Development of protected cultivation for vegetables in Indonesia

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Vegetable:
- considered as one of the sub-sector that accountable to obtain the long-range objective of agricultural development in Indonesia
- good sources of carbohydrates, protein, vitamin and minerals

However:
- Vegetable consumption in Indonesia is still low
- In 2014, vegetable consumption was 40 kg per capita per year
- FAO recommendation is 65 kg per capita per year

With the increase of urbanization, population growth and income, demand for vegetable is expected to increase substantially during the coming decades
- Demand of fresh vegetables was estimated to increase from 5.6 million ton in 2000 to 8.3 million ton in 2013
- Based on the figure, there is still an opportunity for increasing of vegetable production in Indonesia

In Indonesia, most of vegetable crops are grown in the open field
- The tropical climate condition allows the production of vegetables throughout the year

However, vegetable growing in the open field, faces many problems......

In rainy season, vegetable growing is severely hampered by heavy rainfall. The climate condition in the rainy season cause the development of many diseases

In dry season, the vegetable growing will be affected by strong wind and also pests, which are usually developed in dry season
- Other problem: Impacts of climate change
  - The significant impacts includes a decrease in productivity and quality
  - Climate change has caused changes in season and rainfall
  - Due to the changes of seasons, farmers have to shift the time of planting and in many cases farmers failed to harvest

- Protected cultivation is a technique of vegetable growing that may alleviate many of the problems related to vegetable growing in the open field
  - This technique comprises every form of physical protection of the plant, with the primary goal of controlling climate factors, which are detrimental to the development of the plant
  - Advantages:
    - higher yields
    - better product quality
    - extended harvest period
    - reduction of fertilizer & pesticide use

- There is an increase demand for vegetable products, which are cultivated under protected cultivation
  - This is due to the better quality of the products compared to those produced in the open field

- However, the availability of the quality vegetable products has not been able to meet the needs of consumers
  - This is due to the production of vegetables under protected cultivation are still very limited and underdeveloped

- In some areas of West Java, vegetable growing under protected cultivation has been practiced for several years since 1990’s
  - However, the development of vegetable growing under protected cultivation is still very slow since then

- Research collaboration between Indonesia and the Netherlands (Hortin Project) had been initiated research and development activities on vegetable growing under protected cultivation
  - Exploratory survey and workshop conducted in 2003 indicated that compared to other vegetable crops, sweet pepper was the main vegetable cultivated under protected cultivation
• In Indonesia, a plastic house made from bamboo is the common standard structure used by most farmers

• Bamboo is relatively cheap material and easily available in most of areas in Indonesia

• However, the bamboo plastic house is considered has a heavy structure that reduce a lot of light intercepted in the plastic house therefore also reducing the yields of crops grown under this structure

• The new structure of greenhouse i.e. wood-metal plastic house of which the supporting poles were made from wood and the roof construction was made from metal

• Plastic house construction affected the light intensity and temperature in the plastic house

• Research results to compare two types of plastic houses indicated that the wood-metal type plastic house intercepted 12.6% of light higher than that in the traditional bamboo plastic house

<table>
<thead>
<tr>
<th>Plastic house</th>
<th>Yields</th>
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<tbody>
<tr>
<td></td>
<td>2004 (kg/plant)</td>
</tr>
<tr>
<td>Bamboo</td>
<td>3.42</td>
</tr>
<tr>
<td>Wood-metal</td>
<td>3.88</td>
</tr>
</tbody>
</table>

• Investment of wood-metal PH is higher than bamboo PH, but lifetime of wood-metal PH is two times longer than bamboo PH

• Production cost in wood-metal PH = in bamboo PH

• Net-income in wood-metal PH > 50% higher than in bamboo PH

• Both plastic houses could not withstand from the strong wind
Due to the higher temperature inside the plastic house, a modification was made to reduce the temperature with putting a ventilation on top roof. However, the difference of temperature was not significant between the two types of plastic houses.

- The higher quality type of plastic house used by limited big farmers is made from metal.

- Other types of structure used by some farmers include netting house.
- Reduced the pesticide application.

Irrigation system & nutrition application

- In general, the farmers used manual irrigation using plastic hose.
- Simple drip irrigation was introduced to these sweet pepper farmers.
- The simple drip irrigation introduced to the farmers could increase the water use efficiency compared to the manual irrigation.

- The cost of production per plant using the drip irrigation system is higher compared to that of the manual irrigation system (US$ 0.84 vs. US$ 0.67).
- But because the yields of sweet pepper per plant using the drip irrigation system is higher than that with the manual irrigation system (2.19 kg vs. 1.98 kg), the return of the system using drip irrigation is better than that of the manual irrigation system.

Rain shelter:

- Higher yields and better quality.
Effect of stem population on the yields of sweet pepper (2005)

<table>
<thead>
<tr>
<th>Stem population</th>
<th>Yields (kg/m²)</th>
<th></th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Class A</td>
<td>Class B</td>
<td>Total</td>
<td></td>
</tr>
<tr>
<td>6.7 stems/m²</td>
<td>5.53</td>
<td>0.94</td>
<td>6.83</td>
<td></td>
</tr>
<tr>
<td>8.3 stems/m²</td>
<td>6.66</td>
<td>1.20</td>
<td>8.30</td>
<td></td>
</tr>
</tbody>
</table>

Effect of system/technique of side shoot pruning and fruit selection:
- a) Conventional system (the technique mostly used by farmers)
- b) Introduction system/technique

Effect number of stem per plant:
- 2 stems/plant:
- 3 stems/plant:
- 4 stems/plant:

Effect number of stem per plant in four sweet pepper varieties:

<table>
<thead>
<tr>
<th>No. stem per plant</th>
<th>Total yield (kg/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6 month</td>
</tr>
<tr>
<td>2 stems</td>
<td>9.6</td>
</tr>
<tr>
<td>3 stems</td>
<td>10.2</td>
</tr>
<tr>
<td>4 stems</td>
<td>10.3</td>
</tr>
</tbody>
</table>
IPM on sweet pepper cultivation:

- In order to reduce the pesticide application, biological controls of thrips using a predatory mite (*Amblyseius swirskii*) and a predatory bug (*Orius laevigatus*) were introduced.
- However, only *A. swirskii* could survive under the tropical plastic house condition.
- This predator could reduce the thrips population in the plastic house and reduce the pesticide application by 35%.

Other pest control strategy disseminated to farmers was the spraying technique. The recommended spraying technique could reduce the insecticide application by reducing spraying volume and increase the effectiveness in controlling the insect pests.

Conclusions

- Many farmers practiced the protected vegetable cultivation; however, the development for protected cultivation are still limited.
- High cost for greenhouse investment has led farmers to use simple plastic house constructed with bamboo.
- However, the simple bamboo greenhouse has many disadvantages i.e. reduced light transmission, increased temperature, and relatively short life span.

Although new structure has been introduced but the use of this new structure is still very limited.
- Attention needs to be given to improving the greenhouse structure adaptive and appropriate to farmer needs and tropical climate conditions.
- Several areas still need to be developed include innovative production systems, selection of varieties, improved cultural practices, integrated soil and water management, and IPM.
- Other areas related to supply chain include packaging, storage, processing, distribution and marketing.

Thank you