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**and Sub-tropical Horticultural Crops**

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# Research and Development on Horticultural Crops in Indonesia

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## Abstract

The objectives of Indonesian horticulture research and development is encourage horticulture agribusiness to increase horticultural product competitiveness, capable to provide employment, increasing farmers' income, to strengthen the region's economy and support growth of national income. In the last five years, increasing of Indonesian horticulture import average 21,63% for fruit and 14,97% for vegetables. Vegetable production areas in Indonesia are mostly located in the low land (<450 m above sea level). Total harvested area for highland is 36,44% from the total of vegetable area, however the highland area contribute 51,16 % from total vegetable production. The focus of research issues are on Variety and Seed Production, Agricultural Machinery and Equipment, Post Harvest, Crop Management and Cultivation, Pest and Disease Control, Policy Analysis and Recommendations, and Germplasm Database. Agribusiness Development Center (ADC), is the appropriate extension service model for Indonesian horticulture agribusiness. Future strategy program for Indonesian Horticulture are Developing Region, Product Quality Improvement, Plant Protection System Strengthening, Strengthening Seed System, Institutional Strengthening, Post Harvest Handling, Acceleration Access Funding and Partnership, Dissemination of Horticultural Product.

Key word: horticulture, Indonesia, fruit, vegetable, floriculture, medicinal plant.

## Introduction

Horticulture development has contributed for the agricultural sector and the national economy, which can be seen from the value of the Gross Domestic Product (GDP), the number of households rely on income from horticulture sub-sector, employment and improved incomes. Horticulture development also increase the value and volume of international trade on horticultural products and the availability of food sources for society.

Development of horticulture at various centers and regions has been facilitated by the government through various programs and activities with funds from the center government (APBN) and local (APBD), and the support of the people (farmers and private). The objectives of horticulture development is encourage horticulture agribusiness to increase horticultural product competitiveness, capable to provide employment, increasing farmers' income, to strengthen the region's economy and support growth of national income.

Development of horticulture in the perspective of the new paradigm not only focused on increasing crop production only but also related to broad strategic issues in the development. Development of horticulture is an integral part of the effort: 1) Protecting the environment, job creation, and increased revenue, 2) Attractive for small and medium scale investment, 3) Control of inflation and price stabilization strategic commodities (chili and shallot), 4) Preservation and development of national identity (orchids, herbs, etc.), 5) Improved food security through the provision of alternative carbohydrate, and 6) Supporting the development of the tourism sector

Horticultural commodities also have high economic value, so the horticulture agribusiness (fruit, vegetables, floriculture, and medicinal plants) can be a source of income for communities and small, medium, and large-scale farmer, because it has advantage of high selling value, diversity, availability of land and technology resources, and the potential of domestic market and increasing of international market. Product supply from national horticulture geared to meet the needs of domestic consumers, whether through traditional and modern market, as well as the overseas market (export).

Some problems still faced by horticultural businesses include: low productivity, scattered locations, small business scale and yet efficient, policy and regulation banking, transportation, exports and imports have not fully supports the national horticultural agribusiness. This led to a national horticultural products are less able compete with horticultural products originating from other countries. Therefore, to increase the contribution of horticulture sub-sectors in the future required the support of all parties in Integrated appropriate duties and functions.

### **Current Situation of Indonesian Horticulture**

Program target of Indonesian horticulture development in 2012 is increasing in crop production, productivity, product quality and safety, and product competitiveness. Increasing in production area, crop manajemen, and post harvest handling is needed for fruit, vegetable, floriculture, and medicinal plant. Production target for Indonesian Horticulture in the year of 2012 is presented in Table 1.

Tabel 1. Production Target for Indonesian Hortikultura in the Year of 2012

	<b>Comodities</b>	<b>Production</b>
<b>a. Fruit</b>		
1	Citrus (ton)	2.138.688
2	Manggo (ton)	2.351.473
3	Mangosteen (ton)	102.361
4	Durian (ton)	766.150
5	Banana (ton)	6.399.335
6	Other fruit tree/shrubs (ton)	3.705.287
7	Annual fruit/vein (tons)	762.001
8	Other fruit/terna(tons)	2.445.805
	<b>Total Fruit (tons)</b>	<b>18.671.100</b>
<b>b. Vegetable</b>		
	<b>Comodities</b>	<b>Production</b>
1	Chili (tons)	1.423.500
2	Shallot (tons)	1.122.000
3	Potato (tons)	1.128.100
4	Mushroom (tons)	67.100
5	Other tuber vegetable (tons)	494.600
6	Leavy Vegetable (tons)	3.313.100
7	Other Vegetable fruit (tons)	4.043.500
	<b>Total Vegetable (tons)</b>	<b>11.591.900</b>
<b>c. Medicinal Plant</b>		
	<b>Comdities</b>	<b>Production</b>
1	Ginger (tons)	28.903
2	Other Medicinal Plant Rhizome (tons)	351.636
3	Medicinal Plant non Rhizome (tons)	73.625
	<b>Total Medicinal Plant (tons)</b>	<b>454.200</b>
<b>d. Floriculture</b>		
	<b>Comodities</b>	<b>Production</b>
1	Orchid (stalk)	14,948,699
2	Chrysanthemum (stalk)	201 368 750
3	Flowers and other ornamental leaves (stems)	215 205 222
4	Containerized Plant (tree)	15,711,863
5	Jasmine (kg)	23,943,123

Tabel 2. Production, Import and Export Value of Indonesian Fresh Vegetables 2011

No	Komodities	Value (US \$)			% Value Import/ Product value
		Production	Import	Export	
1	Garlic	8.505.038	235.656.613	52.493	2.770,79
2	Shallot	523.452.481	72.283.013	3.021.622	13,81
3	Potato	655.657.190	35.038.244	2.068.066	5,34
4	Carrot	216.096.119	14.887.204	11.525	6,89
5	Chili	1.274.739.584	6.710.401	1.482.072	0,53
6	Mushroom	91.910.050	1.124.589	989.083	1,22
7	Cabbage	2.082.470.230	846.449	4.970.137	0,04
8	Cauliflower	116.843.087	219.097	882	0,19
9	Tomatoes	3.882.609.990	74.132	565.967	0,002
10	Cucumber	965.923.210	42.591	40.282	0,004
11	Eggplant	599.684.848	116	883.678	0,00002
12	Other vegetable	1.592.921.059	29.309.824	3.685.213	1,84
<b>Total</b>		<b>12.010.812.885</b>	<b>396.192.273</b>	<b>17.771.020</b>	<b>3,30</b>

In the last five years, increasing of Indonesian horticulture import average 21,63% for fruit and 14,97% for vegetable. Fruit and vegetables import value was 17,61 trillions IDR, higher than rice import of 10,6 trillions IDR, soybean (9,38 trillions IDR), wheat (17,02 trillions IDR) . Production, import and export value of fresh vegetable presented on Table 2, and for fresh fruit on Table3.

Tabel 3. Production Import and Export Value of Indonesian Fresh Fruit 2011

No	Komodities	Nilai (US \$)			% Value Import/Product value
		Production	Import	Export	
1	Citrus	198.171.967	211.089.260	1.171.930	106,52
2	Apple	407.605.931.823	189.336.608	113.921	0,05
3	Grape	438.455.224.512	121.217.600	9.582.386	0,03
4	Pear	60.513.688.462	106.753.329	60	0
5	Durian	298.194.123	38.192.411	-	12,81
6	Strowberry	80.888.592.742	1.072.230	376.321	0,001
7	Banana	27.362.822	849.998	1.011.593	3,11
8	Mango	-	808.043	2.024.952	0,00
9	Pineapple	3.744.214.535	461.567	203.790.312	0,01
10	Watermelon	32.417.237	446.045	142.937	1,38
11	Cantaloupe	106.671.341	358.106	334.124	0,34
12	Pepaya	472.152.014	147.641	514.670	0,03
13	Jack fruit	1.652.686.259	50.501	3.545	0,003
14	Rambutans	155.935.168	15.700	393.007	0,010
15	Mangosteen	2.959	14.655	9.985.684	495,33
16	Dukuh	64.104.430	2.150	-	0,003
17	Starfruit	2.252.824	334	1.026	0,015
18	Other fruit	2.175.588.948	185.423.399	12.136.147	8,52
<b>Total</b>		<b>996.393.192.165</b>	<b>856.239.577</b>	<b>241.582.615</b>	<b>0,09</b>

Vegetables are important commodities that consumed to support human health. Current developments, vegetable consumption in Indonesia is still low at 40.90 kg/capita/year in 2007. This value is still below the FAO standard of 73 kg/capita/year, while the standard for healthy sufficiency of 91.25 kg/capita/year). Total production of vegetable crops Indonesia in 1999 amounted to 7.7545 million tons and increased to 9.1025 million tons out 2009, so that in 10 years there was an increase of 2.9%. Nevertheless, in 2010, Indonesia still imports vegetables with a total value of U.S. \$ 396.192.273, or about 3.30 % of the total production. The volume of imports of vegetable crops is currently increase.

Vegetable production areas in Indonesia are mostly located in the low land (<450 m above sea level). Production center of the most high value vegetable, however, is located in highland where subtropical vegetable crops also can be grown. It can be seen from Table 4, that total harvested area for highland is 36,44% from the total of vegetable area, however the highland area contribute 51,16 % from the total production.

Table 4. Harvested area, Production, Yield/Ha of Indonesian Vegetable for 2010

No	Comodities	Harvested Area (Ha)	Production (Tons)	Yield (Ton/Ha)
<b>A.</b>	<b>Low Land</b>			
1	Kangkong	55.164	350.879	6,36
2	Amaranth	48.844	152.334	3,12
3	Yard-long bean	85.828	489.449	5,70
4	Cucumber	56.921	547.141	9,61
5	Eggplant	52.157	482.305	9,25
6	Chili	122.755	807.160	6,58
7	Chili bird	144.350	521.704	4,56
8	Shallot	109.634	1.048.934	9,57
9	Red bean	22.251	116.397	5,23
	<b>Total Lowland</b>	<b>697.904</b>	<b>4.516.303</b>	
<b>B</b>	<b>High land</b>			
1	Tomato	61.154	891.616	14,58
2	Radish	2.083	32.381	15,55
3	French bean	36.483	336.494	9,22
4	Chinese cabbage	59.450	583.770	9,82
5	Welsh Onion	57.593	541.374	9,40
6	Garlic	1.816	12.295	6,77
7	Cabbage	67.531	1.385.044	20,51
8	Cauliflower	8.728	101.205	11,60
9	Potato	66.531	1.060.805	15,94
10	Carrot	27.149	403.827	14,87
11	Chayote	10.693	369.846	34,59
12	Mushroom	684	61.376	0,90
13	Bell Pepper	161	5.533	34,37
	<b>Total Highland</b>	<b>400.056</b>	<b>5.785.566</b>	
	<b>Total</b>	<b>1.097.960</b>	<b>10.301.869</b>	
	<b>% Lowland</b>	<b>63,56</b>	<b>43,84</b>	
	<b>% Highland</b>	<b>36,44</b>	<b>56,16</b>	



## Research Program

To improve the welfare of the community, various innovations have been produced by the Indonesian Research Institute and University. Through the Research Institute that produced a national strategic technologies and Assessment Institutes for Agricultural Technology in regions that produce site-specific agricultural technologies, the IAARD (Indonesian Agency for Agricultural research and Development) directs its programs to encourage agricultural system and an efficient business, by utilizing agricultural resources optimally fit the paradigm of agricultural development. Research focuses on this following aspect

**a. Variety :** New superior varieties are one of more important technologies, especially for their contribution to increasing productions and productivity.

**b. Agricultural Machinery and Equipment:** Producing a variety of prototype equipment and agricultural machinery that would benefit the farmers. The prototype is the result of research activities and engineering machinery.

**c. Agricultural Post Harvest:** Postharvest technology is believed to be the key to enhancing the value-added and basic development of competitive agro-industries. R&D results are intended to improve the postharvest handling and processing technology innovation to support food security of agricultural products, value added, competitiveness and exports.

**d. Crop Management and Cultivation:** To obtain best results for agricultural products, cultivation techniques need to be done properly. This sub menu presents a variety of agricultural techniques and assessment that produces by the research institutions.

**e. Pest and Disease Control:** Control of pests and diseases play an important role in maintaining the quality and productivity of agricultural products in order to get the maximum results.

**d. Policy Analysis and Recommendations:** To achieve maximum results in agricultural production, the research institution issued a variety of policy analysis and recommendations derived from research and studies in depth.

**e. Germplasm Database:** Germplasm is the fourth of natural resources in addition to water resources, soil and air which is very important to conserve. Germplasm conservation as the genetic resources will determine the success of agricultural development programs.

## **Extension to Farmers**

The extension activities in Indonesian horticulture in general is very weak, due to the main focus of the government is in rice or field crop production. Only a few extension specialist in horticultural sector, therefore the adoption of horticultural technology by the farmer is very slow. **Bogor Agricultural University** cooperates with **Taiwan Technical Mission** sponsored by **Taiwan ICDF** developed **Agribusiness Development Center** as a model for Indonesian horticulture extension service.

Agribusiness Development Center (ADC) is a concept of integrated agribusinesses center that integrate production and marketing activities in a single package. This concept was introduced by Taiwan Technical Mission of Taiwan ICDF Project collaboration with Bogor Agricultural University, Bogor Indonesia. Mentoring and empowerment of farmers to be come part of the ADC. From the physical side, the ADC consists of at least experimental plots (demonstration plot), both at the open field or under greenhouse and screen house production system, an adequate water source, packing house, and training room. In the ADC, the marketing research done first to identify the commodities that have high market demand and economically viable (ie, relatively stable prices, supply is still low, and the cost of production is still affordable). The marketing team not only finds ADC market opportunities, but has to produced a market commitment that passed out to the production team.

The technology developed by universities or research institutes outside the university used to support the production of the commodity requested by markets. Technology could be a technology for crop management (seeds, cultivation techniques, fertilizer, etc.) as well as the post-production quality assurance of products through appropriate post-harvest handling (storage, grading, packing, and labeling). Furthermore the technology is tested (yield trial) on a demonstration plots in ADC. Trial is needed to determine which technology is most appropriate and most feasible use on ADC environment that represent of land owned by farmers. From the results of this trial, ADC's Expert Team will develop technical guidelines (manual guide) for the production of certain commodities in that region. Technical guidance was then used as a guide for farmers ADC partner when they become ADC member to do expansion of plant production to meet market needs.

As already described above, the ADC does not run itself. Basically ADC is a place where groups to do a bisnis together. Farmers group is a partner of ADC to supply commodities to the market. Before becoming a partner, farmers will be trained in the ADC in order to run the production according to the manual guide, so that the results meet required quality and quantity of the market. Farmer partners under contract with ADC will obtain technical assistance in production and post harvest handling. Production planning consists of determining the commodity, the scheduling

time of planting, carried out by ADC team and subsequently implemented by farmers. Production planning is important to ensure continuity of production to meet the commitments already made by the market. Quality assurance of products produced by farmers conducted in ADC is consist of grading (sorting the products by size, color, shape, etc.), security (eg e-coli bacteria-free, pesticide levels within safe limits), good packaging techniques and meet certain standards , and so forth.

Through the ADC 's pattern, investors who develop ADC has benefit financially from the difference between purchase price and selling price of farmers to market th. ADC cut operational costs such as mentoring and quality assurance. While farmers earn profit from the difference in production costs and the price on ADC packing house. This activity can only be sustainable if investors and farmers earn a reliable profit. ADC developed under cooperation between Bogor Agricultural University (IPB) with business partners, IPB act as a supplier of technology and a team of experts in the production and quality assurance. IPB responsible for the implementation of yield trials to guide the preparation of manuals and training for farmers and farmer co prospective partners. Business partners will act as a fund investor since the preparation of this ADC until the passage of events. Assistance to farmers in the short term is still done by the IPB, but in the long run can be carried out jointly by the partners, a nearby college and the local agricultural extension agents to take advantage of the cooperation scheme Academic-Business-Government (ABG). Figure 1 illustrates the concept of ADC has been described above.

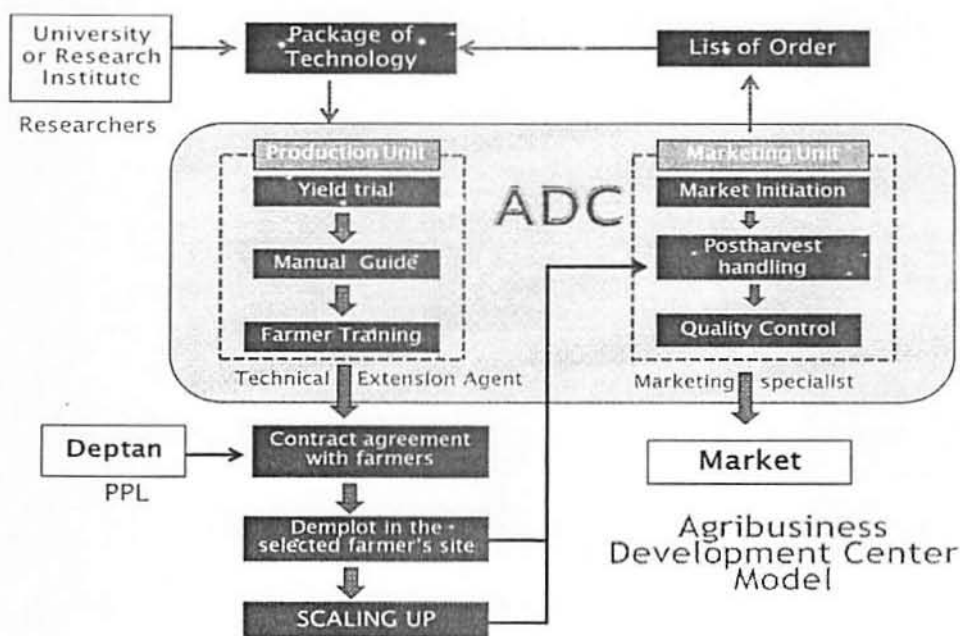


Figure 1. The concept of Agribusiness Development Center

## **Challenges for Indonesian Horticulture**

### **1. Production Area**

Vegetable production areas in Indonesia are located in the low land and highland. Production center of the most high value vegetable, however, is located in highland where subtropical vegetable crops also can be grown. Small scale type farmers (with small area) were dominant in Indonesian vegetable growers. This conditions cause many difficulties to introduce a new extensive mechanization (tractor) system, and new other technology which is more efficient. Various crop production techniques are used by vegetable farmer, because Indonesia does not have a strong vegetable research institution, especially for dissemination. Extension activities for horticulture in general was not work. Consequently, most vegetable farmer produce a low quantity, quality, and continuity of the product. The farmer also faces conversion production area from horticulture to other purpose. Developing an intensive small scale production system may be the best solution for Indonesian vegetable farmer.

### **2. Pest and Diseases**

Because high temperature and humidity all season, Indonesian vegetable farmer face lot of serious problem in pest and diseases. Pesticide is not easy found in Indonesia. Almost 30%-40% of the production loss in the field by pest and diseases. Inappropriate using pesticide is common problem in vegetable production. It can cause serious health and environmental problem

### **3. Fertilizer Recommendation**

There is no fertilizer recommendation for the vegetable production, therefore farmer never tested their soil before planting. Fertilizer application made base on farmer experiences and manual guide for agronomic crop. Consequently, it is difficult to produce high quality product.

### **4. Seed Production System**

Vegetable seed availability is the major factor for vegetable production in Indonesia, especially sub-tropical crops. Limited vegetable seed company is established in Indonesia. Therefore, expired seed with low viability, and illegal seed were found in the market. These situations make difficulties to achieve production target market on vegetable production.

## **5. Horticultural Technology**

Most of the Indonesian vegetable farmer used conventional technology to grow their crop. They usually adopt production technology from agronomic crop (rice) for fertilization, pesticide application that totally inappropriate for vegetables. However, some farmers have started to produce their vegetable in the greenhouse with hydroponics system. This technology have a good progress and prospect in Indonesia, may be this is the best choice for Indonesian vegetable farmers for their future, due to production area type (small scale) and also Indonesia is a big market (fourth populated country in the world) for high quality vegetables.

### **Way forward: Horticulture Development Strategy for Indonesia**

#### **1. Developing Regions.**

Goal of developing horticulture region are (1) Increase production, productivity and quality, (2) Develop a horticultural business diversity ensure the preservation of the functions and benefits of the land, (3) Create jobs, (4) Improving the effectiveness and efficiency of services, (5) Enhance opportunities and increase household incomes and the state, and well-being, quality of life, economic capacity and peasant society, and (6) Increase bonding communities around the area that has responsibility to preserve and safety. The benefits of the development of horticulture including: (1) Ease of handling various integrated horticultural commodities in accordance with the similarity of characteristics, (2) Creating space all horticultural commodities that are important in a region dealt with proportionately and reduces the desire addressing areas of national priority commodities that are not appropriate for the region, (3) To be a vehicle for implementing decentralization of development significantly by division and linkage functions between levels of government more proportional, (4) Promote synergy of various resources, and (5) Provide an incentive for implementing in the district, (6) Accelerate growth income, employment and the growth of the sectors related businesses.

#### **2. Product Quality Improvement**

Improving the quality of the product will be focused on the application of GAP (Good Agricultural Practices) and GHP (Good Handling Practices), registration of garden / land business, registration packinghouse and application environmentally friendlyness cultivation techniques. Implementation of GAP with Standard Operation Procedure (SOP) specific locations, specific commodity and specific objectives market, is intended to increase productivity and quality of products produced by farmers to meet consumer requirements and highly competitive for certain products, compared with the product their counterparts from abroad. GAP Implementation in Indonesia has been supported by rising Regulation of the Minister of Agriculture on Guidelines for Fruit Cultivation and Vegetables Good (Good Agricultural Practices For Fruit and Vegetable). Thus the application of GAP by actors businesses/farmers received legal support from the government central and local levels.

The purpose of the application of GAP / SOP include: (1) Increase production and productivity, (2) Increase quality of horticulture including consumer safety, (3) Improve competitiveness, (4) Improving the efficiency of use of natural resources, (5) Maintain soil fertility, and environmental sustainability of production systems sustainable, (6) Encourage farmers and farmer groups to have the mental attitude of a responsible the health and safety of themselves and the environment, (7) Increase the chances of acceptance by the international market, (8) Provide security to consumers, whereas the target to be achieved is the establishment food safety, high productivity, quality assurance, business sustainable horticultural agribusiness and increased power competitiveness. Some of the activities in order to support quality improvement products include: facilitation of harvest, post-harvest facilities, and cold chain storage and distribution facilities. Besides, it is necessary comparisons (benchmarking) standard form of GAP-based production systems and quality standards products with export destinations.

### **3. Plant Protection Systems Strengthening**

Strengthening plant protection system will be directed in order to develop the application of Pest Control Integrated Management (IPM) large scale (Area Wide Integrated Pest Management / IPM, Areas of Low Pest Prevalance / ALPP to fly fruit), development of agro-clinics, the development of the Enemy Natural and Biological Agents, Biopesticide development and Field School Integrated Pest Management (SLPHT).

### **4. Strengthening Seed Systems**

Strengthening seed systems will be conducted development of seed systems are inexpensive, timely and easy to reach farmers. Institutional strengthening consisting from the Institute for Seed Control and Certification (BPSB) and Hall Horticulture Seeds (BBH). Strengthening seed systems also focused on the revitalization of the breeding centers through the provision of seed source in accordance with the masterplan development and the collection of varieties and breeders coaching, breeder association , cooperative breeders and local seed companies.

### **5. Institutional Strengthening**

Institutional business is very important to improve competitiveness and bargaining power of farmers in the supply chain. Therefore need to build institutions capable of strengthening cooperation between the farmer/farmer group union or cooperation among traders. Vertical integration is a collaboration between businesses in different segments, namely between groups of farmers with traders, including it tripartite cooperation between farmer groups, merchants and associations. To improve farmers' bargaining power and increase effectiveness and efficiency of effort required formation and activation of farmer groups and the combined group farmer (gapoktan). The existence of joint farmer groups also will help in disseminating, implementing

technology and access to finance, and thus the scale businesses become larger and economically.

## **6. Postharvest Handling**

Characteristics of horticultural commodities is both voluminous (may require a large) and perishable, so it takes handling postharvest fast and precise. The main thing that arises due to improper handling and rapid is the high loss or damage results. It is due, among other postharvest handling products horticulture is still done traditionally or compared to conventional pre-harvest activities. Visible that the low application of technology, the harvest /postharvest limited, access to information in application of technology and post-harvest facilities are also limited impeding the increased ability and knowledge of farmers/entrepreneurs. Handling postharvest horticulture in general aim to extend freshness and reduce the level of loss results are implemented through the use of facilities and good technology.

## **7. Acceleration Access Funding and Partnership**

Accelerated access to financing will be directed in order facilitating ease of getting access to credit schemes such as KKPE, KUR. Besides, it also provided facilitation strengthening / venture capital for LM3 and auxiliaries PMD remains a concern, especially in supporting capital strengthening agribusiness development horticulture. Strengthening partnerships will also continue to be built to build CSR programs of private companies.

## **8. Dissemination of Horticultural Products**

Correctional horticultural products intended to be efforts to increase public awareness in national consumption of horticultural products. Corrections a long-term investment impact of new can be felt in the coming period. Dissemination of horticulture product will be done sustainably so hopefully will motivate business company in the development of horticulture.

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