial wilt                           | Disease-resistant rootstock varieties        |
| Eggplant   | *Fusarium* wilt                                           | Disease-resistant rootstock varieties        |
|            | bacterial wilt                                           | Disease-resistant rootstock varieties        |
|            | stem rot, anthracnose, fruit rot, fruit and shoot borer   | Chemical inducers                            |
| Garden Peas | whiteflies  
powdery mildew  
Ascochyta leaf blight, pod borer, leaf miner | BCA  
BCA, varieties varieties |
| Potato     | mole cricket, potato cyst nematode                        | BCA                                           |
| Snap bean  | Whiteflies  
bean rust, pod borer                                      | BCA varieties                                |
| Tomato     | whiteflies, powdery mildew, root knot nematode  
fruit worm, stem rot, leaf mold, late blight, early blight | BCA  
Chemical inducers |
## Details: BCA Products – Project 2.3

<table>
<thead>
<tr>
<th>PESTS and DISEASES</th>
<th>PRODUCTS (BCA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>whiteflies</td>
<td><em>Beauveria &amp; Verticillium</em></td>
</tr>
<tr>
<td>cutworm</td>
<td>Entomopathogenic nematode (EPN)</td>
</tr>
<tr>
<td>mole cricket</td>
<td>EPN</td>
</tr>
<tr>
<td>pod borer</td>
<td>EPN, <em>Metarhizium</em></td>
</tr>
<tr>
<td>powdery mildew</td>
<td><em>Verticillium sp. &amp; Bacillus subtilis;</em></td>
</tr>
<tr>
<td>root knot nematode</td>
<td>EPN</td>
</tr>
<tr>
<td>potato cyst nematode</td>
<td>EPN</td>
</tr>
<tr>
<td><em>Alternaria</em> and black leg</td>
<td><em>Trichoderma, Pseudomonas sp., Bacillus pumilus</em></td>
</tr>
<tr>
<td>Sclerotinia white mold</td>
<td><em>Bacillus subtilis, Trichoderma</em></td>
</tr>
</tbody>
</table>
CHALLENGES AHEAD

The modernization of agriculture through green revolution program provided impetus in increasing productivity in the last 5 decades. However, the paradigm shift in agricultural production resulted in change in the landscape of the agro-ecosystem. An IPM strategy must be pursued to give emphasis on environmental friendly approaches to preserve the diversity of friendly and beneficial insects.
To enhance utilization of technologies for farmers adoption, technology transfer modalities through Techno Gabay Program and Community Participatory Approach to showcase the use of BCA is a priority of the government.
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