Seed System, Production and Marketing of Eggplant in Three Major Producing Provinces in the Philippines

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This study discusses the seed system, production and marketing of eggplant, Solanum melongena L., considered as one of the most important vegetable crops in the Philippines. Data analyzed were obtained from focus group discussions in major eggplant producing provinces of Pangasinan, Batangas and Quezon; key informant interviews with representatives of government agencies and seed companies, and traders; and secondary sources such as government reports and other publications. The eggplant seed system is generally organized, involving public and private sectors. There are different varieties available in the market but seed developers do not opt for seed registration nor plant variety protection because of the rigorous process involved. Instead, seed companies adopt well-established seed production and quality control strategies and vigorous marketing and promotion to improve sales. Commercial growers of eggplant adopt hybrid seeds, while open-pollinated varieties (OPVs) are mainly used for small-scale production. Between 2000 and 2009, eggplant production increased by 21% despite a relatively lower increase (6%) in area planted. Average yield ranged 8-10 mt ha⁻¹. Eggplant production is profitable, but major problems include fruit and shoot borer (FSB) infestation, bacterial wilt, irrigation supply and climate-related problems. Production involves intensive use of pesticides, bearing some implications on human health and environment. This should call the attention of Local Government Units which are in the forefront of providing extension services. Moreover, research and development should continuously receive adequate support to address these concerns. Research and development thrusts could include varietal improvement of eggplant and alternative pest control strategies such as integrated pest management (IPM) technology and intercropping. The current effort on R & D of Bt eggplant addresses the problem of FSB and heavy dependence of farmers on pesticides. With the stringent regulatory system of the Philippines on the commercial propagation of GM crops, adverse impact on human health and environment will be curtailed.

Keywords: Eggplant seed system, eggplant marketing, eggplant production

INTRODUCTION

Produced all year round in almost all parts of the country, eggplant (Solanum melongena L.) is considered an economically important and the most popular vegetable crop in the Philippines. It is a good source of vitamins, fiber and minerals; potassium, vitamin C, protein and other phytonutrients (Maghirang 2001; Tan 2007).

Asia produces 87% of the world’s eggplant production and accounts for 90% of the world’s production area (Chen and Li 2008). The Philippines ranked 7th among the world’s top eggplant producers although eggplant is grown primarily for domestic market. The leading vegetable crop in the country in terms of area planted and volume of production (Hautea and Narciso 2007), eggplant accounted for the highest value and 28% of the total volume of major vegetables grown in the country (ABSP II 2010).

This paper analyzes the eggplant industry’s profile, particularly its seed system, production and marketing. It presents trends in area planted, production, and yield; examines existing policies as well as problems affecting the industry; and recommends policy interventions to help improve the industry. The findings could be useful to the eggplant industry’s stakeholders in responding to the demands of consumers; and in charting directions of policies and programs for the further development of the industry.

METHODOLOGY

Analytical Tools Used in the Evaluation

Industry analysis requires a careful industry definition, analysis of structure and behavior of players. It examines the product market scope and marketing system, trends in production, input supply, stakeholders and institutions involved, and the potentials and constraints facing industry players (Rola et al. 2008). The analysis is anchored on the interaction of three components – the seed system, production and market (Figure 1). The seed system refers to the flows...
Figure 1. Conceptual framework

RESULTS AND DISCUSSION

The Eggplant Seed System
Seed system is comprised of the actors: i) (farmers and institutions); ii) the materials such as varieties and their characteristics; and the processes such as research and development (R & D), seed production and quality management, seed distribution and marketing (Hodgkin and Jarvis 2004). Seed system may be formal or informal or a combination of the two. Formal seed system corresponds to the ‘organized seed sector’ where seed production and supply mechanisms are operated by public or private sector with well-defined methodologies, e.g. seed production techniques and quality control system, and regulated by national and/or international policies (Reusche and Chopra 1993; Louwaars 2007; Jarvis et al. 2004). The informal seed system is identified as the farmers’ or the local seed system since it operates at farmer and community levels in terms of production and exchange mechanisms, local seed selection, production and diffusion, following their own procedures (Louwaars and van Marrewijk 1996; Jarvis et al. 2004).

In the Philippines, the eggplant seed system is dominantly formal with private seed companies and government institutions playing a major role in R & D, seed production and quality control, marketing and distribution (Figure 2). The actors are indicated in the boxes, the product [e.g. open-pollinated varieties (OPVs), hybrid seeds] in oval shape, and the processes by lines, with broken lines indicating that the process is optional. The R & D process is illustrated in the upper portion of the diagram, while seed distribution and marketing in the lower half of the diagram. Hybrid seeds are mainly distributed by private seed companies, while OPVs come from both private seed companies and the government institutions (e.g. DA, BPI, and IPB). Based on KIs and FGDs, the informal seed system (at the bottom left portion) is relatively small or limited (about less than 1%) as saving seeds from harvested eggplant fruits is rarely practiced. Saved seeds are based on farmers’
selection and may also be sourced from cultivars coming from the formal system. Likewise, based on KIs and FGDs, 65-75% of eggplant farmers use hybrid seeds; 25-35% use OPV. Almost all farmers buy seeds every planting except those who get free OPV seeds from the LGUs through government programs promoting backyard planting of vegetables.

Research and Development
Private seed companies and the national government are the major institutions involved in R & D of eggplant (Figure 2). Considerations in improvement of varieties include: shelf life of fruits (3-4 days); tolerance/resistance to pests and diseases; yield increase of 10-15%; prolificacy and earliness in fruit setting; plant stand; adaptability; and consumer acceptability. Life span of a variety is 10 years if it sold well in the market.

Three private seed companies, namely: East-West Seed Co. Inc.; Kaneko; and Allied Botanical Corporation have strong R & D program. State Colleges and Universities (SCUs) such as UPLB are engaged in R & D of OPV. However, lack of funding constrains further improvement of OPVs. Breeding takes 5 years and thus, difficult to sustain. There is no native eggplant variety in the Philippines as eggplant originally came from India. Traditional varieties are called as such because they have been used for a long time. Maintenance of traditional variety (i.e. OPV) is important for gene reserves, genetic biodiversity, and germplasm (Rodel Maghirang, Pers Comm).

The IPB of UPLB is currently developing the Bt (Bacillus thuringiensis) eggplant variety resistant to fruit and shoot borer (FSB), one of the major pests of eggplant. Ex-ante assessment on the economic, health and environmental impacts of Bt eggplant have been conducted suggesting the benefits form the new technology (Francisco et al. 2009; Krishna and Qaim 2007).

Regulation
Government agencies with regulatory role in the seed system include BPI and its National Crop Research and Development Centers (NCRDCs), National Seed Quality Control Services (NSQCS) and National Seed Industry Council (NSIC) (Figure 2). Two major policies govern the seed industry in the Philippines: i) Republic Act (RA) No. 7308, also referred to as the Seed Industry Development Act of 1992; and ii) RA No. 9168, known as the Philippine Plant Variety Protection (PVP) Act of 2002. However, these policies state that registration and plant variety protection are voluntary.

Based on RA No. 7308, NSIC approval is based on superior yield, better agronomic characteristics, fruit characteristics, or higher levels of resistance to diseases and insects over the check varieties. Permit to propagate means the material is safe, and there will be no problem in its progeny when it is crossed with other lines. The BPI and NSQCS, and research institutions such as UPLB and PCARRD have significant roles under this Act.

Variety accreditation of eggplant requires that the variety should be as good as or better than a check variety in terms of horticultural characteristics, e.g., 10% higher yield. For national recommendation, field trials of two wet and two dry seasons are needed to compare yields with check variety which must be conducted in a minimum of six locations for 2 years, i.e. 2 in Luzon, 2 in Visayas, and 2 in Mindanao. For regional recommendation, the trials can be conducted in at least two locations for at least two growing seasons. Two OPVs from IPB are registered with NSIC, namely: ‘Mara’ and ‘Mamburao’ in 2007. The SCUs, DA Regional Field Units (RFUs), Regional Integrated Agricultural Research Centers (RIARCs) usually have their seeds registered with NSIC at no cost. The advantage of having the seeds registered is to be able to join government bidding in seed procurement and this could be used in promoting the seed. To the farmers, the advantages of using registered seeds include coverage by crop insurance and access to loans from the Land Bank of the Philippines (LBP) or Quedancor. However, one observation of BPI is that the developers do not opt for seed registration because of the long process...
involved. Instead, seed companies adopt well-established seed production and quality control strategies and vigorous marketing and promotion to improve sales. The IPB also has an in-house registration – Germplasm and Technology Registration and Release Office (GTRRO), and may opt to have the eggplant varieties registered here (Artemio Salazar, Pers Comm).

Under the PVP Act, the breeder also has the option to apply for PVP to acquire exclusive rights over the propagating material so that it cannot be sold without the owner's permission; or to acquire defensive protection, being the first-to-file or the one-and-only developer, to exclude others from producing or using the product without the breeder's permission. Application for PVP requires only planting twice in one location but with more detailed data. For eggplant, breeder's right is valid for 20 years. Hybrid varieties with PVP are 'Domino', 'Morena', and 'Banate King' (all from East West); and 'Mustang' from the Allied Botanical Corporation (Vivencio Mamaril, Pers Comm).

Seed companies also join the Philippine Seed Board Industry Association (PSIA), i.e. established in 1976, to make readily available to the farmers high quality seeds of superior varieties of all economically important crops. The privileges of being a member of PSIA include: guarantee of being a good supplier of high quality seed, joining government bidding in seed procurement, and subsidy by PSIA in techno-demo through High Value Commercial Crops (HVCC) funds.

Policies on the R & D and propagation of genetically modified eggplant are more stringent based on DA Administrative Order No. 8 of 2002. Bt eggplant developed by IPB-UPLB is currently undergoing multi-locational field trials after going through the rigorous application procedures (e.g., risk assessment) involving the Institutional Biosafety Committee (IBC), BPI, the National Committee on Biosafety of the Philippines (NCBP), and the Scientific and Technical Review Panel (STRP). Approval for propagation of Bt eggplant would require further evaluation and risk assessment such as food safety assessment by the Bureau of Agriculture and Fisheries Product Standards (BAFPS), and public consultation.

**Seed Production and Quality Control**

For commercialization, seed companies have their seeds reproduced locally or abroad and repacked in the Philippines. For imported seeds, import permit, currently referred to as plant quarantine clearance (as per BPI AO No. 01 of 2005), must be obtained from BPI.

Local seed production is done through contract growing (e.g. 0.5 ha per contract grower) and the seed company provides foundation seeds and other inputs, and buys the raw seeds, e.g. at PhP650-700 kg⁻¹. The NSF, seed marketing arm of IPB-UPLB, also enters into contract seed growing of OPV eggplant and buys the raw seed at PhP170 kg⁻¹. Procedures for seed production and seed quality management include: isolation distance; proper cultural management; proper timing of harvest; proper processing such as in drying and seed extraction; proper maintenance, e.g. storage 15-18°C temperature; and proper packaging (0.003 mm plastic).

Quality management practices include the following concerns: genetic analysis (e.g. to test if seed is hybrid); seed purity; seed germination rate (must not be lower than 85%); testing before packaging; storage temperature of 10-12°C (the lower the temperature, the longer the shelf life); and packaging with aluminum foil reduces respiration. Shelf life (4-6 months if MC is low) is also important (Rene Rafael Espino, Pers Comm).

**Seed Distribution and Marketing**

Private seed companies dominate the eggplant seed market, having a well-established network and better marketing and promotion campaign than the government sector. In Region IVA for instance, East West dominates with 80% share of the market, while other companies such as Kaneko, Ramgo and Allied, share the remaining 20%. East West has a bigger share of hybrid seeds in the market, while Kaneko has more product lines for OPV.

Major market of OPVs from UPLB includes LGUs, DAR-FUs, and UPLB La Granja Experiment Station in La Carlota, Negros (starting 2010). UPLB cannot meet the demand because of financial and personnel constraints. There are also accredited seed growers in SCUs in Nueva Vizcaya and Cotabato in Mindanao. The BPI also does retail marketing of seeds.

Seed companies also have their own marketing strategies. For example, with term discount, dealers paying within 15 days after delivery get a 5% discount, while payment within 16-30 days have 2.5% discount. Another scheme is volume discount based on Business Pact Agreement (BPA) or on historical value of sales (e.g. over 3 years).

As part of marketing strategies (Figure 2), seed companies provide technical assistance to both farmers and seed dealers, such as training on basic characteristics of the product; company-related policies; cultural management; and identification of pests and diseases and their control. They also provide farmers marketing assistance, e.g. market matching by tying up vegetable wholesalers with growers. They join trade shows (e.g. Agri link), Aral Saka (study tour); training on production; farmers meetings; and conduct of techno-demo with LGUs or directly with farmers.
On the government side, one relevant policy is Republic Act 7900, also referred to as the HVCC Law which promotes the production and marketing of high value crops by providing PhP1 B fund allocation for credit. Eggplant is part of the general program on 20 species of vegetables. The GMA Programang Gulayan para sa Masa provides seeds to farmers and households through the RFUs and LGUs. At the household level, the objective is to improve nutrition through promoting backyard gardening of OPV eggplant. This is also done in partnership with the Department of Education. For commercial production (≥1,000 m² and above), hybrid seeds are distributed to farmers on a 50-50 cost-sharing scheme.

The HVCC Program also provides funding for field trials, demonstration sites, and field days in vegetable growing areas, jointly done with PSIA to give opportunity for seed companies to promote their seeds. The RFUs, through bidding process, also buy from seed companies the seeds they distribute to the farmers. They also provide organic fertilizers and conduct training among households on how to save seeds for sustainability. For commercial production, training on production practices is also conducted.

In the retail market, there are about 30 eggplant varieties with prices based on package weight ranging from 1-1,000 g (Table 1). Despite the suggested retail prices of seeds, actual prices in the market could vary across dealers and locations. Dealers could increase or lower their prices depending on their targets. Dealers also try to avoid left-over seeds as there is a 20% deduction in the amount refunded for seeds returned to seed companies within three months.

**Farmers’ Preference for Eggplant Varieties**

Farmers’ selection of varieties is based on both seed and fruit qualities as well as varietal traits. Criteria in seed selection include: i) seed quality such as viable, undamaged, mature, cleaned, with high germination capacity; ii) locally adapted to their conditions and their purposes (e.g. long fruiting season; good taste); iii) and new or improved and ideally with new characteristics to meet old problems. Qualities of eggplant fruit are based on consumers’ preferences such as: color of the fruit (i.e. purple or green); shape (i.e. cylindrical, oblong, round); size (i.e. long and heavy). Based on retailers’ classification, large (primera) eggplant is 11-12 inches (28-30 cm) long; medium (segunda or semi) is 8-10 inches (20-25 cm), and small (tercera) is below 8 inches (below 20 cm). Weight is based on number of fruits per kilo, e.g. 1 kilo of large eggplant may have 6 pieces (pcs); medium – 8 pcs; and small – 12 pcs. The general preference in the market is the hybrid, purple and elongated eggplant. Farmers also consider other features such as shelf life and transportability (i.e. firmness) of fruit. Varietal traits such as high yield and better resistance to diseases are most important to farmers.

Experts have varying views on the performance of hybrid and OPVs. Some claim that with the same inputs, hybrid seeds have 10-15% higher yield than OPVs, while others say that OPVs can match performance of hybrid. There are also claims that OPV has shorter storability (2 days); delayed maturity; and class B, medium-sized uniformity standard.

There are some variations in preferences by region (Table 2). For example, in the north, green and oval eggplant is preferred, (e.g. Ilocos round green, Aurora round green) mainly for local dishes. A newly released hybrid, ‘Banate King’ with long, purple fruit is exclusive to Mindanao. There are also special (but small) markets such as for green, elongated eggplant in San Juan and Lemery, Batangas; and the Japanese variety in Nueva Ecija. Greenhouse eggplant is grown in Tagaytay City and Baguio City with one plant producing 10 kg with a production life of 10 months.

**Eggplant Production**

**National Trends**

Eggplant production in the Philippines generally increased from 2000 to 2009, and averaged 186,575 mt year⁻¹ despite changes in weather and pest infestation (BAS 2010). In 2000, eggplant production was 166,146 mt, which increased to 200,942 mt in 2009. The top three regions in terms of average production per year were Ilocos Region, CALABARZON and Central Luzon (Figure 3). From 2000 to 2009 the top two producing provinces were Pangasinan and Quezon, while Batangas ranked eighth. These provinces had respective shares of 30, 13, and 2% to the total country’s production in 2009 (Figure 4).

Area planted to eggplant in the country showed an increasing trend from 2000 to 2009 ranging from 19,949 ha in 2000 to 21,170 ha in 2009. Average area planted per year was 20,945 ha, with small farms ranging 0.5-2 ha. The top five regions in terms of area planted were; Ilocos, Central Luzon, Cagayan Valley, Central Visayas, and CALABARZON (Figure 5). Among the provinces, Pangasinan ranked first; Quezon seventh; and Batangas eighth during the 2000-2009 period. In 2009, these provinces ranked first, sixth, and tenth, respectively, contributing 17, 4, and 3% to the country’s eggplant hectarage. Average yield in the country is 9.5 t ha⁻¹. CALABARZON and Ilocos Region remain in the top rank and the performance of SOCCSKSARGEN, with its expansion in area planted is notable.

**Production Environment**

Eggplant is best planted towards the end of the rainy season to coincide with the long dry months to reduce or avoid fruit rotting. Eggplant grows best in temperature ranging 22-32°C. Flower fertilization and yield are significantly reduced at extreme temperatures of ≤15°C and ≥33°C (EPA 2010).
Table 1. Retail price of eggplant seeds, Philippines, 2010.

<table>
<thead>
<tr>
<th>Weight</th>
<th>Hybrid variety</th>
<th>Estimated Price/kg</th>
<th>Open Pollinated Variety</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(PhP/pack)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50 g</td>
<td>632-1,149</td>
<td>12.65 - 22.98</td>
<td>Domino F1 (East West); Morena F1 (East West)</td>
</tr>
<tr>
<td>7 g</td>
<td>35</td>
<td>16.50</td>
<td>Spitfire (ABC); Early bird (ABC)</td>
</tr>
<tr>
<td>3 g</td>
<td>300</td>
<td>42.85</td>
<td></td>
</tr>
<tr>
<td>1 g</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,000 g</td>
<td>5,625</td>
<td>15.00</td>
<td>Mistisa, Dumaguete Long Purple (National Seed Foundation, IPB-UPLB)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Weight</th>
<th>Price range (PhP/pack)</th>
<th>Estimated Price/kg</th>
<th>Variety (Source)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 g</td>
<td>300</td>
<td>3.00</td>
<td>Long purple (ABC)</td>
</tr>
<tr>
<td>50 g</td>
<td>165 - 388</td>
<td>3.30 - 7.76</td>
<td>Long purple (ABC); Claveria Long Purple (Kaneko)</td>
</tr>
<tr>
<td>5 g</td>
<td>60</td>
<td>12.00</td>
<td>Batangas Long Purple (East West)</td>
</tr>
<tr>
<td>3 g</td>
<td>31</td>
<td>10.33</td>
<td>Long purple, long green (Kaneko)</td>
</tr>
<tr>
<td>1 g</td>
<td>49</td>
<td>49.00</td>
<td>Dumaguete Long Purple (Ramgo)</td>
</tr>
</tbody>
</table>

*The price range refers to varieties specified in the last column, but there are 30 varieties within the price range.

Notes: East-West Price effective Jan 15, 2010; Kaneko price effective July 15, 2010.
Exchange rate: US$ = PhP44
Source: Unit Price list of East West and Kaneko; KI of ABC and Kaneko executives; NSF-IPB-UPLB

Table 2. Regional preferences for eggplant varieties in the Philippines.

<table>
<thead>
<tr>
<th>Region</th>
<th>Hybrid</th>
<th>OPV</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAR</td>
<td>Morena, Casino, Banate King, Spitfire, Checkmate, Cluster King, Mustang</td>
<td>Batangas Long Purple and Native</td>
</tr>
<tr>
<td>Region I</td>
<td>Casino 901, Morena, Domino</td>
<td>Dumaguete Long Purple, Pepito OPV, Mayumi OPV, Aurora Round Green</td>
</tr>
<tr>
<td>Region II</td>
<td>Morena, Casino, Gwapito</td>
<td>Batangas Long Purple, Dumaguete Long Purple, Long Violet, Aurora Green, Liwit</td>
</tr>
<tr>
<td>Region III</td>
<td>Morena, Casino, Gwapito</td>
<td>Long Purple</td>
</tr>
<tr>
<td>Region IVA</td>
<td>Casino, Morena</td>
<td>Batangas Long Purple, Dumaguete Long Purple</td>
</tr>
<tr>
<td>Region IVB</td>
<td>Casino, Morena</td>
<td>Long Purple</td>
</tr>
<tr>
<td>Region V</td>
<td>Morena, Casino</td>
<td>Batangas Long Purple</td>
</tr>
<tr>
<td>Region VI</td>
<td>Casino 901</td>
<td>Batangas Long Purple, Fond May</td>
</tr>
<tr>
<td>Region VII</td>
<td>Casino, Morena, Spitfire, Jackpot</td>
<td>Long Purple, Batangas Long Purple</td>
</tr>
<tr>
<td>Region VIII</td>
<td>Morena, Casino</td>
<td>Batangas Long Purple, Señoríta</td>
</tr>
<tr>
<td>Region IX</td>
<td>F1 Sikat, Casino, Banate King</td>
<td>Fond May, Sarangani Long Purple, Bulakena</td>
</tr>
<tr>
<td>Region X</td>
<td>Casino, Morena</td>
<td>Batangas Long Purple, Claveria Long Purple, Dumaguete Long Purple, American Beauty</td>
</tr>
<tr>
<td>Region XI</td>
<td>Morena, Casino, Banate King</td>
<td>Dumaguete Long Purple, American Beauty</td>
</tr>
<tr>
<td>Region XII</td>
<td>Banate King</td>
<td>Dumaguete Long Purple, American Beauty</td>
</tr>
<tr>
<td>Region XIII</td>
<td>Banate King and Casino</td>
<td>Claveria Long Purple, Dumaguete Long Purple, American Beauty</td>
</tr>
<tr>
<td>ARMM</td>
<td>Banate King, Morena, Casino, F1 Sikat</td>
<td>Batangas Long Purple, American Beauty</td>
</tr>
</tbody>
</table>

Source: DA-High Value Commercial Crop Regional Coordinators

Figure 3. Top eggplant producing regions, 2000-2009

Figure 4. Top eggplant producing provinces, 2000-2009
The AR Chupungco et al.

Farmers in Sta. Maria Commercial growers adopt hybrid seeds which they purchase from seed dealers. Farmers in Sta. Maria received technical assistance, given opportunities to attend trainings, and update on farm production. Among the production inputs, farmers spend 41% for pesticides, 16% for fertilizer, and 1% for seeds (Figure 6).

With yields ranging 21.6-27.5 t ha⁻¹, and farm prices ranging from PhP10-20 kg⁻¹, net income range from PhP76,482 in Sta. Maria (lower than the national average of PhP160,551 ha⁻¹) to PhP264,530 in Tanauan (higher than the national average (Table 3). Also shown in Table 3 are the costs and returns of eggplant production estimated by Maghirang et al. (2007), where net income in 2007 was PhP160,551 ha⁻¹, 21% lower than the average net income for the three study sites in crop year 2009-2010. However, the average yield for the three study sites was 62% higher than the yield in 2007. This could be attributed to the improvement in yield due to introduction of new varieties.

Production problems cited were mainly the fruit and shoot borers (which may cause a 30% reduction in yield if left uncontrolled) and bacterial wilt. Other problems include fruit fly and water supply particularly in upland areas.

Eggplant Marketing
Market players
Aside from the farmers, the major players in the eggplant market were the assembler-wholesaler-retailers (AWRs), wholesaler-retailers (WRs), and retailers.

The AWRs are those who procure eggplant from several growers and sell them regularly in large volume outside or inside the province, but may also do retailing activities. Some of them are also eggplant growers.

The WRs, on the other hand, usually have permanent stalls in public markets or major trading centers, and sell either in bulk or small quantities to retailers and household consumers. Retailers sell small quantities of eggplant to consumers and operate either at the roadside or occupy stalls in public markets. The general product flow was: farmers → AWRs → WRs → consumers. From the WRs, the eggplant goes to retailers and consumers.

Trends in Farm, Wholesale, and Retail Prices of Eggplant
National trends. Based on the data available from BAS on farm, wholesale, and retail prices were only

Costs and Returns of Eggplant Production
Commercial growers adopt hybrid seeds which they purchase from seed dealers. Farmers in Sta. Maria used 2 cans per ha (50 g per can) of 'Morena' or 'Checkmate'; Tiaong, 3 cans of 'Morena'; and Tanauan, 4 cans of 'Casino' or 'Morena'. Hence, the cost of seeds per ha was lowest in Sta. Maria (PhP1,740), and highest in Tanauan (PhP3,600) (Table 3). However, costs of pesticides and labor in pesticide application was highest in Sta. Maria with PhP113,160, with 1-2 sprays daily; and lowest in Tanauan with PhP43,200 per ha, with weekly spraying. In Tiaong, once the harvesting stage starts, application is done every 4 days. Among the production inputs, farmers spend 41% for pesticides, 16% for fertilizer, and 1% for seeds (Figure 6).

Recommended soil type is deep sandy loam and clay loam with moderate moisture supply, high fertility (Agri-Center 2008), and a soil pH of 5.5-6.8 (Chen and Li 2008).

The FSB damage is considered the most serious for eggplant production because yield losses could be 51-73% (Hautea and Narciso 2007). Thus, spraying chemical pesticides is done every other day (once harvesting starts) which accounts for 24-25% of production cost (ABSP II; Paredes 2005). Meanwhile, losses in eggplant production due to bacterial wilt was estimated at 15% in Batangas, 40% in Nueva Ecija, and 30% in Pangasinan in 1998 (IPM CRSP 2007). The use of IPM strategy in Bangladesh and India for the control of FSB in eggplants with different methods consisting of resistant cultivars, sex pheromone, cultural, mechanical and biological control (Srinivasan 2008) increased profit margins and production area and reduced pesticide use and labor requirements. Thus, the use of IPM technology among eggplant growers will be upscaled to other regions of South and Southeast Asia, including the Philippines and Nepal.

Institutional Linkage
In the study sites, eggplant growers have linkage with the LGUs, particularly the HVCC Coordinator, Provincial and Municipal Agriculturists, private seed companies and other local organizations. Farmers receive technical assistance, given opportunities to attend trainings, and update on farm production. There are also vegetable growers associations such: i) Quezon Vegetable Industry Council that monitors production and identifies needs of vegetable industry; ii) and Tiaong Farmers' Multi-purpose Cooperative that provides pesticides and fertilizer loans. In Pangasinan, there is the newly organized vegetable growers' association Kabalikat ng Samahang Maggugulay at Magpuputas Cooperative (KASAMA).

Costs and Returns of Eggplant Production
Commercial growers adopt hybrid seeds which they purchase from seed dealers. Farmers in Sta. Maria

Figure 5. Trends in area planted to eggplant in ha by region, 2000-2009

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The FSB damage is considered the most serious for eggplant production because yield losses could be 51-73% (Hautea and Narciso 2007). Thus, spraying chemical pesticides is done every other day (once harvesting starts) which accounts for 24-25% of production cost (ABSP II; Paredes 2005). Meanwhile, losses in eggplant production due to bacterial wilt was estimated at 15% in Batangas, 40% in Nueva Ecija, and 30% in Pangasinan in 1998 (IPM CRSP 2007). The use of IPM strategy in Bangladesh and India for the control of FSB in eggplants with different methods consisting of resistant cultivars, sex pheromone, cultural, mechanical and biological control (Srinivasan 2008) increased profit margins and production area and reduced pesticide use and labor requirements. Thus, the use of IPM technology among eggplant growers will be upscaled to other regions of South and Southeast Asia, including the Philippines and Nepal.

Institutional Linkage
In the study sites, eggplant growers have linkage with the LGUs, particularly the HVCC Coordinator, Provincial and Municipal Agriculturists, private seed companies and other local organizations. Farmers receive technical assistance, given opportunities to attend trainings, and update on farm production. There are also vegetable growers associations such: i) Quezon Vegetable Industry Council that monitors production and identifies needs of vegetable industry; ii) and Tiaong Farmers' Multi-purpose Cooperative that provides pesticides and fertilizer loans. In Pangasinan, there is the newly organized vegetable growers' association Kabalikat ng Samahang Maggugulay at Magpuputas Cooperative (KASAMA).

Costs and Returns of Eggplant Production
Commercial growers adopt hybrid seeds which they purchase from seed dealers. Farmers in Sta. Maria used 2 cans per ha (50 g per can) of 'Morena' or 'Checkmate'; Tiaong, 3 cans of 'Morena'; and Tanauan, 4 cans of 'Casino' or 'Morena'. Hence, the cost of seeds per ha was lowest in Sta. Maria (PhP1,740), and highest in Tanauan (PhP3,600) (Table 3). However, costs of pesticides and labor in pesticide application was highest in Sta. Maria with PhP113,160, with 1-2 sprays daily; and lowest in Tanauan with PhP43,200 per ha, with weekly spraying. In Tiaong, once the harvesting stage starts, application is done every 4 days. Among the production inputs, farmers spend 41% for pesticides, 16% for fertilizer, and 1% for seeds (Figure 6).

With yields ranging 21.6-27.5 t ha⁻¹, and farm prices ranging from PhP10-20 kg⁻¹, net income range from PhP76,482 in Sta. Maria (lower than the national average of PhP160,551 ha⁻¹) to PhP264,530 in Tanauan (higher than the national average (Table 3). Also shown in Table 3 are the costs and returns of eggplant production estimated by Maghirang et al. (2007), where net income in 2007 was PhP160,551 ha⁻¹, 21% lower than the average net income for the three study sites in crop year 2009-2010. However, the average yield for the three study sites was 62% higher than the yield in 2007. This could be attributed to the improvement in yield due to introduction of new varieties.

Production problems cited were mainly the fruit and shoot borers (which may cause a 30% reduction in yield if left uncontrolled) and bacterial wilt. Other problems include fruit fly and water supply particularly in upland areas.

Eggplant Marketing
Market players
Aside from the farmers, the major players in the eggplant market were the assembler-wholesaler-retailers (AWRs), wholesaler-retailers (WRs), and retailers.

The AWRs are those who procure eggplant from several growers and sell them regularly in large volume outside or inside the province, but may also do retailing activities. Some of them are also eggplant growers.

The WRs, on the other hand, usually have permanent stalls in public markets or major trading centers, and sell either in bulk or small quantities to retailers and household consumers. Retailers sell small quantities of eggplant to consumers and operate either at the roadside or occupy stalls in public markets. The general product flow was: farmers → AWRs → WRs → consumers. From the WRs, the eggplant goes to retailers and consumers.

Trends in Farm, Wholesale, and Retail Prices of Eggplant
National trends. Based on the data available from BAS on farm, wholesale, and retail prices were only
Table 3. Costs and returns (PhP/ha) of eggplant production by study site, Philippines, crop year 2009-2010.

<table>
<thead>
<tr>
<th>Item</th>
<th>Tiaong</th>
<th>Tanauan</th>
<th>Sta. Maria</th>
<th>Philippines 2007*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Costs (PhP)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seeds</td>
<td>2,700</td>
<td>3,600</td>
<td>1,740</td>
<td>2,550</td>
</tr>
<tr>
<td>Fertilizer and labor in application</td>
<td>39,750</td>
<td>36,430</td>
<td>22,070</td>
<td>33,050</td>
</tr>
<tr>
<td>Pesticides and labor in application</td>
<td>89,870</td>
<td>43,200</td>
<td>113,160</td>
<td>10,000</td>
</tr>
<tr>
<td>Other costs (e.g., land preparation, other labor costs)</td>
<td>105,600</td>
<td>84,240</td>
<td>61,548</td>
<td>75,660**</td>
</tr>
<tr>
<td>Total production cost (PhP)</td>
<td>237,920</td>
<td>167,470</td>
<td>198,518</td>
<td>121,260</td>
</tr>
<tr>
<td>Yield (kgs)</td>
<td>24,000</td>
<td>21,600</td>
<td>27,500</td>
<td>15,000</td>
</tr>
<tr>
<td>Price/kg</td>
<td>15-20</td>
<td>15-20</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>Gross Revenue (PhP)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At price of PhP10/kg</td>
<td>-</td>
<td>-</td>
<td>275,000</td>
<td>-</td>
</tr>
<tr>
<td>At price of PhP15/kg</td>
<td>360,000</td>
<td>324,000</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>At price of PhP20/kg</td>
<td>480,000</td>
<td>432,000</td>
<td>-</td>
<td>300,000</td>
</tr>
<tr>
<td>Net Income (PhP)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At price of PhP10/kg</td>
<td>-</td>
<td>-</td>
<td>76,482</td>
<td>-</td>
</tr>
<tr>
<td>At price of PhP15/kg</td>
<td>122,080</td>
<td>156,530</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>At price of PhP20/kg</td>
<td>242,080</td>
<td>264,530</td>
<td>-</td>
<td>160,551</td>
</tr>
</tbody>
</table>

*Source: Maghirang, et al. (2007)
**Includes all labor and other costs

Figure 6. Average percent share of cost of production inputs to total production costs, all study sites, 2009-2010.

Figure 7. Trends in average monthly farmgate, wholesale and retail prices of long purple eggplant, per kg, Philippines Jul 2009 – Jun 2010.

for the Long Purple variety, an OPV. During the 2000-2009 period, farm prices in the Philippines generally rose from PhP10.58 to PhP16.50 kg⁻¹; wholesale prices, ranging PhP13.30-23.80 kg⁻¹; and retail prices ranging PhP22.20-35.00 kg⁻¹. Average price margins for the 10-year period were PhP4.61 between farm and wholesale prices, PhP9.72 between wholesale and retail prices, and PhP14.33 between farm and retail prices. Monthly farm, wholesale and retail prices have similar trends, highest in the months of October to December and January, and lowest from March to August (Figure 7).

Prices in the study areas. Prices of eggplant are based on the prevailing market price, and can change within the day depending on the interaction of supply and demand forces in the market. Farmers or traders can quote the price but they can also negotiate. Retailers dictate the price to consumers, while AWRS/WRs dictate the price to retailers. Calling or sending messages using cellular phones is very useful in making market deals between farmers and traders. No discounts are given even if volume of eggplant bought is large. Farmers are paid mostly in cash. If picked-up on credit, the buyer has to pay the farmer at least one-fourth of the total amount in cash, and the rest would have to be given in the next harvest which

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Eggplant seed system, production and market
is 3-4 days after. The WRs pay the AWRs most oftentimes in cash; and some suki in 1-2 days after getting the eggplant. Retailers usually pay the WRs in cash.

In Tiaong, farm prices could range PhP2-30 kg⁻¹ over the year. Eggplant is classified into first class which costs PhP25-30 kg⁻¹; second class, PhP10 kg⁻¹; and third class or rejects. In San Pablo, one of the outlets of Tiaong farmers, farm price during regular days is PhP20 kg⁻¹ for first class; PhP10 for second class; and PhP5 for rejects. Wholesale price is PhP25 for first class; PhP15 for second class and PhP10 for rejects and retail price is PhP30 for first class; PhP20 for second class; and PhP15 for rejects. If supply is low, farm price is PhP60 kg⁻¹; wholesale price is PhP70; and retail price is PhP80 "for good" eggplant. If supply is high, a "good" eggplant is sold at PhP5 kg⁻¹ at the farm level, PhP7.50 on wholesale, and PhP10 on retail.

In Tanauan, farm price per kg could range PhP2-35 averaging PhP20. If farm price is PhP10-12 kg⁻¹, wholesale price would be PhP15 kg⁻¹. After Typhoon Ondoy in September 2009, farm price ranged from PhP6 kg⁻¹ in June to PhP40 kg⁻¹ in September. Wholesale price ranged PhP10-50 kg⁻¹. Over a year, wholesaler-retailer price could range PhP10-50 kg⁻¹ and retail price at PhP15-80.

In Pangasinan, retail price per kg ranges PhP10-40 for the 'Morena' variety, and PhP20-60 for the native varieties. There is about PhP3-5 kg⁻¹ price difference between farm price and wholesale price and about PhP5 kg⁻¹ between wholesale and retail prices. In Divisoria, Manila, retail price of eggplant in 2009 ranged PhP20-80 kg⁻¹. Manila retailers usually add a mark-up of PhP5 kg⁻¹ if price is low, and about PhP10 kg⁻¹, if there is shortage in the supply and their buying price is high.

**Market Channel in the Study Areas**

Metro Manila is the major market of eggplant in the study areas. Particularly in Divisoria, eggplant also comes from other provinces, e.g. Bulacan and Nueva Ecija.

**Tanauan, Batangas.** The Tanauan Public Market is one of the major trading centers for eggplant in Batangas and the adjacent provinces of Quezon, Oriental Mindoro and Laguna. Tanauan farms produce 30% of the supply in the market, 42% come from the province of Quezon (Tiaong, Sariaya, and Candelaria); 21% from Oriental Mindoro; and 7% from Laguna (e.g. San Pablo City). About 85% of the traded eggplant in the Tanauan Public Market are transported to Metro Manila, with about 5% going to Pampanga and Bulacan, while the remaining 15% goes to the local market and the adjacent provinces.

There are about 60 retailers and 20 AWRs/WRs (coming from Tiaong, San Pablo, Cavite, Pasig, Pampanga and Bulacan) in the Tanauan Public Market. They get their supply from the AWRs/WRs in the trading post in Tanauan that handles about 0.5-2.5 mt daily. Around 85% of the volume is being sold at wholesale.

Some AWRs have been providing financial support to farmers in the amount of PhP20,000-40,000 per farmer, in addition to the seeds and fertilizer which are given in kind per cropping season. This is being done in exchange of a sure supply of eggplant from these farmers.

**Tiaong, Quezon.** In Tiaong, mostly AWRs pick up the eggplant from the farms. There is also a trading post in nearby town of Sariaya. Market outlet includes Divisoria (50%), Tanauan (25%), and San Pablo (25%) wet markets. The local market gets less than 1% of the market volume. In San Pablo market, there are about 25 AWRs/WRs and 50 retailers of eggplant, some of whom were in the business for 7-20 years.

**Pangasinan.** In Pangasinan, 75% are marketed to Metro Manila (Divisoria, Balintawak), 15% to the local market, and the rest to Ilocos and Baguio. About 70% handled by the AWRs, and 30% by retailers. During the months of November to January, the province of Isabela procures eggplant from Pangasinan, but it is the latter that procures eggplant from the former during the month of February.

Villasis, Pangasinan is one major market of eggplant. There are about 10 WRs and 40 retailers of eggplant, some of whom were already 14-20 years in the business. The WRs usually handle 100 kg or more, while retailers handle about 10-40 kg daily. About 60% of the eggplant sold is the 'Morena' and 40% is OPV (e.g. 'Palupalo', 'Baginay').

**Transport Cost and Market Fees**

In Tiaong, trucking cost or jeepney rental per trip of 3,000 kg-load is PhP3,500 to Divisoria, PhP1,500 to Tanauan, and PhP1,000 to San Pablo. Transport losses could be around 20 kg per trip. The barangay unit also collects a PhP10 fee per jeepney load. In San Pablo market, one of Tiaong's outlets, one cart of vegetables is charged a market fee of PhP10 per ticket per day.

Tanauan farmers did not incur any marketing cost as traders provide the plastic bags and pick up the eggplants from their farms. But for market fees, a vegetable retailer has to pay PhP350 per jeepney load or PhP2 ticket per bundle of 10 kg of eggplant, and PhP1,500 mo⁻¹ for the stall which may include other vegetables.
From Pangasinan, the cost of transporting eggplant to Divisoria is PhP0.20 kg⁻¹. Market fee is PhP20 day⁻¹ for all the commodities handled. Since eggplant is only about one-tenth of all commodities handled, retailers pay only PhP2 market fee for handling eggplant. No marketing problems were cited except that about 5% of the volume handled go to waste if demand is low.

**Other Marketing Concerns**
The major marketing problem reported by farmers and traders is the low market price of eggplant during peak season when there is an oversupply. On the other hand, some traders also experience supply shortage particularly during the dry season; and quality is affected, e.g., occurrence of hardened portion due to lack of water, and dark-colored seeds. But if there is shortage of eggplant, even rejects (those with holes) can be sold in the market. There is usually no wastage as some retailers sell 75% of **segunda** or "semi" and 25% rejects. During high supply, rejects sold is reduced to 20%, and to 5% during regular days.

Deterioration of quality of eggplant due to transport is another concern of sellers. Losses due to transport could account for 10-20% of the total volume handled.

**CONCLUSIONS AND RECOMMENDATIONS**

Eggplant remains to be an important vegetable crop in the Philippines accounting for around 28% of the total volume of vegetable production. Trends in production, area and yield are increasing for the past 10 years (2000-2009). In the study sites, eggplant ranked from first to third among the vegetables grown, generating net incomes of PhP76,482-264,530 ha⁻¹.

The eggplant seed system is generally a formal or organized system, where both public and private sectors have well-established seed production, quality control techniques and distribution schemes. Commercial growers generally use hybrid seeds produced by private seed companies, being high yielding and with good marketing qualities. The OPVs are mainly used for small-scale production and government seed dispersal programs.

There are over 30 varieties in the seed market. Only two varieties developed by UPLB are registered with NSIC and four varieties have PVP. One observation of BPI is that variety developers do not opt for seed registration because of the rigorous process involved. Instead, seed companies adopt stringent seed quality management and strengthen their promotional campaign and market linkage. Since the private seed companies dominate the eggplant system, the government must strengthen its linkage with them in order to learn, share or exchange technological and marketing innovations. Since seed registration is a voluntary process, the government, being a regulatory entity, should monitor quality control practices of seed companies to avoid 'fly-by-night' seed suppliers.

The major farm production problems cited were the FSBS, fruit fly, and bacterial wilt disease. One emerging concern is the heavy application of pesticides in the study areas, i.e. weekly in Tanauan, every 4 days in Tiaong, and 1-2x a day in Pangasinan. This should call the attention of Local Government Units which are in the forefront of providing extension services. There should be training on Integrated Pest Management, and use of alternative pest control strategies, e.g., intercropping with other crops. For instance, Maghirang et al. (2007) advised that aromatic crops like ginger, basil, and lemongrass should be planted to repel insect pests while flowering plants like Sunflower, Cosmos, and Zennia should be grown as border rows to attract beneficial insects. Moreover, fruits and shoots damaged by borers should be removed and burned while egg masses of these borers found on the underside of the leaves should be gathered and destroyed.

Research and development should continuously receive adequate support to address these concerns. R & D thrusts could include varietal improvement of eggplant and safer pest control technologies. If Bt eggplant seeds would be commercialized, dependence of farmers on pesticides would be greatly reduced. Although its release would require rigid tests and procedures, monitoring the socio-economic and environment impact of its use should be sustained over the years. Also, development of drought tolerant varieties should be pursued to address water supply problem particularly in rainfed areas.

The main marketing problem reported was the low market price of eggplant during times of oversupply, thus raising the need to put up a processing center for eggplant in the area. Since eggplant is a highly traded commodity, a supply chain study of eggplant should also be explored to determine inefficiencies in the market and make the industry more profitable and sustainable.

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LITERATURE CITED


