CAPSA Working Paper No. 100

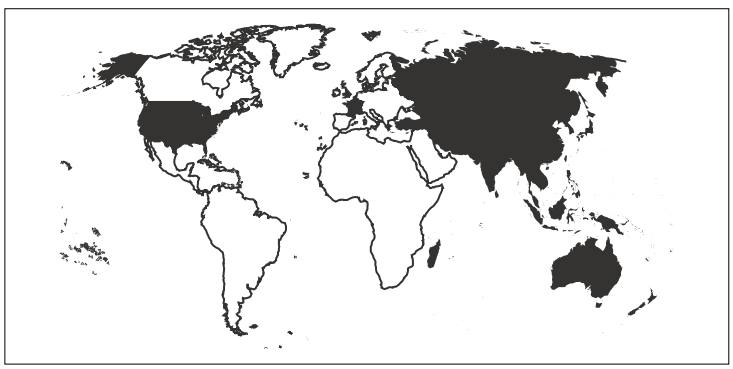
Sustainable and Diversified Vegetable-based Farming Systems in Highland Regions of West Java

Edited by Tomohide Sugino

United Nations
ESCAP

JIRCAS
JAPAN

ESCAP is the regional development arm of the United Nations and serves as the main economic and social development centre for the United Nations in Asia and the Pacific. Its mandate is to faster co-operation between its 53 members and nine associate members. ESCAP provides the strategic link between global and country-level programmes and issues. It supports Governments of the region in consolidating regional positions and advocates regional approaches to meeting the region's unique socio-economic challenges in a globalizing world. The ESCAP office is located in Bangkok, Thailand. Please visit our website at <www.unescap.org> for further information.



The shaded areas of the map indicate ESCAP members and associate members.

UNESCAP-CAPSA

The Centre for Alleviation of Poverty through Secondary Crops' Development in Asia and the Pacific (CAPSA) is a subsidiary body of UNESCAP. It was established as the Regional Co-ordination Centre for Research and Development of Coarse Grains, Pulses, Roots and Tuber Crops in the Humid Tropics of Asia and the Pacific (CGPRT Centre) in 1981 and was renamed CAPSA in 2004.

Objectives

CAPSA promotes a more supportive policy environment in member countries to enhance the living conditions of rural poor populations in disadvantaged areas, particularly those who rely on secondary crop agriculture for their livelihood, and to promote research and development related to agriculture to alleviate poverty in the Asian and Pacific region.

CAPSA Working Paper No. 100

Sustainable and Diversified Vegetable-based Farming Systems in Highland Regions of West Java

Edited by Tomohide Sugino

United Nations
E S C A P

New York 2008

Table of Contents

List of Tables

Chapter 5

Chapter 6

Chapter 7

List of Figures

Glossary of Terms

Bata	: Local land measurement (means: brick)
BPP (Balai Penyuluhan Pertanian)	: Agricultural Extension Service Unit
Dinas Pertanian Kabupaten Bandung	: Agricultural Office Bandung District
Dinas Pertanian Tanaman Pangan	: Agricultural Office for Food Crops
FFV	: Fresh fruit and vegetables
Gadai	: Pawn and share system
Gundul	: Leafless
IPB (Institut Pertanian Bogor)	: Bogor Agricultural University
Kelompok Tani	: Farmer Group
Ojek	: Motorbike taxi
Pasar Induk	: Central market
Pengepakan	: Packing
Potongan panjang	: Uncut leaves
Potongan pendek	: Leaves cut short
Tebasan	: Selling crops to traders before harvest
Tumpangsari	: Mixed-cropping
Warung	: Stall

Foreword

Japan International Research Center for Agricultural Sciences (JIRCAS) carried out collaborative research with the Indonesian Agency for Agricultural Research and Development (IAARD) entitled 'Evaluation and Improvement of Regional Farming Systems in Indonesia' from 1996 to 2003, focusing on an evaluation of vegetable-based farming systems in highland regions of West Java. Based on the achievements of this project, a follow-up study was conducted by JIRCAS and the Indonesian Center for Agricultural Socio-Economic and Policy Studies (ICASEPS) from December 2003 to March 2006.

The study coincided with a research project, 'Identification of Pulling Factors for Enhancing the Sustainable Development of Diverse Agriculture in Selected Asian Countries (AGRIDIV)', co-ordinated by UNESCAP-CAPSA. While the AGRIDIV project focused on poverty alleviation through secondary crop based agricultural diversification, the study concentrated on how small-scale vegetable farmers receive technology innovation to diversify agriculture and possibility of their engaging more in vertical diversification. Mr. Tomohide Sugino, Senior Researcher, Development Research Division, JIRCAS co-ordinated the study while he worked as Project Leader of AGRIDIV project in CAPSA from April 2003 to March 2006. I believe that the simultaneous implementation of the two projects provided synergy and positive impacts on each other.

It is my pleasure to publish the report: 'Sustainable and Diversified Vegetable-based Farming Systems in Highland Regions of West Java', as a result of the study. This report presents the adaptability of short-term crop-rotation technology to farmers' fields, the economic feasibility of the technology and the possibility of farmers' engagement in vertical integration.

I thank the members of the study team for their efforts. Continuous support from the ICASEPS and AIAT West Java is highly appreciated. I thank Mr. Matthew L. Burrows for editing.

Finally, I would like to express my sincere appreciation to Dr. Kenji Iiyama, President, JIRCAS for his support of the study.

April 2008

Taco Bottema
Director
UNESCAP-CAPSA

Acknowledgements

The authors take this opportunity to place on record their sincere thanks to Dr. Tahlim Sudaryanto, Director, ICASEPS and Dr. Pantjar Simatupang, former Director, ICASEPS as well as Dr. Kenji Iiyama, President, JIRCAS, Dr. Shinobu Inanaga, former President, JIRCAS and Dr. Mutsuo Iwamoto, former President, JIRCAS for allowing us to conduct this study.

Dr. Agus Muharam, Director, AIAT West Java, Dr. Saiful Bachrein, former Director, AIAT West Java, Mr. Purwanto, and Mrs. Sri Murtiani, AIAT West Java deserve special thanks for their assistance with our rural surveys.

We would like to also thank staff members of the extension centre in Lembang sub-district for their assistance with our surveys and data collection.

We are deeply grateful to the farmers in Langensari and Cibodas villages, Lembang sub-districts and the traders in Lembang, Bandung, Bekasi and Jakarta for their kindness in co-operating with our interviews.

We would also like to thank Dr. Taco Bottema, Director, UNESCAP-CAPSA, who provided us an opportunity to print this report as a CAPSA Working Paper series.

Last, but not the least, we are equally thankful to all those who have helped directly or indirectly to enable us to produce this report.

Tomohide Sugino, JIRCAS
Mitate YAMADA, JICA
Henny Mayrowani, ICASEPS
Adang Agustian, ICASEPS
Trisna Subarna, AIAT West Java
Titiek Maryaty, AIAT West Java
J.W.T. Bottema, UNESCAP-CAPSA
Togar A. Napitupulu, UNESCAP-CAPSA

Executive Summary

In highland areas of tropical countries, the air temperature range is suitable for the cultivation of cruciferous plants (cabbage, cauliflower, etc.) throughout the year. Due to favourable climatic conditions and relatively higher profitability compared to other crops, continuous cropping of cruciferous plants has become common practice in highland regions of West Java, Indonesia. Short-term crop-rotation systems have proved to be efficient in preventing clubroot damage, which is a serious constraint for farmers in the area. However, the effectiveness of short-term crop-rotation technology was only investigated in the experimental fields. Furthermore, the adaptability of such technology to farmers' fields and its economic feasibility for resource poor farmers were not surveyed in that previous study.

One of the major constraints for small-scale vegetable farmers in the area to mitigate poverty is income fluctuation due to the unstable prices of their products. Vertical integration between vegetable production and marketing, such as contract farming to foster transactions with supermarkets, should be considered as an effective measurement to stabilize and even boost farmer income. It is significant to consider whether farmers can play a more active role in vertical integration.

Against this backdrop and in-line with the research project 'Identification of Pulling Factors for Enhancing Sustainable Development of Diverse Agriculture in Selected Asian Countries (AGRIDIV)', co-ordinated by UNESCAP-CAPSA, a collaborative study entitled 'Sustainable and Diversified Vegetable-based Farming Systems in Highland Regions of West Java' was implemented by the Japan International Research Center for Agricultural Sciences (JIRCAS) and the Indonesian Center for Agriculture, Socio-Economic and Policy Studies (ICASEPS) from December 2003 to March 2006. The objectives of the study are:

- To propose vegetable crop-rotation systems with sufficient economic feasibility to mitigate clubroot damage;
- To disseminate crop-rotation technologies to local farmers and identify constraints in the application of the technologies; and
- To provide policy planners with recommendations to mitigate crop failure due to soil borne diseases as well as stabilize the income of small-scale vegetable farmers in the area.

The study was primarily conducted in two villages in Lembang sub-district, Bandung district, West Java province, Indonesia. The average landholding of the surveyed farmers at the study site was 0.30-0.33 hectares, with an annual household income of 8.8-10.8 million rupiah.

Experiments conducted on the farmers' fields showed that the profit generated through crop rotation is higher than continuous cabbage mono-cropping in the long run. In interviews to evaluate the farmers' acceptance of the technology, the farmers gave relatively higher scores to the visibility of the technology's effect, risk and profitability. Shifts in the cropping pattern to more effective patterns to prevent disease were observed in the village where dissemination activities were implemented. However, farmer knowledge regarding crop-rotation technology remains insufficient, which is reflected by the fact that their cropping patterns are not necessarily the best from the viewpoint of controlling clubroot.

Analyses of the marketing channel, marketing margin and farmer share of marketing activities revealed: (i) monthly prices of vegetable products fluctuate; (ii) marketing channel of vegetable products is relatively complicated; and (iii) marketing share remains unequal among the marketing agents and the highest marketing margin is gained by wholesalers/suppliers and the supermarkets.

The results of interviews to analyse the farmers' perspectives of post-harvest activities disclosed that: (i) most farmers are involved in sorting, grading and cleaning activities, but rarely involved in packing activities necessary for transactions with supermarkets; (ii) farmers receive price incentives from such post-harvest activities; (iii) vegetable traders prefer to deal with handled products; (iv) access to modern markets involves several requirements to be met by the farmers, such as: high quality product, continued supply in quantity and quality, acceptance of the delayed payment system (7-15 days or more).

The fast growing establishment of modern markets in urban areas in Indonesia is not directly affecting the traditional marketing chain of FFV (Fresh fruit and vegetables) distributed to traditional markets. The rapidly growing number of modern market outlets should be considered as additional market opportunity for FFV. Production centres continue their activities as usual although some efforts have been made by suppliers to consolidate FFV production collected from the farmers for sustainable distribution. Suppliers or intermediate traders (locals or inter-regional) who do business with modern markets are the most influential marketing agents dealing with quality and continuity of FFV distribution, however, in terms of quantity, traditional markets are the prime destination of production

centres. The development and investment strategy for greater Jakarta should build on the-across-the-board approach, including both wet markets and where feasible from the surrounding demand, new local wholesale markets.

Recommendations were formulated as a conclusion of the study to improve crop production and the income of small-scale vegetable farmers in the area.

- Continuous dissemination

  Efforts to disseminate adequate technological information should be made. Closer communication between researchers, extension workers, farmers and other stakeholders represents one option to resolve this problem.

- Provision of market information to farmers

  The market price of vegetables fluctuates widely even over short periods of time. Therefore, market information is crucial for farmers to select the kinds of crops to plant in their fields. This is more important for farmers who introduce crop-rotation technologies.

- Collective activities of farmers

  If farmers can sell vegetables directly to supermarkets or shortcut a part of the marketing chains, there is greater potential for farmers to reap higher profits. Since individual farmers cannot meet the standards set to transact with supermarkets, policy support is required to encourage farmers to organize into groups with the capacity to engage the modern market directly.

- Diversifying activities and access to credit

  By diversifying their activities, farmers are expected to generate higher profits which would enable them to accept the delayed payment system. This is a critical condition requested by supermarkets. Better access to credit is another alternative.

- A systematic approach to market participants

  Well connecting rural and urban infrastructure is of course the key to the future. Detailed local analysis will be necessary to make this possible and develop plans. It is recommended to use the same methodology that large retail companies use in sourcing and distribution, spatial modelling, creating time – distance and cost grids.

1. Introduction

Tomohide Sugino[*]

1.1 Background

Most agricultural research institutes that engage in research collaboration in developing regions face conflicts within their objectives or activity goals. While their ultimate goal is poverty alleviation or securing sustainable food production in the world, the immediate objectives of research are more oriented towards 'scientific' outputs rather than direct impacts on poor, rural populations.

The issue of 'scaling up' has become a major concern of research institutes. The basic concept of scaling up is that agricultural research should produce "more benefit and more equity to more people, more quickly and be more long-lasting" (IIRR, 2000). Against this backdrop, donors and other stakeholders are not only calling for increased impacts but they are also placing conditions on the quality of such impacts regarding sustainability and equity (Menter *et al*., 2004).

The research that forms the basis of this working paper, builds on an earlier study, 'Evaluation and Improvement of Regional Farming Systems in Indonesia', carried out by the Japan International Research Center for Agricultural Sciences (JIRCAS) in collaboration with the Indonesian Agency for Agricultural Research and Development (IAARD) from 1996 to 2003. From April 2000, this project focused on the evaluation of vegetable-based farming systems in highland regions of West Java. One of the study objectives of the project was to appraise the cultivation technologies and socio-economic conditions of temperate vegetable production. Under this objective, crop rotation was proven to be efficient in preventing clubroot damage, which is a serious constraint for farmers in the study area. Another finding was that the distribution system for vegetables is fairly competitive and efficient. A primary hindrance for small-scale vegetable farmers in the study area to augment their welfare is fluctuation in income stemming from the unstable price of their commodities. Vertical integration between production and marketing, such as contract farming, is known as an effective measure to stabilize farmer income. Therefore, it was felt that an evaluation of potential farmer engagement in vertical integration would provide useful practical

[*] JIRCAS, Japan (During the study period, assigned as Project Leader of AGRIDIV, UNESCAP-CAPSA, Bogor, Indonesia).

information to policy planners in the region to assist their policy planning process and, in turn, improve the welfare of rural farm households.

This working paper reports on a study that addressed these issues. The study was a research collaboration between JIRCAS and ICASEPS, supported by AIAT West Java.

It is fitting to start this working paper with a brief review of the consumption and demand side of the horticulture sub-sector. Though quite some attention has been given recently to the supermarket revolution, the long-term changes in rural and urban consumption of vegetables and fruit have largely remained unanalysed. Compared to some 20 years ago, however, there is much more attention in the literature to demand for high value produce, even up to the point that one can speak of a need to address production and institutional issues in more detail. However an analysis of consumption and demand which covers the last two decades is still lacking.

There are other good reasons to expand the timeline in analysis. In the late 1980s and 1990s economic growth was high in Indonesia and many of the questions that we see posed today (e.g. the role of supermarkets and direct purchase, benefits of market integration for small farmers, replacing rice or rainfed crops with higher-value horticulture produce) were also raised in that time. This growing demand for vegetables offered good and sustainable options for farm diversification shifting to high value crops even though for some small farmers it is difficult to adjust to higher-cost farming. Nevertheless we have witnessed some successes, usually in partnership with buyers and traders.

The question is whether the changes in demand during that period still persist today? Or has there been any level off in demand afterward, or changes in the structure or the composition of fruit and vegetable consumption? The first paper (Chapter 2) addresses this issue, and provides a context for the remainder of the working paper.

1.2 Objectives and framework of the study

Considering the limitations of earlier studies highlighted in the previous section, the designs of the follow-up studies were based on a results-based approach. The results-based approach is a framework adopted by various international organizations like UNESCAP in the planning, budgeting and management of their work programme. With the application of a logical framework approach to show clear objectives and expected accomplishments prior to implementation, the organization should reflect what it intends to accomplish and not just what it intends to do.

The results-based initiative allows us to determine more clearly and systematically the usefulness, relevance, effectiveness and impact of our work. This approach also enhances our accountability to stakeholders in the use of resources and in delivering results within the organization's sphere of influence.

To implement the study in accordance with the final objectives of technological collaboration, namely sustainable development in developing regions, the goal, outcome, output and activities of this were as follows:

- Goal

  Resource-poor vegetable farmers in highland area of West Java can mitigate damage risks attributable to clubroot and, furthermore, stabilize their income through the policy support of policy planners.

- Outcome

  Resource-poor vegetable farmers in highland areas of West Java apply crop-rotation technologies to mitigate clubroot damage. In addition, policy planners institute effective measures that support technology application by the farmers.

- Output

  The immediate objectives (expected output) of this study are:

  - To propose vegetable crop-rotation systems with sufficient economic feasibility to mitigate clubroot damage;
  - To disseminate crop-rotation technologies to local farmers and identify constraints to the application of the technologies; and
  - To provide policy planners with recommendations to mitigate crop failure due to soil borne diseases and stabilize the income of small-scale vegetable farmers in the area.

- Activities

  To achieve these objectives, study subjects (activities) are selected as follows:

  - To conduct field experiments and rural surveys on local farms to evaluate the economic feasibility of crop-rotation technologies to mitigate clubroot damage and evaluate the possibility of further vertical integration;
  - To organize meetings with local farmers to introduce crop-rotation technologies and carry out interview surveys to investigate any constraints in applying the technologies; and
  - To integrate the findings of the studies and literature review as well as formulate

policy recommendations to mitigate crop failure due to soil borne diseases. Also, to stabilize the income of small-scale vegetable farmers in the area.

1.3 Organization of the study

The major study site was located in Lembang sub-district, Bandung district, West Java province (Figure 1.1). Some surveys were conducted in wholesale markets in Jakarta, Bekasi (West Java) and Bandung. Two farmers in Langensari village, Lembang were nominated as collaborators by AIAT West Java. The field experiments were conducted from February 2004 to June 2005.

During the study period, three rural surveys were conducted by ICASEPS and JIRCAS, with the assistance of AIAT West Java and *BPP* Lembang. In the first survey, conducted from 1-3 December 2004, 40 farmers in Langensari village and nearby Cibodas village were surveyed to investigate the distribution pattern of harvested vegetables as well as the cost/benefit of vegetable production. In the second survey, undertaken from 16-18 February 2005, vegetable traders both in Lembang and the wholesale market in Jakarta were surveyed to find out the marketing system for vegetables. The third survey, from 19-21 September 2005, involved 40 vegetable farmers and 11 traders in Lembang and evaluated the possibility of promoting vertical integration between production and marketing.

Figure 1.1 Location of study site (Lembang sub-district)

On the completion of the study, a workshop entitled "*Peningkatan Teknologi dan Diversifikasi Vertikal pada Komoditas Sayuran Dataran Tinggi di Jawa Barat* (Technology Improvement and Vertical Diversification of Vegetable Production in the Highlands of West

Java)" was organized for 21 November 2005 at AIAT West Java to introduce the final results of the study and discuss their implication on policy planning. Farmers, administrative staff from local government agencies, staff members of AIAT, researchers and other stakeholders involved with vegetable production and marketing in the study area attended the workshop.

1.4 Structure of the working paper

The preliminary chapter (Chapter 2) provides a brief review of the consumption and demand side of the horticulture sub-sector, and provides a context against which the major study should be viewed.

The remaining chapters are presented as a series of papers on the core research activities of the study. Chapter 3 reports on the experience of crop rotation and several cultural practices in highland areas to control clubroot damage in Indonesia and Japan. Chapter 4 describes the results of field experiments and surveys focused on the economic feasibility of crop rotation technology (and farmer acceptance of the developed technology) to reduce clubroot damage in the highlands of West Java. Chapters 5 to 7 report on case studies in Lambang, Bundung, West Java. Chapter 5 investigated the economic conditions and cropping patterns of vegetable farms in highland areas. Chapter 6 analyses the marketing channel, marketing margin and farmers' share in the marketing of vegetable products in highland areas. From the farmer's perspective, Chapter 7 analyses post-harvest activities relating to vegetable produce as one aspect of marketing activities. It investigates how such activities affect the price incentives for farmers. The final chapter provides some concluding remarks including policy implications and recommendations.

2. Vegetables and Fresh Fruit: Long-term Trends in Consumption

Togar A. Napitupulu[*] *and Taco Bottema*[**]

2.1 Introduction

Prior to the 1997 economic crisis, high economic growth in Indonesia resulted in increasing income per capita and a consequent a shift in demand for food, from staples to a composite of high-quality food, more protein and fresh vegetables and fruit. On the supply side, farmers responded to these changes by replacing rice or rainfed crops with higher-value horticultural produce such as vegetables and fruit. Farmers on densely populated Java have always grown horticultural crops in large quantities, for their own consumption and for augmenting their incomes. The issue of farm diversification has not lost its importance, while many questions are being asked with some urgency whether small farmers would actually have a chance at all in supplying the demanding high-end side of the market. In general the trends in the late 1980s and the 1990s show that the growing demand for vegetables offered good and sustainable options for farm diversification shifting to high-value crops. The major difficulty was that small farmers on their own found it difficult to shift to a higher cost-management system. Yet, some succeeded, usually in partnership with buyers and traders.

It is generally accepted that with a given set of tastes and preferences, as income rises the proportion of income spent on food falls, even if actual expenditure on food rises. In other words, the income elasticity of demand of food is less than one (Engel's Law). As a rule of thumb, one may assume that in a largely self-sufficient agrarian and service-poor community, around 70 per cent of income is spent on food. This proportion goes down with increases in income and an expanding package of expenditure items, such as transport, education, electricity, etc. In that process one also observes changes in the expenditures on foodstuffs; the proportion spent on staples goes down, the proportion spent on meat, fish, dairy and also restaurants goes up. In the fresh fruit and vegetable (FFV) sub-sector one usually sees a shift towards a more diverse package of FFV, better quality produce and out-of-season produce, which has to be brought in and is more expensive. Bulk and cheap

[*] Senior Economist, UNESCAP-CAPSA, Bogor, Indonesia.
[**] Director, UNESCAP-CAPSA, Bogor, Indonesia.

vegetables are replaced with finer foods – similar to the case of Europe and the West which saw the replacement of cabbage with a larger variety of leafy vegetables, and the replacement of local fruit with out-of-area fruit. Given the huge variety of species that feature in the horticultural or FFV sector, this sub-sector is the cutting edge of changes in consumer behaviour.

Now, two to three decades later, the trend in demand of the 1980s needs to be revisited. Is the demand still growing? Has this growth been due to income increase or is it simply proportionate to population growth? Have there been changes in the income elasticity? Who is catering to this growing demand, the supermarkets or the traditional markets? A study by the World Bank indicates that the current estimate of the share of supermarkets of food retail in Indonesia is at roughly 10 to 15 per cent. However, our study indicates that the share of fresh fruit and vegetables is quite small, that is, only about 1 per cent. Is there any shift in the type of the vegetables and fruit consumed?

This paper addresses the consumption side of the above issues. It draws on a desk study conducted by CAPSA with the Indonesian Ministry of Agriculture in 2007.

2.2 Methodology

2.2.1 Theoretical framework

In the FFV sector in Indonesia one would expect over the last 20 years or so to see shifts in the items that appear as luxury foods. In general one can say a structural shift is occurring when items appear on menus as luxury goods which come from outside. This means that demand and consumption are maintaining a trade system, with its price signals and quality rewards[1]. The other, more important primary indicator of a structural change is when locally produced items which appeared as luxury goods have reduced in their standing to normal or even inferior goods. Now, in this regard Indonesia, and especially Java, represents a totally unique configuration of both highly concentrated demand, and a variety of climate zones which makes the production of both tropical FFV and temperate zone FFV (apples, the 'Western' package) possible. Under these conditions one would expect structural change in the trade system that imports produce to manifest itself at a relatively late stage.

[1] The same type of reasoning applies to the staples, where one observes a shift from a single staple consumer package towards a multi-staple package. For meats and fish the same applies, with culture and value-determined patterns. Dairy is virtually a long-term winner everywhere.

2.2.2 The model

The above hypothesized changes in patterns of food consumption, are explained by the changes in the income elasticity of the various FFV products. Using expenditure as proxy of income and assuming other variables are constant (*ceteris paribus*), the demand for the various FFV products is established as per the following equation:

$Q_i = \alpha I^{\beta} \varepsilon_i$ ……. (1)

Where Q is the amount of each product consumed, and I is expenditure (Ferrari, 1994). The model is further transformed into logarithmic form to make it conform to the Ordinary Least Square Estimation, where the estimator of β is the expenditure elasticity. The estimation is done partially, i.e., each equation for each product is estimated separately.

2.2.3 The data

The study uses the Susenas (National Socio-Economic Survey) data from the 1980s onwards. There are limitations in the power of the expenditure and consumption data. They do not pick up the foodstuffs consumed outside households, and given the vast popularity of fast food (outside the household) in Indonesia, the data are likely to underestimate expenditures on food somewhat. Second, and maybe more importantly, they do not pick up fruit consumed as received or acquired for free. This is especially important in peri-urban and rural areas. Third, the datasets used provide a picture for the whole of Indonesia, and the data do not pick up any geographical or regional differences in consumption patterns. However, data do pick up urban-rural differences in consumer behaviour.

It remains always an important question whether the statistical tools that are available, the expenditure and consumption data, include new market entrants. In other words data boundaries play a big role and this is why one has to perform periodic primary consumer surveys, coupled to supply surveys, checking on the items of popularity.

2.3 Results and findings

2.3.1 Consumption of vegetables and fruit

The consumption survey data show two characteristics that would seem counter-intuitive to the notion of structural change in consumption patterns. First, there is hardly any proportional change in the consumption among the various food categories; in fact there is a slight downward trend in both vegetables and fruit consumption. Second, rural vegetable consumption remains relatively high and steady while urban consumption of vegetables is on a relative decline. Consumption of vegetables is much below the consumption of rice as

the main staple food. For example, in 2006, the percentage of monthly expenditure on vegetables was about two-fifths that of rice, i.e., 8.34 per cent and 21.45 per cent respectively, while that of fruit was about 18 per cent of rice, i.e. 3.96 per cent (Table 2.1). These proportions show a slight declining trend from 1996 to 2006. The absolute expenditure, however on vegetables and fruit exhibits an increasing trend while urban consumption grew slightly faster than rural consumption (Tables 2.2 and 2.3).

Table 2.1 Monthly expenditure on selected food of total food expenditure, 1996 and 2006

(percentage)

Commodities	1996			2006		
	Urban	Rural	Rural & urban	Urban	Rural	Rural & urban
Rice	17.65	27.58	23.12	16.41	26.98	21.45
Vegetables	8.51	9.33	8.96	7.51	9.24	8.34
Fruits	6.21	4.41	5.21	4.34	3.55	3.96
Meat	7.71	4.43	5.84	4.28	2.61	3.49
Fish	8.40	9.28	8.65	8.49	9.36	8.90
Tubers	0.87	1.51	1.21	0.79	1.49	1.11
Total food	47.97	63.10	55.27	46.99	61.72	53.01

Source: Expenditure for Consumption of Indonesia 2006, based on Panel Susenas 1996 and 2006.

Table 2.2 Urban-rural expenditure on vegetables, 1996–2006 [a]

(Rupiah)

	1996	1999	2002	2003	2004	2005	2006
Urban	4 104	9 525	10 962	12 159	11 282	12 182	13 876
	(4.08)	(5.28)	(4.01)	(3.99)	(3.53)	(3.48)	(3.53)
Rural	3 112	7 949	8 780	9 795	9 378	10 641	12 202
	(5.90)	(7.26)	(5.75)	(5.87)	(5.47)	(5.44)	(5.70)

Source: Expenditure for Consumption of Indonesia 2006, based on Panel Susenas, February 2006.
Note: [a] Figures in parantheses indicate percentage of total expenditure.

Table 2.3 Urban-rural expenditure on fruit, 1996–2006 [a]

(Rupiah)

	1996	1999	2002	2003	2004	2005	2006
Urban	3 000	3 696	7 853	8 908	8 254	9 088	8 023
	(2.98)	(2.05)	(2.87)	(2.92)	(2.59)	(2.60)	(2.04)
Rural	1 469	2 287	4 280	5 071	4 518	5 868	4 693
	(2.79)	(2.09)	(2.80)	(3.04)	(2.64)	(3.00)	(2.19)

Source: Expenditure for Consumption of Indonesia 2006, based on Panel Susenas, February 2006.
Note: [a] Figures in parantheses indicate percentage of total expenditure.

One important observation of this contribution is that over the years there has not been a substantial change in the pattern of expenditure of the population. The percentages of per capita expenditure on food and non-food in 1996 were 55.34 and 44.66 respectively. In 2006, the corresponding figures show only a relatively small change with the expenditures on food at 53.01 per cent (Table 2.4). The pattern is also similar when we look within the food category. Within the food category, the percentage per capita expenditure on FFV was 17.69 in 1996, which declined to 15.38 per cent in 2006, in a similar fashion to the decline of rice or cereals from 23.12 in 1996 to 21.44 per cent in 2006.

However, prepared food and tobacco increased substantially over the period, by 4.1 and 3.24 per cent respectively (Table 2.5).

Table 2.4 Percentage of monthly average per capita expenditure on food and non-food in Indonesia, 1996-2006 (percentage)

Commodity groups	1996	1999	2002	2003	2004	2005	2006
Food	55.34	62.94	58.47	56.89	54.59	53.86	53.01
Non-food	44.66	37.06	41.53	43.11	45.41	46.14	46.99
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Source: Expenditure for Consumption of Indonesia 2006, based on Panel Susenas 1996 and 2006.

Table 2.5 Percentage of monthly average per capita expenditure by commodity group in Indonesia, 1996-2006 (percentage)

Food groups	1996	1999	2002	2003	2004	2005	2006
Cereals	23.12	26.66	21.32	18.20	17.30	17.82	21.44
Tubers	1.22	1.24	1.10	1.14	1.40	1.28	1.12
Fish, meat, eggs, and milk	19.84	17.13	19.34	19.87	20.12	19.42	17.98
Vegetables, legumes, and fruit	17.69	16.90	16.39	17.00	15.92	16.30	15.38
Miscellaneous	14.61	14.46	13.49	13.10	13.65	13.96	13.40
Prepared food	15.35	15.07	16.58	17.25	18.84	19.30	19.42
Alcoholic	0.14	0.08	0.14	0.14	0.15	0.12	*
Tobacco and betel	8.03	8.46	11.64	13.29	12.62	11.80	11.27
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Source: The 2004, 2005 and 2006, Panel National Socio-Economic Surveys.
Note: * In 2006, this group was already combined with the prepared food and beverages group.

A close look at the percentage of monthly expenditure on fruit by expenditure classes reveals increasing figures from 1.43 per cent of total expenditure for lower class to 2.04 per cent for the highest class in the urban population. A similar pattern can be observed for the rural population. For vegetables, the proportions are reversed, i.e., from 8.83 per cent to 3.53 per cent of total expenditure for the urban population and from 9.50 to 3.30 per cent for the rural population. Interestingly however, the figures are slightly higher for the rural population compared to the urban population (Table 2.6).The per capita expenditure shows an increasing proportion from the lowest to the highest expenditure class, both for urban and rural populations (Table 2.7). The reverse direction for vegetables can be explained by the fact that there is a sharp increase in total expenditure of the highest class.

Table 2.6 Rural-urban monthly average expenditure on fruit and vegetables as a percentage of total expenditure, by expenditure class, 2006 (percentage)

Monthly expenditure class ('000 Rp)	Fruit		Vegetables	
	Urban	Rural	Urban	Rural
40–59	0	1.81	0	9.50
60–79	1.43	1.22	8.83	8.18
80–99	1.38	1.39	7.85	7.12
100–149	1.53	1.73	7.10	6.87
150–199	1.61	1.98	5.62	6.19
200–299	1.89	2.27	4.83	5.81
300–499	2.18	2.54	3.87	5.12
500–up	2.09	2.58	2.28	3.30
Total of food	2.04	2.19	3.53	5.70

Source: Susenas data, 2006 (BPS).

Table 2.7 Rural-urban monthly per capita expenditure on fruit and vegetables by expenditure class, 2006 (Rupiah)

Monthly expenditure class ('000 Rp)	Fruit		Vegetables	
	Urban	Rural	Urban	Rural
40–59	0	933	0	4 903
60–79	1 049	883	6 492	5 920
80–99	1 280	1 264	7 261	6 480
100–149	1 985	2 197	9 203	8 728
150–199	2 847	3 436	9 924	10 761
200–299	4 719	5 502	12 028	14 068
300–499	8 380	9 506	14 914	19 125
500–up	17 649	18 332	19 241	23 461
Total of food	37 909	42 053	79 063	93 446

Source: Susenas data, 2006 (BPS).

Figures in Table 2.8 shows that higher incomes, which are reflected by higher monthly expenditure classes, consume more vegetables and fruit. Annual per capita consumption of vegetables was 31.95 kg for the lowest class to 42.57 kg for the highest class of the urban population, while for fruit; the figure was from 6.03 kg to 43.78 kg.

Table 2.8 Rural-urban annual per capita consumption of fruit and vegetables by expenditure class, 2006 (kg)

Monthly expenditure class ('000 Rp)	Vegetables		Fruit	
	Urban	Rural	Urban	Rural
40–59	0	31.69	0	n.a.
60–79	31.95	33.45	6.03	n.a.
80–99	34.93	33.48	7.85	n.a.
100–149	37.99	38.99	10.72	n.a.
150–199	33.61	40.37	13.52	n.a.
200–299	35.45	n.a.*	18.88	n.a.
300–499	39.24	n.a.	27.98	n.a.
50– up	42.57	n.a.	43.78	n.a.
Average	38.44	n.a.	25.58	n.a.

Source: Susenas data, 2006 (BPS).
Note: * n.a. = not available.

Table A1 (see Appendix) shows the annual average per capita consumption of vegetables of the urban population. The data indicate that among the vegetables, spinach is consumed the most, followed by swamp cabbage, string beans, onions and cabbage. We can also see that the amount consumed is relatively constant throughout the year over the period from 1987 to 2006. For example, in 1987 annual per capita consumption of spinach was 5.52 kg and in 2006 it was 4.62 kg. Swamp cabbage consumption was 5.36 kg in 1987 and this was slightly reduced to 5.01 kg per capita in 2006. Consumption of string beans was 3.54 kg per capita in 1987, which increased marginally to 3.59 kg per capita in 2006. Notice that this per capita consumption is very small on a daily consumption basis. For instance, 4.62 kg per capita consumption per year is about a tenth of an ounce per day, i.e., 0.13 ounce per day.

A similar pattern can be found for fruit. Table A2 (see Appendix) indicates the average consumption of fruit in urban areas. As illustrated in Table A2, the highest annual average consumption of fruit per capita in urban areas is banana with 6.14 kg per capita per year, followed by rambutan with 5.82 kg, orange with 4.21 kg, and the other fruits are below 1 kg per capita per year (2006).

2.3.2 Analysis of expenditure elasticity

One argument says that the increasing demand for vegetables and fruit is due to the increasing income of the population, in particular among the urban population. In order to study the validity of this argument, we derived elasticity of expenditure for some selected vegetables and fruit as presented in Table 2.9 and 2.10. Our findings indicate that the demand for vegetables appears not to be responsive to changes in income. This is reflected by the fact that most of the vegetables have negative income elasticity, and are inferior goods from the urban consumer's perspective. Demand for fruit however, is growing at a faster rate compared to vegetables, and also, they are relatively more sensitive to changes in income; this may possibly be due to the fact that there are more people with higher earnings and a higher health consciousness. This finding is consistent with the descriptive analysis presented earlier (Table 2.6 and 2.7). The study indicates that most fruits are considered to be normal goods while orange, apple and watermelon are considered to be luxury goods, having elasticities of over 1.0.

Table 2.9 Expenditure elasticities for selected vegetables

Produce	Urban			Rural			Urban and Rural		
	Elasticity	R-square	t-stat	Elasticity	R-square	t-stat	Elasticity	R-square	t-stat
Spinach	-0.0340	0.0896	-0.887	-0.0980	0.4404	-2.5096	-0.0706	0.3401	-2.0306
Swamp cabbage	-0.0078	0.0073	-0.244	-0.0167	0.0384	-0.5657	-0.0091	0.0152	-0.3521
Cabbage	-0.1036	0.5013	-2.836	0.0011	0.0009	0.0280	-0.0470	0.2054	-1.4382
Chinese cabbage	-0.3202	0.7670	-5.132	-0.2625	0.7411	-4.7860	-0.2423	0.7304	-4.6565
Darker-coloured mustard greens	0.0776	0.7069	4.3933	0.1278	0.4937	2.7932	0.2576	0.8606	7.0287
Beans	-0.1022	0.4405	-2.510	0.0024	0.0002	0.0401	-0.0341	0.0546	-0.6800
String bean	-0.0360	0.1286	-1.087	-0.0459	0.1541	-1.2075	-0.0609	0.2852	-1.7866
Tomato	0.0213	0.0309	0.5054	0.2477	0.0970	0.9270	0.1286	0.6204	3.6165
Carrot	0.1035	0.4904	2.7750	0.3693	0.8604	7.0221	0.2650	0.8335	6.3302
Unripe corn	0.3073	0.6872	4.1929	0.3363	0.6327	3.7122	0.4742	0.8337	6.3345
Onion	0.0216	0.033	0.5295	0.0395	0.0702	0.7775	0.0494	0.1430	1.1554
Garlic	-0.4666	0.4311	-2.462	0.6834	0.9865	24.2154	0.6422	0.9879	25.6013
Chilies	0.0727	0.2615	1.6832	0.1263	0.3976	2.2979	0.1208	0.4504	2.5609
Green chili	0.1325	0.4900	2.7726	0.0673	0.1897	1.3689	0.0937	0.3875	2.2499

Source: Processed using data on Expenditure for Consumption of Indonesia, National Socio-Economic Survey.

Table 2.10 Expenditure elasticities for selected fruit

Produce	Urban			Rural			Urban and Rural		
	Elasticity	R-square	t-stat	Elasticity	R-square	t-stat	Elasticity	R-square	t-stat
Orange	1.0533	0.6190	3.6057	0.5143	0.8220	6.0789	0.5194	0.9095	8.9668
Mango	0.6187	0.1465	1.1719	-0.1742	0.0252	-0.4555	-0.122	0.0161	-0.3619
Apple	1.1027	0.5603	3.1931	0.6709	0.6827	4.1496	0.6411	0.6311	3.6997
Rambutan	0.8588	0.5819	3.3371	0.2857	0.2617	1.6840	0.2769	0.3052	1.8750
Lanzon	0.6997	0.1532	1.2032	0.1609	0.0157	0.3581	0.1566	0.0157	0.3580
Durian	0.6131	0.2297	1.5446	-0.0108	0.0002	-0.0413	-0.0013	0.0000	-0.0053
Pineapple	0.1191	0.0199	0.4033	-0.2867	0.7434	-4.8154	-0.3603	0.8782	-7.5971
Banana	0.379	0.1819	1.3340	-0.2218	0.8686	-7.2741	-0.2412	0.9205	-9.6300
Watermelon	1.0611	0.6430	3.7962	0.7292	0.6911	4.2310	0.5941	0.6852	4.1733
Melon	0.7012	0.5493	3.1227	0.0607	0.0679	0.7635	0.6465	0.5657	3.2282
Tomato	0.5154	0.2699	1.7200	0.3853	0.1771	1.3124	-0.0774	0.2095	-1.4563

Source: Processed using data on Expenditure for Consumption of Indonesia, National Socio-Economic Survey.

Table 2.11 Expenditure elasticities for vegetables, Java 1980, Indonesia 1984, 1990

Vegetable	Java (1980)				Indonesia (1990)				Indonesia (1984) [a]
	Urban	R-square	Rural	R-square	Urban	R-square	Rural	R-square	All Indonesia
Spinach	0.254	0.93	0.283	0.85					0.61
Eggplant	0.165	0.53	0.632	0.83					
Cabbage	1.184	0.82	0.979	0.96	0.670	0.87	0.952	0.84	1.28
Potato	1.585	0.84	1.985	0.91	1.269	0.99	1.081	0.98	
Carrot	1.437	0.90	1.809	0.72					
Cucumber	0.991	0.77	1.620	0.92					
Tomato	0.909	0.93	1.823	0.97					
Shallots	0.470	0.96	0.716	0.99	0.965	0.95	1.072	0.93	0.69
Chili	0.717	0.93	1.091	0.98	1.087	0.97	1.175	0.98	0.60
Garlic	0.568	0.97	0.623	0.96					
Beans									1.41
Swamp cabbage									0.40

Source: Roche, 1987 (Java 1980); Hukum ,1989 (all Indonesia 1984); present study (Indonesia 1990).
Note: [a] Income elasticity.

2.4 Conclusion and policy recommendation

2.4.1 Conclusion

Long run changes in household expenditure on consumption of fresh fruit and vegetables appear to be in line with the declining trend of food consumption as a whole compared to non-food items. However there appears to be an increasing proportion of expenditure on prepared food relative to other items under the food category over the years. Similarly, annual average per capita consumption appears to be relatively stable over the years, with a declining trend for some vegetables. A similar trend can also be found in fruit, some of which have an increasing trend.

Over the years, we found a general shift in the consumer perception of vegetables from strongly being considered to be normal goods (having an income elasticity close to one), to weakly being considered to be normal goods (having an income elasticity close to zero). Some of the vegetables even came to be considered inferior goods (having negative elasticity). A similar trend was also revealed for fruit. However, some fruits that were earlier categorized as normal goods, have now become luxury goods.

2.4.2 Policy implication

Based on the characteristics of vegetables and fruits in general with respect to changes in income, it would be counter productive to devise a policy which gives them priority at a massive scale. For example, caution should be exercised in promoting policies

that recommend the expansion of fruit and vegetable production as a means of improving the income of farmers as a whole, or in identifying this commodity as a major source of sectoral growth, because of the limited demand trend, which is at best in line with population growth. Any policy therefore in developing fruit and vegetables at the supply side should be pursued in an evolutionized fashion that responds to changes in the growing trend for high-quality and specialized produce such as, presumably, organic produce.

3. Vegetable Crop-Rotation Technologies to Prevent Clubroot Damage: Crop Rotation and Several Cultural Practices

Mitate Yamada[*]

Abstract

Highland areas of tropical countries have an air temperature range suitable for the cultivation of cruciferous plants throughout the year. However, this suitability and, therefore, subsequent adoption of cruciferous plants throughout the year has lead to severe clubroot damage.

In Japan, vegetables are also often grown under continuous cropping and damage associated with continuous cropping is frequently observed. In this chapter, the experience of crop rotation and several cultural practices in highland areas to control clubroot damage in Indonesia and Japan are reported.

Resting spores of *P. brassicae* can survive for long periods in soil; however, short-term crop rotation with corn can alleviate the most severe damage. Recently, it was reported that clubroot damage to Chinese cabbage cultivation has been controlled using trap crops. A combination of resistant varieties of Chinese cabbage and endophyte inoculation also prevented yellows. Crop rotation in one year showed remarkable success in suppressing clubroot damage and with the addition of a fallow period in the dry season; the effect of the crop rotation became more stable for longer periods of time. Plant growth and yield were better in crop rotations than of continuous systems. Although the reduction of clubroot damage differed to some extent, all the non-host plants showed positive results. The combinations of plants in the cropping system are flexible and easily adjusted to farmer conditions.

Keywords: damage from continuous cropping, crop rotation, trap crops, antagonistic plants, clubroot, cabbage, radish, potato, bacterial wilt.

* Japan International Co-operation Agency (During the study period, assigned as Senior Researcher, JIRCAS, Japan).

3.1 Introduction

In Japan, vegetables are often grown using continuous cropping due to the small size of land ownership and to promote the effective use of fields, machines and markets. Several vegetable diseases are attributable to continuous cropping such as bacterial brown rot, fusarium wilt, clubroot, black rot and yellows, in addition to nematode injury (Yamada and Nakagawa, 1998). Although control measures for these diseases are based on the use of chemicals, the importance of promoting sustainable cultivation and environmentally friendly technologies is being increasingly recognized. Therefore, crop rotation seems a key technology to address these problems. Though crop-rotation technology is important, it must be flexible, clearly defined and attractive to farmers. Furthermore, it is also difficult to identify the optimum rotation in terms of duration and to select the best sequence.

Appropriate systems and practices must be utilized and adjusted to prevailing natural and economic conditions. Therefore, a large number of potential methods must be developed and evaluated to ensure the adoption of the best technology. In highland areas of tropical countries the air temperature range is similar to the spring or autumn in Japan throughout the year. This allows cruciferous plants, such as cabbage and Chinese cabbage to be grown throughout the year and has lead to severe clubroot damage. On the other hand, the effect of crop rotation in these areas might progress more rapidly than in Japan because farmers in such areas can utilize short-term crop rotation, are less constrained by the use of activity-specific machinery and have good access to alternative crops.

3.2 Cultivation methods to control plant diseases

3.2.1 Suppress cabbage clubroot disease (*Plasmodiphora brassicae* WORONIN) by incorporating sweetcorn

The summer in Japan is very hot and humid similar to tropical countries and, therefore, it is very difficult to grow temperate vegetables such as cabbage. In highland areas, however, farmers are able to produce good quality cabbage and earn a good income during the summer season. Consequently, farmers grow cabbage over wide areas of their farmland, which results in the continuous cropping of cabbage and its associated diseases, for instance clubroot, black rot, etc. To avoid clubroot, large amounts of chemicals are applied but in spite of various efforts, the situation is becoming more serious. In one of the highland areas in Gifu prefecture, where farmers are encountering similar problems, the cultivation of sweetcorn has been expanding and fields are being left fallow due to labour

shortages. Against this backdrop, Akaike set up nine plots in a field where cabbage is continuously cropped as shown in Table 3.1 (Akaike, 1992).

Table 3.1 Effects of sweetcorn introduction on outbreaks of cabbage clubroot

Plot	1988	1989	1990	1991
1	SC	88	SC	49
2	SC	SC	14	82
3	SC	SC	SC	2
4	FL	95	FL	66
5	FL	FL	30	79
6	FL	FL	FL	15
7	90	100	100	97
8	42+P	50+P	64+P	48+P
9	4+C	12+C	4+C	1+C

Source: Akaike, 1992.
Notes: Figures show the index of severity of clubroot (0-100).
Figures also show cultivation of cabbage.
SC: Sweetcorn.
FL: Fallow; +P: PCNB; +C: Chloropicrin.

Sweetcorn cultivation and fallow fields were used at three different frequencies on the continuous cropping field. For a control, plots with continuous cabbage cropping with or without the application of chemicals (PCNB or chloropicrin) were also established.

The results are shown in Table 3.1. The cultivation of sweetcorn over a three-year period suppressed the outbreak of clubroot almost completely. The effect of fallow fields was more limited but displayed a similar tendency. The introduction of sweetcorn or fallow fields for two years did not control the disease completely but was effective. The rotation of cabbage and sweetcorn led to a decrease of the incidence of clubroot. Therefore, three or four-year rotations for cabbage cultivation in fields with severe outbreaks can be recommended. Although sweetcorn is more effective at combating the disease, the main constraint of sweetcorn was the lack of host plants in the summer season. It should be emphasized that the resting spores of *P. brassicae* can survive for long periods in the soil, however, short-term crop rotation can alleviate the most severe damage.

3.2.2 Radish as a trap crop of clubroot disease

Clubroot is widely observed in Japan because not only important vegetables in the cruciferous family, such as cabbage, Chinese cabbage, radish, cauliflower, broccoli but also many other kinds of minor leafy or root vegetables are widely cultivated and most of them are host plants of clubroot. Resting spores are easily activated by root exudates from not only the root of a susceptible plant but also the root of a resistant plant (Suzuki *et al*., 1992),

suggesting that the trap effect could be obtained. Recently, it was reported that clubroot in Chinese cabbage cultivation has been controlled using trap crops.

Yamada *et al.* (1997) cultivated resistant radish varieties and Chinese cabbage was transplanted post harvest. Clubroot spores were activated by radish cultivation but could not multiply in the root of the resistant varieties and their number decreased. To maximize the effect, Chinese cabbage has to be cultivated carefully in many aspects such as the planting position of the seedlings, application of fertilizer and moreover the re-use of mulching film to prevent contamination with polluted soil. When the Chinese cabbage was transplanted, adding 5-7 grams of calcium cyanamide into the holes is recommended to enhance the effects.

In another report, resistant radish varieties (Watanabe and Iwase, 1997) were grown for two months and incorporated into soil. In this study, radish could not be harvested, but many methods of sowing radish, including broadcasting, could be employed. Ploughing the radish must be performed one month before transplanting the Chinese cabbage to obtain the best results.

3.2.3 Other environmentally friendly technologies for the control of plant diseases

In Tochigi prefecture, there is a famous and special cultivation of *Kanpyou*; bottle gourd (*Lagenaria siceraria* STANDLEY *var. hispida* HARA). Farmers traditionally grow bottle gourd with Welsh onion (*Allium fistulosum L*.) because they know that damage attributable to fusarium wilt is mitigated by mixed cropping. Arie *et al.* (1987) showed the mechanism of this phenomenon as the beneficial effect of endophytes. They showed that *Pseudomonas gladioli* multiplied in the below-ground parts of the Welsh onion and reduced fusarium wilt of bottle gourd.

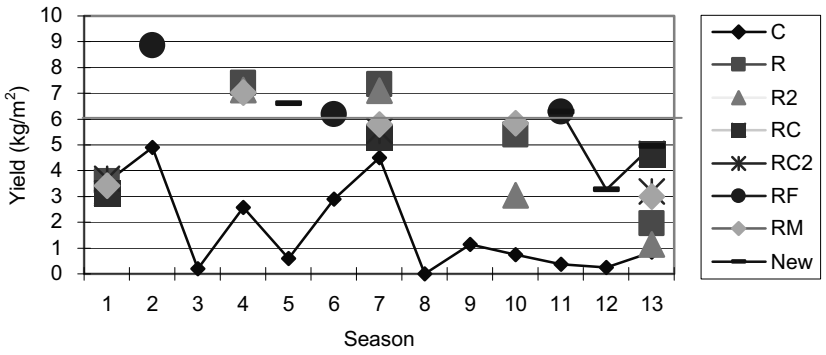
Yellows of Chinese cabbage is a major problem in the largest production area, namely, Ibaraki prefecture. Watanabe *et al*. (1999) obtained good results by selecting resistant varieties and combining them with the inoculation of endophytes. This method can be applied in fields with mild or moderate outbreaks. Many attempts have been made to apply these technologies to many kinds of vegetables; however, as a general method to curb diseases, dissemination is limited because of unstable results. Notwithstanding, as shown in the case of Chinese cabbage, stable results can be obtained by determining the conditions of application. In terms of clubroot, no successful results using this technology have been obtained.

3.3 Controlling clubroot using short-term crop rotation in the highlands of West Java

Indonesia is a typical tropical island country with numerous mountains and volcanoes. This geographical condition is suitable for temperate vegetable cultivation throughout a year, which has lead to continuous or high-frequency cropping of cabbage and other cruciferous plants, such as Chinese cabbage, *pakchoy* and so on, especially in areas close to large cities, resulting in severe incidence of clubroot damage. To resolve the clubroot problem in cabbage production, short-term crop-rotation systems, namely three crop-rotation cycles per year, were designed and investigated under field conditions. Combined vegetable crops were selected from carrot and potato that are widely produced in highland areas. As a control, continuous cropping (C) of these vegetables was designed and two-crop sequences in the cropping combinations (R and R2) were set up. The insertion of fallow periods for one cropping season (RF) was also tested because in many places cropping is limited by insufficient water supply during the dry season. The effects of corn cultivation (RC) and mixed rotation cropping (RM) were also investigated. Regarding the abbreviations, R stands for rotation; RC for rotation with corn after every rotation of R; and R2 is also a rotation but in a different order than R. Consequently RC and RC2 became two-year crop rotations.

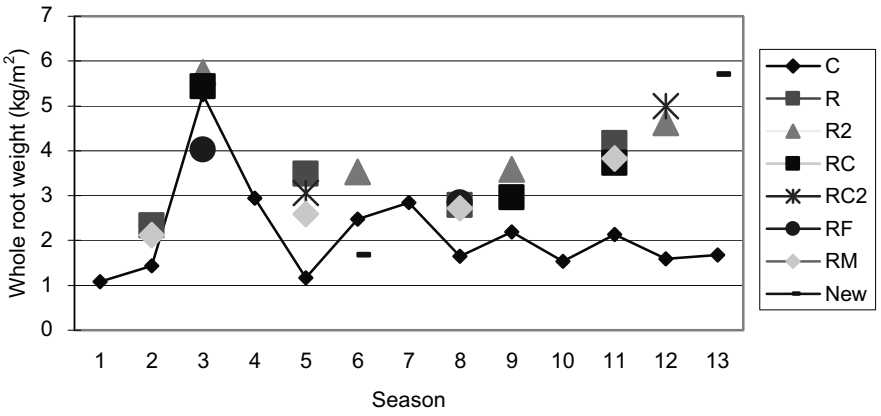
The yield trend of continuous cropping of cabbage is shown in Figure 3.1. Data connected by lines show the yields of continuous cropping (C) plots. In the first season, yields in all the cabbage plants were rather low because of improper pest management, especially diamondback moths, but without the severe damage symptoms of clubroot disease. From the second season until the sixth, yields in the continuous cropping plots showed large fluctuations but were consistently lower than those of the crop-rotation plots or non-continuous cropping plots. However, after season 10, some of the one-year crop-rotation plots began to show unsatisfactory yield levels. The cabbage yield level of the one-year crop rotation is unsustainable for long and repeated employment. Instead, longer term crop rotation, namely RF showed more stable and higher yields. These results suggest that one-year crop rotation, cabbage-carrot-potato, can alleviate the losses attributable to clubroot but not to the initial level. Therefore, an additional fallow period in the dry season is required. As the fields are without irrigation water and consequently it is very difficult to grow vegetables in the dry season, it is practical to leave the field fallow. Even if the one-year crop rotation must be modified for long-term stabilization, it is still very short term compared to spore longevity.

Figure 3.1 Effect of crop rotation on cabbage yield



Source: By author.

Figure 3.2 Effect of crop rotation on carrot yield



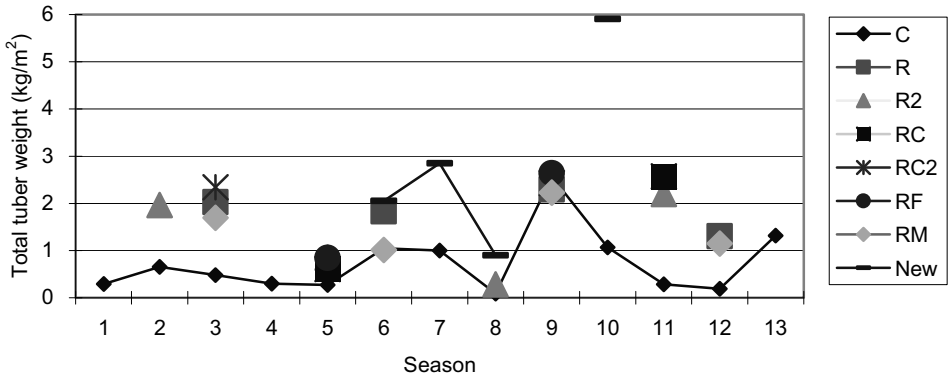
Source: By author.

Crop rotation showed some beneficial effects on cabbage cultivation, but for the evaluation of the system as a whole, results from carrot and potato rotation cultivation should be considered. The yield trend of carrot in the continuous cropping is shown in Figure 3.2. No severe damage by pests was observed. As a result, no bad effects, despite continuous cropping, were observed until season seven but subsequently, the yields from crop-rotation plots gradually increased. According to the observation, initial growth of the

continuous plots was hampered greatly but recovered in late growth from season eight. As with the middle or late growth, there were no symptoms of disease in the continuous plots, the poor initial growth may stem from a lack of manure application over long periods of time. In the case of rotation plots, manure was applied in the cultivation of combination crops.

In the case of potato, wilting and dying of the top part of the plant were observed at the early stage on the continuous plots from the second planting and the phenomenon worsened with the advance of planting. The yield of potato in the continuous plots was severely stunted as shown in Figure 3.3. A side effect of the poor growth affecting the top part of the plant in the early stage was that tubers became smaller and the number of rotten tubers increased. As a result, the weight of tubers in the continuous plots was only 1/3 of those in the rotation plots in the third season. The sequence of rotation did not affect the recovery of damage in the same way as the cabbage plants.

Figure 3.3 Effect of crop rotation on potato yield



Source: By author.

Thus, crop rotation had positive effects on all of the combined plants. However, if the combination is restricted, the utilization of cropping systems becomes difficult for the farmers. Many plants and fallow periods under various conditions were tested to evaluate the ability to eliminate clubroot damage. Before the evaluation, severely infested fields were created by continuous cabbage cropping as shown in Figure 3.4. Eight months of cultivation, corresponding to two growing seasons for cabbage, were undertaken as shown in Figure 3.5. Short-period plants such as lettuce and radish were grown several times and long-period plants such as peanut and chilli were grown once. After eight months of

cultivation on these plots, cabbage was planted on all the plots and growth and yield were compared.

Figure 3.4 The clubroot infested field

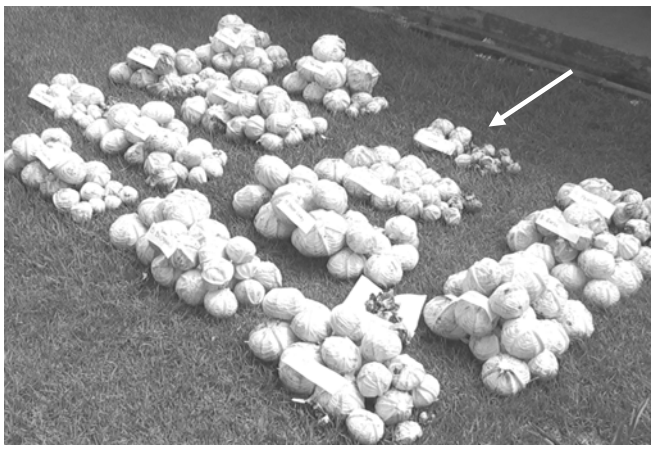
Source: By author.

Figure 3.5 Cultivation of many plants in the infested field

Source: By author.

Figure 3.6 Harvested cabbage cropped after the cultivation of various plants

(the second right of the backmost row is the continuous cabbage cropping)

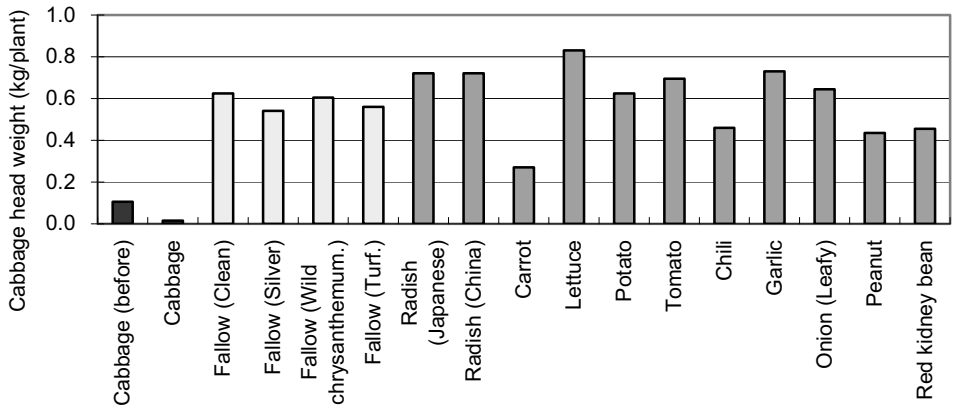


Source: By author.

As shown in Figure 3.6, all kinds of plant cultivation were effective in reducing clubroot damage. Details are shown in Figure 3.7. Using fallow periods under clean conditions, silver mulching film and weeding showed almost the same positive effects. Potato and Welsh onion cultivation fared equally to fallow periods. The affect of radish, lettuce and garlic was greater than just fallow periods but that of peanut, red kidney bean and carrot cultivation was lower. Although the effect on reducing clubroot damage varied

between the crops introduced, all non-host plants reduced clubroot damage. Farmers can decide upon a combination of crop rotation that fits both their field and economic conditions taking into consideration the infestation level and efficiency of selected plants.

Figure 3.7 Effect of crop cultivation on recovering from clubroot damage



Source: By author.

3.4 Future perspective

As mentioned previously, although many environmentally friendly technologies have been developed, their application in farmers' fields is not common. As the selection of cropping is based on or strongly affected by economic aspects such as the prices of vegetables, available capital, land ownership, labour and agricultural machinery availability, improved cropping systems are often in conflict with farmer selections. Moreover, cropping systems are usually specific or adapted to the environment tested and difficult to generalize. Therefore, to widen the range of crops for selection and clarify the process of finding proper cropping systems, the expected effects are important for the adoption of these technologies. However, it is very important to prevent severe outbreaks of known or unknown pests and also prevent the excess use of agro chemicals based on environmentally friendly agricultural technology to utilize the effects of crop combinations. The development of new technologies compatible with the economic and natural conditions of a particular environment is very important. In this regard, a participatory approach involving close collaboration with researchers and farmers should be advocated to identify the most suitable technologies for specific systems.

4. The Farmers' Perceptions and Economic Feasibility of Crop Rotation to Reduce Clubroot Damage in the Highlands of West Java

Tomohide Sugino[*]*, Henny Mayrowani*[**]*, Trisna Subarna and Titiek Maryaty*[***]

Abstract

The highland area of West Java is one of the production centres of vegetables in Indonesia. However, rapid growth in vegetable production has lead to intensive production in the area and, consequently, soil borne diseases, especially clubroot affecting cruciferous vegetables, have become a serious problem. The profitability of crop-rotation technology, which was developed through collaborative research between Japan and Indonesia was surveyed. Experiments on the farmers' fields have shown the profit generated from crop rotation is higher than continuous cabbage mono-cropping in the long run. In interviews to evaluate the farmers' acceptance of the technology, the farmers gave relatively high scores to the technology in terms of visibility of effect, low risk as well as profitability. An effective shift in the cropping pattern to prevent the disease was observed in villages where dissemination activities were implemented. However, farmers' knowledge remains insufficient, which is reflected by the fact that the cropping patterns used by the farmers are not necessarily the best ones to control clubroot. It is important to underpin dissemination activities through close collaboration between researchers and policy planners to realize the potential effects of crop rotation.

Keywords: dissemination, *Plasmodiophora Brassicae*, technology, vegetable.

4.1 Introduction

Horticulture, including vegetables, in Indonesia has four important roles, namely (i) a source of nutrition, especially vitamins and minerals; (ii) a source of employment and income as high-value commodities; (iii) a source of raw material for agro-industry; and

[*] JIRCAS, Japan (During the study period, assigned as Project Leader of AGRIDIV, UNESCAP-CAPSA, Bogor, Indonesia).
[**] ICASEPS, Bogor, Indonesia.
[***] AIAT West Java, Indonesia.

(iv) a source of foreign exchange through commodity exports (Anonymous, 2005). Though the consumption of vegetables has remained almost stable and, indeed, domestic production has shrunk, the per capita supply of vegetables is low, namely 80 grams per day per capita in 2003 (calculated from FAO, 2006), which is far below the recommended vegetable intake in industrialized countries of 2.5 cups per day (HHS and USDA, 2005).

Highland areas of West Java represent one of the vegetable production centres in Indonesia. The area has various advantages for vegetable production such as the short distance from consumption areas like Jakarta and Bandung, a moderate climate that is suitable for temperate zone vegetables and the extended experience of farmers in terms of vegetable cultivation.

However, with the rapid growth in vegetable production, intensive production has become very common in the area and soil borne diseases have become a serious problem due to continuous mono-cropping, excessive use of chemicals and inadequate knowledge of diseases by local farmers. Many farmers in the area suffer from clubroot in their fields (Table 4.1). Of the temperate zone vegetables, cabbage, cauliflower, Chinese cabbage and some others in the cruciferous family can be relatively lucrative. The production of these crops in Lembang, West Java has expanded but faces losses attributable to clubroot disease, which prevails as the primary cause of continuous cropping loss in the highlands of West Java (Yamada *et al*, 2005). Recently, this has lead to a contraction in the production area (Table 4.2).

Clubroot is a disease caused by *Plasmodiophora Brassicae*, which is a fungus of the myxomycete variety. It attacks plants belonging to the cruciferous family. When a plant is infected, its roots become swollen and its leaves may also wilt during the hottest part of the day. Premature death, stunted growth and poor head quality are also symptoms associated with clubroot, which often spur economic losses as a result of outbreaks (Christensen, 2005).

Table 4.1 Number of farmers who observed clubroot in their fields

	Langensari		Cibodas	
	Farmers	%	Farmers	%
Observed	17	85	14	70
Not yet	3	15	6	30
Total	20	100	20	100

Source: Field study, 2005.

Table 4.2 Production trends of major vegetables in Lembang

Year	Cabbage			Chinese cabbage			Green bean			Tomato		
	Harvested area (ha)	Production (ton)	Yield (ton/ha)	Harvested area (ha)	Production (ton)	Yield (ton/ha)	Harvested area (ha)	Production (ton)	Yield (ton/ha)	Harvested area (ha)	Production (ton)	Yield (ton/ha)
1998	285	21 157	74	385	5 775	15	430	1 616	3.8	398	7 883	19.8
1999	237	18 531	78	390	5 802	15	181	578	3.2	428	3 597	8.4
2000	317	22 760	72	380	5 994	16	410	1 347	3.3	508	5 462	10.8
2001	322	23 360	73	9	135	15	179	529	3.0	413	6 387	12.5
2002	250	18 078	72	268	402	2	205	820	4.0	543	6 435	11.8
2003	220	5 374	24	523	785	2	452	3 976	8.8	839	17 819	2.2
Growth (%/year)	-4.56	-14.92	-13.42	7.17	-17.28	-18.00	1.02	29.22	26.83	22.16	25.21	1.45

Source: Lembang Extension Center, 2003.

Since spores of clubroot can survive in the soil for around seven years, long-term (6 to 10 years) crop rotation away from Cruciferae is recommended. However, this is unrealistic if we consider the small size of fields belonging to the vegetable farmers in Lembang (0.30-0.33 hectares per household, see Chapter 5). Collaborative research between JIRCAS (Japan International Research Center for Agricultural Sciences) and IAARD (Indonesian Agency for Agricultural Research and Development) has concluded that crop rotation excluding Cruciferae for two or three cropping seasons (8 to 12 months) can prevent outbreaks of the disease (Yamada *et al*, 2005). This appears to be more acceptable than long-term crop rotation considering the small size of landholding in the area. However, the economic feasibility of such a proposal had yet to be evaluated.

In this chapter, the results of the field experiments and surveys focused on the economic feasibility of crop-rotation technology and farmer acceptance of the developed technology is described. The study was implemented from February 2004 to June 2005.

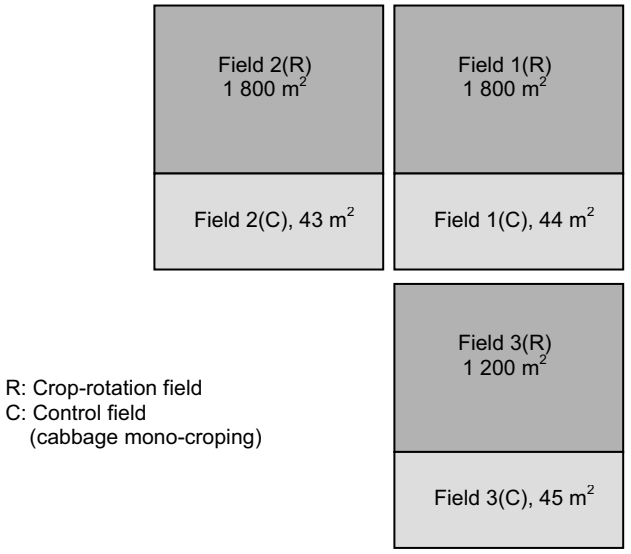
4.2 Methods

The study was carried out in two villages, Langensari and Cibodas in Lembang sub-district, Bandung district, West Java province, Indonesia. Both villages are located around 12 kilometres north of Bandung city, the provincial capital of West Java and 120 kilometres from Jakarta. The condition of transportation infrastructure is good. Both villages are connected with other areas by paved roads and can be reached within 30 minutes from Bandung and 3 hours from Jakarta. According to the information collected from the extension centre in Lembang, as of 2003, Langensari had 9,403 residents in 2,372 households, including 1,779 farm households. Conversely, Cibodas recorded 8,257 residents in 2,128 households, including 1,915 farm households.

Two collaborate farmers (Mr. D and Mr. N) were selected in Langensari who cultivate upland crop fields of 0.18 ha (Field 1) and 0.30 ha (Fields 2 and 3). The land of the latter is divided into two parcels (0.18 ha + 0.12 ha) (Figure 4.1). Each field is divided into two parts, namely a crop-rotation field and a control field. The control fields, on which continuous cabbage mono-cropping was practised during the study period, are much smaller than the crop-rotation fields. Clearly it is difficult to ask the collaborative farmers to allocate larger fields for cabbage mono-cropping due to the expected losses caused by clubroot. Having been explained the various crop rotations to prevent clubroot, the farmers selected cropping patterns in accordance with crop-rotation technology developed by the JIRCAS-IAARD project (Figure 4.2). After four cropping seasons, the data regarding cost, revenue,

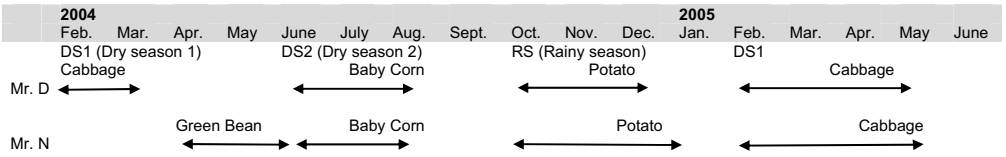
production and outbreaks of clubroot disease were collected from the farmers. The field experiment was carried out from February 2004 to June 2005.

Figure 4.1 Location of the experimental fields



Source: By authors.

Figure 4.2 Cropping patterns of collaborate farmers



Source: By authors.
Note: DS (Dry season); RS (Rainy season).

On-site meetings with farmers of Langensari village were organized both at the beginning (15 May 2004), to introduce the technologies, and the end (14 May 2005), to collect feedback of the experiment. A brochure to explain the technology was printed in the national language (*Bahasa Indonesia*) and distributed to farmers in Langensari village for further dissemination of the technology. Farmers were also interviewed using questionnaires after the respective meetings.

The first survey primarily sought to investigate the usefulness of the brochure and gauge farmer opinion of the new technologies. It was conducted in Langensari village where the experimental fields were located and the number of respondents was 30. Subsequently,

how farmers evaluated the new technology based on the five criteria shown in Table 4.3 was surveyed in Langensari village. The number of respondents was 18.

Another survey was conducted in September 2005, which focused on how farmers altered their own cropping pattern during the study. This was done simply by ascertaining their cropping pattern prior to as well as after the field experiments and comparing the change in both Langensari and Cibodas. The number of farmers surveyed was 20 in each village.

Table 4.3 Evaluation criteria for crop rotation

Profitability: How much has the new technology contributed to farm profits?
Adaptability: How well has the technology been adapted to the farmers' social and economic conditions?
Simplicity: How simple is the technology to apply in the fields?
Risk: How much exposure to risk is there when adopting the new technology?
Visibility: How visible are the results of the new technology observed by farmers?

Source: Questionnaire survey, 2004.

The evaluation was conducted by choosing the respondents' perception from four options (very high, high, low, very low), which were converted into points, namely 3, 2, 1 and 0 respectively.

4.3 Results and discussions

4.3.1 Effectiveness and profitability of crop rotation to mitigate clubroot

The cabbage yield in the first cropping season was 11.8-14.8 tons per hectare (Table 4.4), which is far below the average cabbage yield in the study area, namely 64 tons per hectare representing the average cabbage yield in Lembang sub-district from 1999 to 2003 (average yield figures are from the extension centre in Lembang). This suggests that the experimental fields were already highly affected by clubroot. The cabbage yield in the control fields (continuous cabbage mono-cropping) dropped further in the second crop season and did not recover. In the fourth season, the cabbage yield in the crop-rotation fields was monumentally higher than the control fields in all three study fields, which suggests that crop rotation can prevent clubroot and boost yields.

The profit structure of the cropping system in the experimental fields is presented in Table 4.4. The profits of alternative crops such as bean, maize and potato are lower than the profit of cabbage in the crop-rotation fields in the fourth cropping season, which was considered less affected by clubroot. However, if we compare the profit of the cropping

system over a longer time frame, namely, total profit of four cropping seasons; it is clear that continuous cabbage mono-cropping is less profitable than crop rotation due to the fall in yield in the long run. The study has proved that the profits generated by crop rotation are higher than continuous cabbage mono-cropping in the long run, which implies the technology has sufficient economic feasibility for further dissemination.

Table 4.4 Production costs, profits and yields of the experimental fields

(rupiah per hectare, except yield)

	Field 1		Field 2		Field 3	
	Rotation	Control	Rotation	Control	Rotation	Control
Cropping Pattern	Cabbage-Maize-Potato-Cabbage	Cabbage-Cabbage-Cabbage-Cabbage	Bean-Maize-Potato-Cabbage	Cabbage-Cabbage-Cabbage-Cabbage	Bean-Maize-Potato-Cabbage	Cabbage-Cabbage-Cabbage-Cabbage
	F1R	F1C	F2R	F2C	F3R	F3C
1st	Cabbage	Cabbage	Bean	Cabbage	Bean	Cabbage
Material	4 913 889	3 047 922	2 694 444	3 397 945	3 158 333	3 465 784
Paid labour	2 168 333	0	2 589 444	0	2 230 000	0
Others	1 000 000	0	1 000 000	0	1 000 000	0
Total cost	8 082 222	3 047 922	6 283 889	3 397 945	6 388 333	3 465 784
Revenue	12 589 444	10 038 610	7 305 833	10 123 774	7 844 167	10 507 726
Yield (t/ha)	14.8	11.8	5.8	11.9	5.3	12.4
Profit	4 507 222	6 990 688	1 021 944	6 725 829	1 455 833	704 194
2nd	Maize	Cabbage	Maize	Cabbage	Maize	Cabbage
Material	1 944 444	3 236 430	1 944 444	3 164 409	3 033 333	4 061 810
Paid labour	1 009 444	0	1 682 222	0	1 732 500	132 450
Others	1 000 000	0	1 000 000	0	1 000 000	0
Total cost	3 953 889	3 236 430	4 626 667	3 164 409	5 765 833	4 194 260
Revenue	5 950 000	6 041 335	5 595 833	7 099 486	7 260 417	7 130 243
Yield (t/ha)	7.2	3.2	7.0	3.7	8.5	3.8
Profit	1 996 111	2 804 906	969 167	3 935 077	1 494 583	2 935 982
3rd	Potato	Cabbage	Potato	Cabbage	Potato	Cabbage
Material	32 075 000	3 725 301	31 202 778	3 222 793	38 266 667	4 282 561
Paid labour	4 491 667	0	4 375 000	0	5 100 000	0
Others	1 000 000	0	1 000 000	0	1 000 000	0
Total cost	37 566 667	3 725 301	36 577 778	3 222 793	44 366 667	4 282 561
Revenue	45 463 333	6 904 383	44 965 278	7 099 486	52 495 833	7 549 669
Yield (t/ha)	20.6	3.6	19.0	3.7	23.3	4.0
Profit	7 896 667	3 179 082	8 387 500	3 876 693	8 129 167	3 267 108
4th	Cabbage	Cabbage	Potato	Cabbage	Potato	Cabbage
Material	8 366 667	3 258 006	7 947 778	3 372 256	11 921 667	4 247 241
Paid labour	3 351 111	0	2 750 556	0	4 009 167	0
Others	1 000 000	0	1 000 000	0	1 000 000	0
Total cost	12 717 778	3 258 006	11 698 333	3 372 256	16 930 833	4 247 241
Revenue	31 000 000	7 358 619	28 708 333	6 725 829	42 375 000	7 947 020
Yield (t/ha)	30.6	4.1	28.3	3.7	41.9	4.4
Profit	18 282 222	4 100 613	17 010 000	3 353 573	25 444 167	3 699 779

Source: Field experiment, 2004-2005.

4.3.2 Dissemination and evaluation of the technology

The results of the first interviews, conducted after the dissemination of the brochure explaining crop-rotation technology, showed that all 30 respondents were interested in the crop-rotation technology described in the brochure. The results of the second round of interviews seeking to investigate the farmers' evaluation of the crop-rotation technology are shown in Table 4.5. The results indicate farmers allotted the highest score to 'visibility', followed by 'profitability' and 'risk'. The scores undoubtedly reflect the high visibility of the technology, that is, that farmers can see the dramatic effects of the technology by comparing the experimental fields to the control fields. Furthermore, the scores reflect the low risk exposure of the technology, that is to say crop rotation does not require specific inputs or additional investment. The high score for profitability suggests that although the profit generated by alternative crops is lower than cabbage, farmers clearly understand the benefit of crop rotation in the long run.

Table 4.5 Farmers' evaluation of crop-rotation technology

	Profitability	Adaptability	Simplicity	Risk	Visibility	Total
Average score	2.39	1.22	1.94	2.28	2.61	10.44
Total score/Full score (3*5=15)						0.70

Source: Interview survey, 2005.

It is important to explore how farmers altered their cropping pattern after witnessing the occurrences in the experimental fields and taking part in the dissemination activities. Table 4.6 shows the cropping patterns before and after the field experiments. The cropping patterns were classified into three categories from the viewpoint of clubroot prevention. Pattern 0 indicates that all three crops cultivated in the three cropping seasons of a given year are cruciferous vegetables susceptible to clubroot (Cabbage – Chinese cabbage – Cauliflower). Pattern I indicates that alternative crops resistant to clubroot are cropped in one of the three cropping seasons in a given year (for example, Cabbage – Chilli – Cabbage). Pattern II indicates that alternative crops were cropped in more than two of the three cropping seasons in a given year. Since fallow periods have positive effects on preventing clubroot similar to crop rotation (Yamada *et al*, 2005), a fallow season was given the same status as an alternative crop. For example, Cauliflower – Tomato – Fallow is classified as pattern II.

The results showed that before the field experiments (2003/04), 50 per cent (Langensari) and 65 per cent (Cibodas) of surveyed farmers in the two study villages implemented pattern II, which is appropriate in terms of clubroot prevention. On the other

hand, after the field experiments (2004/05), the ratio of farmers using pattern II in Langensari increased to 60 per cent, while in Cibodas it fell to 55 per cent. The results suggest that the field experiments and dissemination activities in Langensari had positive impacts on the farmers in the village to alter their cropping pattern to prevent clubroot damage. However, the negative changes observed in Cibodas, which neighbours Langensari, are due to the lack of field experiments and dissemination activities carried out.

Table 4.6 Change of crop-rotation system before and after the project (number of farmers)

	Langensari			Cibodas		
Pattern	2003/04	2004/05	Change	2003/04	2004/05	Change
0	3	1	-2	0	0	0
I	7	7	0	7	9	2
II	10	12	2	13	11	-2
Total	20	20		20	20	
Ratio of II (%)	50	60	+10	65	55	-10

Source: Interview survey, 2005.

Notes: Pattern 0: B (Brasica)-B-B; Pattern I:B-B-O(Other crop, incl. fallow), B-O-B, O-B-B; Pattern II=B-O-O, O-B-O, O-O-B, O-O-O.

It is interesting to note that 50 to 65 per cent of the surveyed farmers practised crop rotation even before the experiment began. However, it is unlikely that the farmers applied crop rotation based on accurate information regarding clubroot prevention. Though more than 90 per cent of the surveyed farmers answered that they were applying crop rotation to prevent clubroot (data not shown), the cropping patterns of 40 per cent and 35 per cent of farmers in the respective villages in 2004/05 were still categorized as pattern 0 or I. This implies that their cropping patterns still have room to be improved. The major constraint is that farmers have several misgivings surrounding the new technology. For example, some farmers practise mixed cropping of cruciferous vegetables and non-cruciferous vegetables in the same field, which reduces the effect of crop rotation. During the study period, we received support from the extension staff in the area but the manpower and resources of the extension organization are very limited, which is a common constraint confronting developing regions. More efforts and policy supports are required to transfer accurate and timely information about soil borne disease prevention to farmers. It has also been recognized that many relevant technologies are not achieving their full potential impact because of low levels of adoption (Menter *et al*., 2004). Therefore, more attention should be paid to the effectiveness of research to produce adoptable technological options. It is crucial to bolster institutional support for dissemination activities through close collaboration between researchers and policy planners to realize the potential effects of crop rotation.

5. Economic Conditions and Cropping Patterns of Vegetable Farms in Highland Areas
(Case study in Lembang, Bandung, West Java)

Adang Agustian[*]*, Henny Mayrowani*[*] *and Trisna Subarna*[**]

Abstract

Vegetables in Bandung district can be relied upon as a source of income for the rural community. Some vegetables such as cabbage, cauliflower and tomato have the potential to develop with production at 221,685, 21,132 and 91,884 tons respectively. The total number of agricultural households in Bandung district is 758,727 households, and average land occupation is 0.30 hectares per farmer. This study was conducted in Lembang, West Java in December 2004, in two sample villages: Langensari and Cibodas. Primary data was collected through interviews with vegetable farmers (cabbage, cauliflower and tomato) and secondary data was collected from published statistical data, reports and other documents from related institutions. Results of the study show that: (i) the average respondent is of productive age with an average education level of 7.22 years in Langensari and 7.29 years in Cibodas. The primary occupation is upland vegetable farming, accounting for 95.65 per cent of respondents in Langensari and 94.12 per cent in Cibodas; (ii) average land holding is 0.33 hectares in Langensari, and 0.30 hectares in Cibodas. Pawn and share systems are not developed at the research sites, but the rental system is very popular for upland farms; (iii) farm profit per hectare per season for upland farms in Langensari is as follows: Rp 2,619,582 for cabbage; Rp 8,837,561 for cauliflower; and Rp 3,386,356 for tomato; while in Cibodas: Rp 1,142,705 for cabbage; Rp 10,135,756 for cauliflower; and Rp 10,135,756 for tomato; (iv) Average household income in Langensari is Rp 10,775,761 per annum. Vegetables (62.39 per cent) contribute the highest share to household income, which is the same in Cibodas with average income of Rp 8,846,984.71 per annum and 69.81 per cent originating from vegetable farming; and (v) with an average total household of four members, per capita income can be calculated as Rp 2,693,940.35/capita/year in Langensari and Rp 2,211,746.18 /capita/year in Cibodas.

[*] ICASEPS, Bogor, Indonesia.
[**] AIAT West Java, Indonesia.

Keywords: socio-economic characteristic, vegetable farm, cabbage, cauliflower, tomato.

5.1 Introduction

Vegetables in Bandung district are relied upon as a source of income for the rural community. Some vegetables such as cabbage, cauliflower and tomato have the potential to develop in highland areas because of the suitable climate and market.

Sutrisno (2000) stated that, generally, horticultural farms have a small and scattered area, which is located far from market or collectors. This condition is exacerbated by the characteristics of horticultural products, namely bulky and perishable. This makes it difficult for collectors or traders to collect the product from farmers in huge amounts based on market demand. Lembang is more suitable compared to other vegetable production centres because of its close proximity to consumers in large city such as Bandung and Jakarta. Vegetables from Lembang are also distributed to other large cities in Java and outer Java. The contribution of vegetables to household income is more than 60 per cent. Vegetable farms are market oriented because the product is primarily for market.

At least four factors should be considered in terms of managing a vegetable farm, including: (i) the socio-economic environment; (ii) farmer characteristics; (iii) technology; and (iv) supporting policy. Landholding or land occupation and farm household conditions are closely related to farm businesses. In this chapter we focus on the analysis of vegetable farm households and financial analyses for cabbage, cauliflower and tomato farms.

5.2 Methodology

The study was conducted in Lembang sub-district, Bandung district, West Java in December 2004. The actual study sites were in Langensari and Cibodas villages. The location was chosen based on the potential of the area as a vegetable production centre for cabbage, cauliflower and tomato. Such commodities were chosen as popular commodities that are grown by farmers usually in crop rotation. A sample of 40 farmers (Langensari: 23, Cibodas: 17) were selected purposively. Respondent farmers are members of *Kelompok Tani* (Farmer Group) Sarimukti and other farmers in *Kelompok Tani* Mekartani Jaya in Cibodas. *Kelompok Tani* Sarimukti is a collaborative farmer group for the field feasibility study of cabbage crop rotation (see Chapter 4).

Primary data was collected through interviews with vegetable farmers (cabbage, cauliflower and tomato); and secondary data was collected from the annual reports, reports

of other studies, statistical books and other documents from several related institutions such as: the Agricultural Office of Bandung District and the Central Bureau of Statistics. Primary data was analysed using descriptive qualitative methods in the form of tables.

Vegetable farm costs and income were analysed using the following formulae:

Πust = TR - TC

Π rt = Πust + Πust other + Πnp

Share Πi (%) = (Πi/ Πrt) x 100

Where: Π ust = farmer income from vegetable farm
Π rt = household income
Πust other = farmer income from other farm
Π np = non-agricultural income
TR = Total return of vegetable farm
TC = Total cost of vegetable farm

5.3 Results and discussion

5.3.1 Description of research site

Lembang is one of the highland vegetable production centres in West Java, with a total area of 10,637.945 hectares, of which upland areas account for 4,367.701 hectares. The total population is 130,424 representing 34,632 households (2003). Lembang sub-district contains 16 villages with 27 farmer groups. The major source of farmer income is from vegetables. Cabbage, cauliflower and tomato are the most popular vegetables grown by farmers in Lembang.

The harvested areas of cabbage, cauliflower and tomato in Bandung district are shown in Table 5.1. In 2004, the harvested area of cabbage was 24,106 hectares with production of 231,685 tons; cauliflower was 1,055 hectares with production of 21,132 tons; and tomato was 2,321 hectares with production of 18,423 tons (Dinas Pertanian Kabupaten Bandung, 2004).

The harvested area of cabbage is tending to shrink, especially in Lembang, which is affecting the production of cabbage. In addition to the contraction of harvested area, lower cabbage production is affected by several factors as follows: (i) the modest cabbage prices are discouraging farmers from growing cabbage; (ii) lower soil fertility is hampering the productivity of cabbage; (iii) clubroot damage is impeding farm production; and (iv) the tendency of land conversion and fragmentation is reducing the amount of land available.

Table 5.1 Harvested area, production and productivity of vegetables in Bandung district, West Java, 2004

Commodity	Area (hectares)	Production (tons)	Productivity (tons/ha)
Cabbage	241 106	231 685	27.815
Cauliflower	1 055	21 132	20.031
Tomato	2 321	18 423	7.937

Source: Dinas Pertanian Kabupaten Bandung (Agricultural Office Bandung District), 2004.

5.3.2 Socio-economic characteristics of farm households

The variables of socio-economic characteristic analysed in this study are: the age of the household head; formal education of household head; primary employment of household head; total household members; total household members of working age; and average level of education of household members (not including household head).

As shown in Table 5.2, the average age of the household head is 44.83 years in Langensari and 45.41 years in Cibodas. The number of household members (>10 years old) is three in Langensari and four in Cibodas. Using family labour more optimally is expected to reduce the burden of cost and boost farm profit.

Table 5.2 Respondent characteristics in Lembang, Bandung, West Java, 2004

Description	Value	
	Langensari	Cibodas
Average age of HH head (year)	44.83	45.41
Average education level of HH head (year)	7.22	7.29
Primary employment of HH head (%):		
- Upland farm	95.60	94.12
- Lowland farm (*sawah*)	0	0
- Estate crops	0	0
- Livestock	0	0
- Fisheries	0	0
- Trader	0	5.88
- Home industry	0	0
- Government employee/Police/Army	0	0
- Farm labourer	0	0
- Non-farm labourer	0	0
- Student	0	0
- Others	4.35	0
Total household members (persons)	4	4
Total household members > 10 years old	3	4
Average education level of HH members	7.30	6.58

Source: Field survey, 2004.
Note: HH = households.

The average education level of the head of household in Langensari is 7.22 years and in Cibodas 7.29 years. This is equivalent to first grade elementary school. As a general rule, the education level is one of the key indicators of human resource quality. It follows that the higher the education level, the greater the farming knowledge and skill in managing their farm, especially in adopting newly introduced technologies. The average education

level of all household members is very similar with 7.30 years in Langensari and 6.58 years in Cibodas.

In terms of the primary employment of the household head, managing upland farms is dominant at the research sites. Nearly 96 per cent of respondents in Langensari and 94.12 per cent in Cibodas occupy upland farmland. The farmers cultivate vegetables, such as cabbage, cauliflower and tomato on upland farms. Other popular occupations include trading (5.88 per cent in Cibodas) and other activities such as *ojek* (motorbike taxi) accounting for 4.35 per cent in Langensari.

The average number of household members in Langensari and Cibodas is four, which will affect the farm in terms of potential human resources to develop the farm. This factor is crucial in boosting farm productivity.

5.3.3 Agricultural land asset holding and land rent value

The land asset holdings of farmers in this study are shown in Table 5.3. Most respondents occupied upland farmland. In Langensari, average ownership is 0.10 ha and non-ownership 0.23 ha, with average total occupation of 0.33 ha. In Cibodas, average land ownership is 0.16 ha, larger than in Langensari, while non-ownership is 0.14 ha, with average total occupation of 0.30 ha. Most farmers rent land to expand their farm area. The renting system is well developed in Lembang, meaning that farm land can be occupied for relatively long periods of time through the renting system. Rent payments are made periodically each year and time extensions are also available on an annual basis. The pawn and share system (*Gadai*) is not developed in upland Lembang. The pawn system is used to occupy land. Payments are paid at the beginning of the contract to the land owner. The period of the pawn system is unlimited and the contract remains binding until the owner of the land has repaid the full amount of money received at the beginning of contract. In such a case, it is the owner who needs money so he borrows money from a money lender and invites the lender to occupy his land. The land should be returned to the owner after the owner has settled the debt. The share system is a system for occupying land by sharing the inputs and outputs between the owner of land and the sharecropper. In most cases, input expenditure such as fertilizers, seeds and pesticides are divided among the owner and sharecropper; labour cost is the responsibility of the sharecropper and land tax is the responsibility of the owner. The net profit is divided into two parts, one for the owner and one for the sharecropper.

Rent value was calculated based on local land measurements (1 *bata* = 0.0014 ha) and on average is Rp 434,423.47 up to Rp 520,588.20 per 100 *bata*. Rental value is

different among the villages. In Langensari, the average is Rp 3,103,025 per hectare and in Cibodas the average is Rp 3,718,487 per hectare. Rent is paid at the beginning of contract and subsequently the land can be managed fully by the farmers who rent the land.

Table 5.3 Average agricultural land occupation in Lembang, Bandung, West Java, 2004

Item	Langensari			Cibodas		
	Land ownership	Non-land ownership	Total	Land ownership	Non-land ownership	Total
Irrigated lowland	0.00	0.00	0.00	0.00	0.00	0.00
Rainfed lowland	0.00	0.00	0.00	0.00	0.00	0.00
Upland	0.10	0.23	0.33	0.16	0.14	0.30
Garden	0.00	0.00	0.00	0.00	0.00	0.00

Source: Field survey, 2004.

5.3.4 Crop intensity and cropping patterns of upland vegetable farms

The study found that the average cropping intensity at the study site is 247.83 per cent in Langensari and 241.18 per cent in Cibodas (Table 5.4). This means that upland farmland is not fully cultivated in the third season (MK II: the second dry season) due to a lack of water.

Vegetable farming in Lembang, Bandung, generally commences with the start of the rainy season (MH) in September-October. During the rainy season, cultivation begins in September/October up to December/January; followed by the first dry season (MK I) from January/February to April/May and the second dry season from May/June up to August/September. In the second dry season (MK II), water is very limited and farmers tend to plant secondary crops such as sweet potato. In the second dry season, some vegetables grow near the sources of water like a river or wheel and pump irrigation areas.

The choice to grow vegetables in the second dry season has a consequence in terms of farm cost. Costs rise because there is the additional financial burden of paying for fuel as an irrigation cost. In both sample villages, vegetable farms in the second dry season have tended to rise in number because of the development of pump irrigation. Irrigation pumps are managed by the farmers who own the pumps. After using the pump on their own farm, the farmers rent the pumps to other farmers at a cost of Rp 1,300/*bata*/crop season, or Rp 950,000/ha/crop season.

Table 5.4 Crop intensity by cropping season and major problems related to vegetable cultivation in Lembang, Bandung, West Java, 2004

Location	Crop intensity (IP) (%)				Problems related to its cultivation and IP (%)			
	Rainy season	1st dry season	2nd dry season	Total IP	Labour problems	Lack of capital	Lack of water	Others
Langensari								
Irrigated	0.00	0.00	0.00	0.00	-	-	-	-
Rainfed	0.00	0.00	0.00	0.00	-	-	-	-
Upland	100.00	100.00	47.83	247.83	100.00	0.00	100.00	0.00
Cibodas								
Irrigated	0.00	0.00	0.00	0.00	-	-	-	-
Rainfed	0.00	0.00	0.00	0.00	-	-	-	-
Upland	100.00	100.00	41.18	241.18	100.00	0.00	100.00	0.00

Source: Field survey, 2004.

Cropping patterns at the research sites vary among farmers (Table 5.5). Furthermore, the combination of crops also differs among farmers. It appears a number of crops are used in the *tumpangsari* system (mixed-cropping), making cultivation more complex in such areas.

Actually, the varied cropping patterns provide positive impacts on the farms in the sense of: (i) protecting over supply to stabilize vegetable prices at the market; (ii) substituting other vegetable centre areas in case of excess demand or demand for certain kinds of vegetables that can not be fulfilled by other vegetable production centres; and (iii) as a reference of farmer freedom in cultivating the vegetables they choose to boost income. In the last two years, cropping patterns have witnessed widespread variety based on three key factors: (i) farmers can grow profitable, high-value commodities; (ii) some farmers apply crop rotation to maintain soil fertility; and (iii) farmers consider crops based on the availability of water in the third season (MK II).

As mentioned in Chapter 4, 85 per cent of cabbage farms in Langensari and 70 per cent in Cibodas are attacked by clubroot. Clubroot can destroy cabbage production but crop rotation is one solution to curb clubroot. A study by Yamada *et al*. (2005) showed that crop rotation reduced clubroot on cabbage fields.

Table 5.5 Cropping pattern at the research sites, Lembang, Bandung, 2004

Langensari village (n=23)	Cibodas village (n=17)
Cauliflower – Chinese cabbage – F (2)	Bean – Cauliflower – F (2)
Cauliflower – Cabbage – F (2)	Cauliflower – Broccoli – F
Cauliflower – Cauliflower – F (2)	Cauliflower – Cauliflower – F
Cabbage – Cabbage – F	Cauliflower – Bean – F (5)
Cabbage – Tomato + Green mustard + Bean – Cauliflower	Bean – Tomato – F
Cabbage – Cauliflower	Cauliflower – Bean – Tomato
Cabbage – Chinese cabbage + Tomato – Cauliflower	Cauliflower – Bean – Small chili
Cauliflower – Chinese cabbage + Tomato– F	Cauliflower – Bean – Cabbage
Cabbage – Cauliflower – Chili	Cauliflower – Broccoli – Cauliflower
Chili + Cabbage + Tomato – Bean – F	Cauliflower – Cauliflower – Bean
Cabbage – Chili – Cabbage	Bean – Cauliflower – Potato
Cauliflower + Small Chili – Cabbage – F	Cauliflower – Cauliflower – Cauliflower
Cauliflower – Tomato – F	
Cauliflower – Chili – Bean	
Cauliflower – Green mustard + Tomato – Cauliflower	
Bean – Cauliflower + Chili – F	
Cauliflower + Small chili – Sweetcorn – F	
Cauliflower – Bean – Cauliflower	
Cauliflower – Green mustard + Tomato – Small chili	
Cauliflower + Lettuce – Small Chili + Lettuce – F	

Source: Field survey, 2005.

Notes: Rainy season (MH) – First dry season 1 (MK I) – Second dry season 2 (MK II).
F: Fallow, +: Mixed-cropping, n: number of surveyed farmers.
Number in parenthesis means number of surveyed farmers who conduct the same cropping pattern. If no parenthesis, only one farmer conducts the cropping pattern.

5.3.5 Return, cost and profit of vegetable farms

Cabbage

Farm analyses of cabbage farms in Langensari and Cibodas are shown in Table 5.6. Average production of cabbage per hectare in Langensari is 9,420 kg. With a farm gate price of Rp 714.42/kg, the return on cabbage production is Rp 6,730,071 per hectare. The costs associated with cabbage farms, excluding family labour, total Rp 4,110,489 per hectare and profit per hectare is Rp 2,619,582. The R/C ratio is 1.64 meaning that every Rp 1 of expenditure returns Rp 1.64 from cabbage production.

In Cibodas, average cabbage production per hectare is 3,411 kg and the farm gate price is Rp 706.90/kg. Therefore, cabbage farm returns total Rp 2,411,765 per hectare. With farm costs totalling Rp 1,269,059 per hectare (excluding family labour), the profit of cabbage farms in Cibodas is Rp 1,142,706 and the R/C ratio is 1.90. Even though the R/C ratio of cabbage farms in Cibodas is higher than in Langensari, cabbage is not popular among farmers in Cibodas. Cabbage farms are limited in Cibodas because high-value vegetables for supermarkets have been introduced.

Cauliflower

An analysis of cauliflower farms are shown in Table 5.6. In Langensari, average production is 12,802 kg per hectare, with a farm gate price of Rp 1,254.47/kg the farmers can expect to receive Rp 16,059,783 per hectare from cauliflower cultivation. With a farm cost allocation of Rp 7,223,221 per hectare (excluding family labour), farmers can generate profit of Rp 8,837,562 per hectare. The R/C ratio of 2.22 means that for every 1 rupiah spent, Rp 2.22 is generated in profit per hectare of cauliflower cultivation in Langensari village.

Table 5.6 Farm analysis of cabbage, cauliflower and tomato production in Lembang, Bandung, West Java, MK II, 2004 (per hectare)

Item	Langensari	Cibodas
Cabbage	n = 8	n = 1
Production (kg)	9 420	3 412
Farm gate price (Rp/kg)	714.42	706.90
Return (Rp)	6 730 071	2 411 765
Cost (Rp)		
seed (kg)	4 533	2 942
(Rp)	235 417	88 235
labour : family (Rp)	337 500	158 824
hired (Rp)	756 612	416 118
fertilizer (Rp)	1 663 315	342 353
pesticide (Rp)	788 497	228 235
others (Rp)	666 649	194 118
Total cost : with fam. labour (Rp)	4 447 989	1 427 882
w/o fam. labour (Rp)	4 110 489	1 269 059
Profit (w/o fam labour) (Rp)	2 619 582	1 142 706
R/C ratio	1.64	1.9
Cauliflower	n = 20	n = 16
Production (kg)	12 802	14 400
Farm gate price (Rp/kg)	1 254.47	1 263.89
Return (Rp)	16 059 783	18 200 000
Cost (Rp)		
seed (kg)	26 214	23 060
(Rp)	820 201	823 529
labour : family (Rp)	1 260 072	934 471
hired (Rp)	1 582 156	1 860 118
fertilizer (Rp)	2 662 319	3 113 618
pesticide (Rp)	1 399 774	916 824
others (Rp)	957 772	1 350 155
Total cost : with fam. labour (Rp)	8 482 294	8 998 714
w/o fam. labour (Rp)	7 223 221	8 064 244
Profit (w/o fam. labour) (Rp)	8 837 562	10 135 756
R/C ratio	2.22	2.26

Source: Field survey, 2005.

Notes: in MK II price of cabbage and tomato relatively low; price of cauliflower relatively stable.
n = number of surveyed farmers.

Table 5.6 Farm analysis of cabbage, cauliflower and tomato production in Lembang, Bandung, West Java, MK II, 2004, (continued) (per hectare)

Item	Langensari	Cibodas
Tomato	n = 7	n = 2
Production (kg)	5 842	2 824
Farm gate price (Rp/kg)	866.67	1 033.34
Return (Rp)	5 063 406	2 917 647
Cost (Rp)		
seed (kg)	2 549	2 176
(Rp)	161 232	137 647
labour : family (Rp)	670 380	237 647
hired (Rp)	894 275	500 706
fertilizer (Rp)	512 288	645 882
pesticide (Rp)	1 097 455	673 176
others (Rp)	721 007	103 332
Total cost : with fam. labour (Rp)	4 056 737	2 298 391
w/o fam. labour (Rp)	3 386 357	2 060 743
Profit (w/o fam. labour) (Rp)	1 677 049	856 904
R/C ratio	1.5	1.42

Source: Field survey, 2005.
Note: in MK II price of cabbage and tomato relatively low; price of cauliflower relatively stable.
n: number of surveyed farmers.

In Cibodas, average cauliflower production is 14,400 kg per hectare. The farm gate price is Rp 1,263.89/kg and farmers can expect to receive a return of Rp 18,200,000 per hectare. The largest farm expenditure is spent on inputs such as seeds, fertilizer and pesticide, followed by the labour cost and other expenditure. Therefore, total cost is Rp 8,064,244 per hectare (excluding family labour) and the profit is Rp 10,135,756 per hectare. Cauliflower farms in Cibodas have an R/C ratio of 2.26.

Cauliflower cultivation is limited but practised throughout the year in Langensari and Cibodas. The price of cauliflower is relatively stable and higher than cabbage, therefore farmers are motivated to cultivate it.

Tomato

Tomato farm analysis is also shown in Table 5.6. Average tomato production per hectare is 5,842.37 kg and the farm gate price is Rp 866.67/kg. Farmers can expect returns of Rp 5,063,406 per hectare. The cost of tomato cultivation is Rp 3,386,357 per hectare (excluding family labour), therefore, profit is around Rp 1,677,049 per hectare and the R/C ratio is 1.50.

It is a similar situation in Cibodas. Average production of tomato is 2,823.52 kg per hectare, the farm gate price is Rp 1,033.34/kg, and returns from tomato total Rp 2,917,647 per hectare. Total farm costs amount to Rp 8,064,244 per hectare (excluding family labour). Deducting the costs from the returns, profit is Rp 10,135,756 per hectare. The R/C ratio for tomato farm is 2.26.

The R/C ratio of tomato farms in Cibodas is higher than in Langensari because most of the farmers in Cibodas grow high-quality tomato for the supermarkets.

5.3.6 Farm household income structure

In Langensari, average farm household income is Rp 10,776,761.39 per year (Table 5.7). Vegetable farms make the highest contribution to household income (62.39 per cent). Other sources of household income include trading or *warung* (stall) (6.06 per cent), home industry (8.88 per cent), labourer's wages (5.43 per cent) and other activities such as drivers, services, etc. (13.92 per cent).

Table 5.7 Average annual farm household income at the research sites in Lembang, Bandung, West Java, 2004

Source of income	Langensari		Cibodas	
	Value (Rp/year)	(%)	Value (Rp/year)	(%)
Paddy farm	0.00	0.00	0.00	0.00
Vegetable farm	6 722 717.91	62.39	6 176 396.47	69.81
Fruit farm	26 086.96	0.24	0.00	0.00
Flower farm	0.00	0.00	0.00	0.00
Livestock	0.00	0.00	176 470.59	1.99
Fisheries	0.00	0.00	0.00	0.00
Salary	130 434.78	1.21	282 352.94	3.19
Wage of farm labourer	585 000.00	5.43	847 058.82	9.57
Wage of non-farm labourer	114 782.61	1.07	52 941.18	0.60
Trading/stall, etc.	86 956.52	0.81	0.00	0.00
Gift	0.00	0.00	0.00	0.00
Selling fire wood	956 521.74	8.88	0.00	0.00
Home industries	1 500 000.00	13.92	517 647.06	5.85
Others				
Total	10 776 761.39	100.00	8 846 984.71	100.00

Source: Field survey, 2004.

In Cibodas, average farm household income is lower than in Langensari at Rp 8,846,984.71 per year. The highest source of household income stems from vegetable farms (69.81 per cent); followed by labourer's wages (9.57 per cent), trading/*warung* (8.98 per cent), other activities such as driver, *ojek*, etc. (5.85 per cent), salary of government employee/military/police/private company (3.19 per cent) and dairy farm (1.99 per cent).

The average size of households is four in both Langensari and Cibodas. Therefore, income per capita in Langensari is Rp 2,693,940.35/capita/year and Rp 2,211,746.18/capita/year in Cibodas. Compared to the minimum (poverty line) income of Indonesian rural households from BPS of Rp 1,270,656/capita/year (BPS, 2003), the vegetable farm households at the research sites generate quite high income. This implies that vegetable farms return higher income compared to food crop farms. The development of vegetable farms through new

technology and developing supporting institutions, such as extension, availability of inputs and capital, is vital in the development of vegetable farm household economy.

5.4 Conclusions

1. Cabbage, cauliflower and tomato are popular vegetables in Lembang. They are grown by most of farmers in Lembang as monoculture or mixed-cropping. Mixed-cropping is popular in Lembang for farm diversification, reducing the risk of price volatility and crop diseases. Crop rotation has been introduced to prevent disease.
2. The average age of the farmers is 45 and the level of formal education is up to seven years. In terms of human resources, it shows that most of vegetable farmers in Lembang have good capacity to manage and develop their farm. Because they have a relatively high education level it is easy for them to adopt new technology. In terms of age, they have enough experience in farming to develop their farm. Most have their primary employment in upland farming: 95.65 per cent of sample households in Langensari and 94.12 per cent in Cibodas. Other occupations include traders (5.88 per cent) most are village collectors. Average land occupation is 0.33 hectares in Langensari and 0.30 hectares in Cibodas. In extending the area of land occupation, the land rent system is popular in Lembang. *Gadai* or the pawn and share system is not developed in Lembang.
3. Farm analysis in the dry season (MK II) when the price of cabbage and tomato are relatively low, show the reasonable profits earned by vegetable farms. The profit of cabbage farms is Rp 2,619,582/ha/season in Langensari and Rp 1,142,706/ha/season in Cibodas, with R/C ratios of 1.64 and 1.90 respectively. The profit of cauliflower farms is Rp 8,837,562/ha/season in Langensari with an R/C of 2.22 and Rp 10,135,756/ha/season in Cibodas with an R/C of 2.26. Finally, the profit of tomato farms is Rp 3,386,357/ha/season in Langensari with an R/C of 1.50 and Rp 10,135,756/ha/season in Cibodas with an R/C of 2.26. This analysis shows that growing vegetables has its benefits for farmers. However, the problem is if the profit is insufficient to cover the costs of the farm and the household expenditure.
4. Average household income in Langensari is Rp 10,775,761.39 per year, 62.39 per cent from vegetable farming followed by trading/*warung* 6.06 per cent, home industry 8.88 per cent, labourer's wages 5.43 per cent and 13.92 per cent from other activities such as driver, *ojek,* etc. In Cibodas, average household income is

lower than in Langensari at Rp 8,846,985 per year. Similar to Langensari, the highest contributor to household income is vegetable farming (69.81 per cent), salary as a government employee/military/police/private company is 5.85 per cent followed by labourer's wages at 9.57 per cent, trading/*warung* 8.98 per cent, dairy farm 1.99 per cent and other activities 5.85 per cent. With the average number of household members being four, per capita income per year in Langensari is Rp 2,693,940.35 and in Cibodas is Rp 2,211,746.18. This is quite high compared to poverty line rural household income in Indonesia (Rp 1,270,656/capita/year), but the farmers still have problems providing capital for their farms. Vegetable farms, especially for high-value commodities demanded by traders/suppliers in Lembang, require a lot of capital. Developing the cropping pattern based on market demand and partnership is expected to improve the income of vegetable farmers.

6. Analysis of Vegetable Distribution and Marketing in Highland Areas
(Case Study in Lembang, Bandung, West Java)

Henny Mayrowani and Adang Agustiani[*]

Abstract

The marketing of agricultural products is a primary constraint in the development of agriculture. The prices of agricultural products paid by the consumer are not well transmitted to the farmers because the market is inefficient. The development of agricultural products should concentrate on the development of marketing/trading aspects, not only on production and on-farm aspects. Marketing can be developed through enhanced market infrastructure and market institutions, which are oriented towards price stability and raising the farmers' share in marketing agricultural products. The overarching objective of this study is to analyse the marketing channel, marketing margin and farmers' share in the marketing of vegetable products. The results are: (i) the monthly price of vegetable products fluctuates because of limited supply in the dry season and abundant supply from other vegetable production centres; (ii) the marketing channel of vegetable products is relatively complicated. Vegetables are distributed through village collectors, wholesalers, suppliers, traders from *Pasar Induk* (central market), inter-island traders, supermarkets and retail markets; (iii) the marketing share remains unequal among marketing agents, including farmers; (iv) the highest marketing margin is gained by wholesalers/suppliers and supermarkets; (v) the price is not yet well transmitted to farmers and producers; and (vi) alternative solutions to marketing problems include bolstering farmer institutions to boost the bargaining power of farmers; farm production planning to stabilize supply and price; and diversified farmer activities involving farmers with marketing activities (through handling the product before selling) to raise farmers' share in marketing vegetable products.

Keywords: vegetable, marketing margin, marketing channel, farmers share.

[*] ICASEPS, Bogor, Indonesia.

6.1 Introduction

The marketing of agricultural commodities, including horticultural commodities in Indonesia, still faces numerous hurdles. The main problem is inefficiency in the marketing process of agricultural commodities in Indonesia. Efficiency in the marketing system hinges on the following requirements: (i) ability to distribute agricultural commodities from producer to consumer at the lowest price; and (ii) ability to distribute the share of profit equally among production and marketing agents based on their function in marketing activities (Mubyarto, 1989).

Results of an IPB (Bogor Agricultural University) study in 1990 found that wholesalers receive the highest profit margin in terms of vegetable marketing from vegetable production centres to consumer centres in Jakarta. The profit margins of traders in *Pasar Induk* Kramat Jati, Jakarta are lower than traders in retail markets/traditional markets. Another study of market institutions has shown that the marketing margin of horticultural commodities in North Sulawesi (Kuma'at, 1992) varies among marketing agents. For potatoes, wholesalers receive the highest margin compared to collectors and retailers, while farmers receive the lowest. In most cases the market is not well integrated because: (i) the distances between vegetable production areas and the markets are relatively far, therefore, transportation costs are comparatively high; (ii) producers do not grade the produce; (iii) there is market distortion, namely there is not perfect competition within the market structure rather a trend towards oligopolies; and (iv) the price is not transmitted from consumers to producers. Higher or lower prices in one market are followed by similar hikes or cuts in other markets.

An important constraint to the development of agricultural commodities is the phenomenon that value added in the horticultural agribusiness is gained more by upstream and downstream industries rather than farmers. This phenomenon tends to be stronger for horticultural commodities due to their market oriented nature coupled with the weak bargaining power of farmers. Therefore, the development of production only reaps benefits for upstream and downstream industries.

Consequently, the focus of horticultural development should be placed on marketing (off-farm) aspects and not only production (on-farm) aspects, which can be done through the development of marketing infrastructure and institutions, price stability and raising the farmers' share in the distribution process of horticultural produce.

The purpose of this chapter is to analyse the marketing channel, marketing margin and farmers' share in the marketing of horticultural produce.

6.2 Research method

The study was conducted in Langensari village, Cibodas village, Kramat Jati (Jakarta), Bandung (for supermarkets and *Pasar Induk* Caringin) and Cibitung (Bekasi) in February 2005. Primary data was collected through interviews using a structural questionnaire. The respondents include farmers (40), collectors (9), wholesalers in Lembang (4), wholesalers in *Pasar Induk* (4), suppliers (2), retailers in traditional markets (2) and supermarkets (2). Secondary data was collected from several publications of related institutions, such as the Statistical Office and Agricultural Office.

Data was analysed using quantitative and qualitative/descriptive methods. To analyse the marketing margin and farmers' share the following analytical tools were used:

6.2.1 Marketing margin and distribution

Marketing margin is the difference between farm gate price and consumer price. In this analysis the farm gate price and marketing agent's price were used, the formula is as follows:

$Mm = Pe - Pf$

Where:

Mm = marketing margin at farm level

Pe = price for marketing agent (marketing agent where farmers sell the produce)

Pf = farm gate price

Margin for each level of marketing agent can be calculated by deducting the buying price from the sales price for each level of marketing agent. The formula is as follows:

$Mmi = Ps - Pb$

Where:

Mm = marketing margin for each level of marketing agent

Ps = selling price for each level of marketing agent

Pb = buying price for each level of marketing agent

Each marketing margin contains two important components; cost and profit of the marketing agent, therefore:

$Mm = c + \pi$

$Pe - Pf = c + \pi$

$Pf = Pe - c - \pi$

Where:

c = marketing cost

π = profit of marketing agent

Distribution of marketing margin can be calculated from the percentage of marketing profit and marketing cost in terms of selling price of each marketing agent. The percentage of profit in terms of marketing costs for each agent can be calculated as follows:

$$\text{Profit-cost ratio} = \frac{\pi i}{ci} \times 100 \text{ per cent}$$

Where:

πi = profit of the i^{th} marketing agent

ci = cost of the i^{th} marketing agent

6.2.2 Farmer's share

Farmer's share is the ratio of farm gate price and price for marketing agents as a percentage. Farmer's share as a formula is as follows:

$$Fs = \frac{Pf}{Pe} \times 100 \text{ per cent}$$

Where:

Fs = farmer's share

Pf = farm gate price

Pe = marketing agent's price

6.3 Vegetable price development

Illustrating the development of vegetable prices is necessary because they fluctuate greatly throughout the year. In terms of production planning, farmers must consider the kind of crops to be cultivated and their volume. Farmers grow vegetables when the price of the product is high. In anticipating the supply, in this case production, farmers should analyse the price conditions and sell at a time when prices are high.

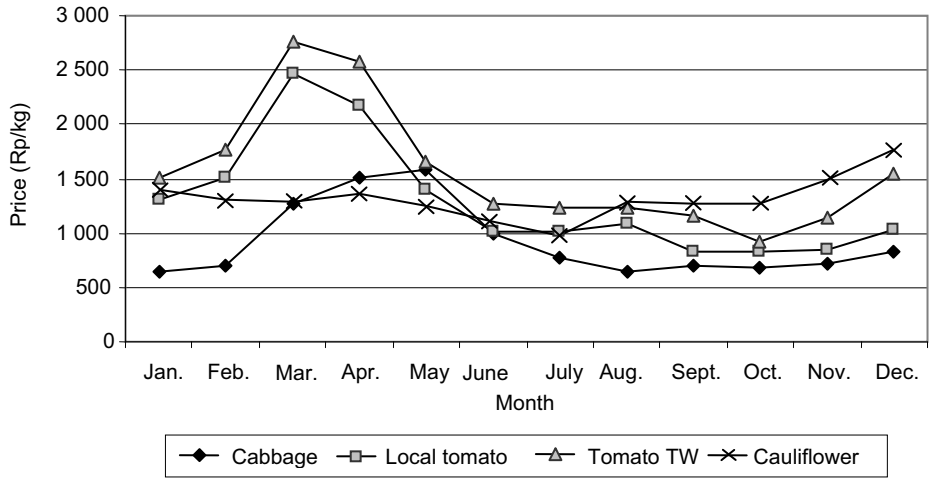
The price mechanism is based on supply and demand. Price analysis can also be used to estimate price, which is necessary when farmers wish to sell their produce. Information on the development of prices is expected to reinforce the bargaining position of farmers in marketing their products.

To understand the fluctuations in vegetable prices, data was collected from the production centres and consumption centres. The data available is for 2002 but the pattern tends to be the same each year; the difference being in nominal price.

6.3.1 Vegetable price development at the production centre

Figure 6.1 shows the performance of farm gate prices of cabbage, local tomato, Taiwan (TW) tomato (high quality variety) and cauliflower at the production centre. The highest cabbage price is in March up to May. One reason is the limited supply because of the dry season (while demand remains stable), therefore the price skyrockets. Prices start to decline in June even though it is still the dry season. This is possible because of an abundant supply from other vegetable production centres such as Garut (West Java) and also from North Sumatra, in an effort to stabilize prices. This is also true for tomato. The trend of cauliflower has different characteristics from other vegetables, namely the price is relatively more stable throughout the year and tends to remain high. This is because the harvested area of cauliflower is limited but it can be produced year round.

Figure 6.1 Monthly development of average farm gate price of cabbage, cauliflower and tomato in Lembang, Bandung, 2002

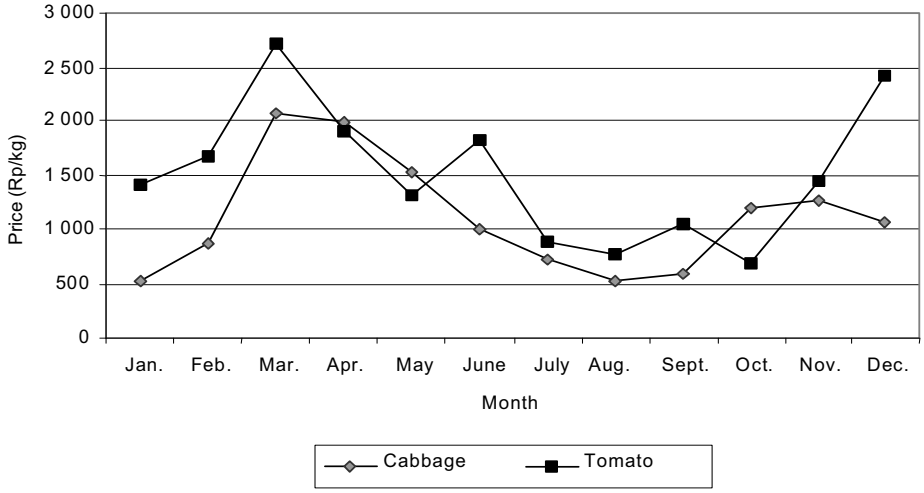


Source: Dinas Pertanian Tanaman Pangan Jawa Barat (Agricultural Office for Food Crops), 2003.

6.3.2 Vegetable price development in the consumer market

Vegetable price development in *Pasar Induk* is primarily affected by the mechanism of supply and demand. The peak price of cabbage in *Pasar Induk* Caringin Bandung is during March-April and the lowest in January, August and September (Figure 6.2). The price of tomato fluctuates more than cabbage because the volume of supply from several tomato production centres is unpredictable. The highest tomato price is during March-April with a slump in August and October.

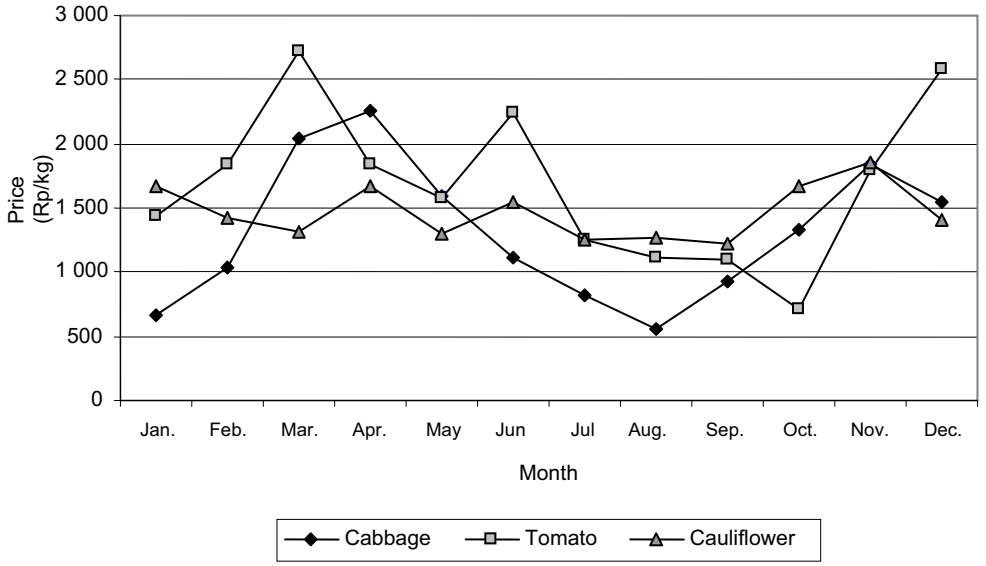
Figure 6.2 Development of monthly average price of vegetables in *Pasar Induk* Caringin, Bandung, 2002



Source: Dinas Pertanian Tanaman Pangan Jawa Barat, 2003.

The fluctuations in vegetable prices in *Pasar Induk* Cibitung, Bekasi, West Java are illustrated in Figure 6.3.

Figure 6.3 Development of monthly average price of cabbage, tomato and cauliflower in *Pasar Induk* Cibitung, 2002



Source: Dinas Pertanian Tanaman Pangan Jawa Barat, 2003.

The prices of cabbage and tomato in *Pasar Indu*k Cibitung are higher than in *Pasar Induk* Caringin but the pattern is the same. This is understandable because Cibitung is farther than Caringin from the production area, therefore, transportation costs and weight loss are higher. The price fluctuation pattern of cauliflower is relatively stable like in other markets and production centres.

6.4 Marketing of vegetables

6.4.1 Marketing of vegetables at the farm level

Most farmers at the research sites sell their products to collectors who live around the villages (Table 6.1).

Table 6.1 Information related to vegetables marketing in Lembang, Bandung, West Java, 2004

a. Langensari Village

Description	Commodity			
	Tomato (n=7)	Cauliflower (n=20)	Cabbage (n=12)	Beans (n=6)
Average number of collectors in the village (persons)	3.3	4.1	3.7	3.4
Respondents have no difficulty in selling the produce in traditional market (%)	43	60	83	33
Farmers know market price information regarding their product (%)	100	95	92	100
Total traders who are contacted before farmers sell the product (persons)	1.9	3.0	3.1	1.6
Main factors in deciding to sell the produce (number of respondents):				
- Time of harvest	3	13	10	3
- Price	3	2	1	0
- Payment method	2	2	1	0
- Others	0	3	0	2
Total traders with whom farmers usually sell the produce (persons)	1.0	1.0	1.1	1.0
Number of respondents who sell the produce to respective traders (persons)				
- Retailer	1	0	0	0
- Village collector	5	16	8	4
- Wholesaler/Supplier	1	4	4	1
- Inter island trader	0	0	0	0
- Exporter	0	0	0	0
- Hotel, restaurant, supermarket	0	0	0	0
- Others	0	0	0	0

b. Cibodas Village

Description	Commodity			
	Tomato (n=3)	Cauliflower (n=16)	Cabbage (n=3)	Beans (n=11)
Average number of collectors in the village (persons)	7.7	7.3	4.3	8.3
Respondents have no difficulty in selling the produce in traditional market (%)	33	50	60	45
Farmers know market price information regarding their product (%)	67	88	67	73
Total traders who are contacted before farmers sell the product (persons)	4.3	3.0	1.0	2.9
Main factors in deciding to sell the produce (number of respondents):				
- Time of harvest	2	12	2	8
- Price	1	3	1	2
- Payment method	0	1	0	1
- Others	0	0	0	0
Total traders with whom farmers usually sell the produce (persons)	1.0	1.1	1.0	1.0
Number of respondents who sell the produce to respective traders (persons)				
- Retailer	1	0	0	1
- Village collector	2	94	3	9
- Wholesaler/Supplier	0	6	0	1
- Inter island trader	0	0	0	0
- Exporter	0	0	0	0
- Hotel, restaurant, supermarket	0	0	0	0
- Others	0	0	0	0

Source: Field survey, 2005.
Note: n = number of surveyed farmers.

Besides the village collectors, some farmers sell their produce to collectors from outside the village or directly to wholesalers, suppliers or retailers/traditional markets. The ratio of farmers who sell their produce directly to traditional markets is relatively high for cauliflower and cabbage (50-83 per cent) and low for tomato and beans (33-45 per cent). To command an appropriate price, farmers should decide the trader to whom they want to sell before going to market. One of the farmers' strategies to find a good price for their produce is to seek price information from the traders. Before selling their produce the farmers contact at least one trader to ask the prevailing market price for their produce. Using this information the farmers sell their produce to the trader/collector offering current market prices. Usually farmers sell their produce to only one trader and sometimes the trader to whom the farmers sell their produce is different trader from the one they got the price information. However, usually most of the farmers work with the same trader since they trust each other. The dominant trader who buys the farmers' produce is the village collector for the four commodities (tomato, cauliflower, cabbage and beans) both in Langensari and Cibodas. A smaller number of respondents sell directly to wholesalers/suppliers and retailers. The main factor influencing when to sell the produce is the time of harvest. Vegetables should be sold immediately after harvest because they are perishable. The other consideration is price. The number of village collectors is, on average, one or two; with one trader from outside the village.

Marketing vegetables from farmers to collectors or wholesalers and suppliers is a process of transaction made through trust. When selling their produce, farmers are always wary; farmers should know the identity of the traders. This is important because the payment system is deferred payment, over a period of one to two days. Only 8.6 per cent of farmers in Langensari and 9.4 per cent in Cibodas receive cash from village traders (Table 6.2). And only 1 per cent of farmers in Langensari receive money in advance in selling their produce.

Table 6.2 Payment system in vegetable marketing based on the destination market in Lembang, Bandung, West Java, 2004

Description	Commodity					
	Tomato	Cauliflower	Cabbage	Beans	Other	Average*
a. Langensari village						
I. Village trader** :						
Frequency of buying from farmers***						
- always	1.5	2.5	2.7	1.5	0.0	1.6
- often	3.7	3.8	3.0	0.0	0.0	2.1
- sometimes	2.4	2.0	2.0	4.0	0.0	2.1
Payment system (%):						
- cash	25.0	9.0	9.0	0.0	0.0	8.6
- in advance	0.0	5.0	0.0	0.0	0.0	1.0
- deferred	75.0	86.0	91.0	100.0	0.0	70.4
Period of time (days) :						
- cash	-	-	-	-	-	-
- in advance	-	-	-	-	-	-
- deferred	1	2	2	1	2	2
II. Trader** from outside village						
Frequency of buying from farmers***						
- always	0.0	1.7	1.5	0.0	0.0	0.6
- often	1.5	1.5	2.0	2.0	0.0	1.5
- sometimes	2.0	1.5	1.5	0.0	0.0	1.0
Payment system(%):						
- cash	100.0	0.0	0.0	0.0	0.0	20.0
- in advance	0.0	0.0	0.0	0.0	0.0	0.0
- deferred	0.0	100.0	100.0	100.0	0.0	60.0
Period of time (days) :						
- cash	-	-	-	-	-	-
- in advance	-	-	-	-	-	-
- deferred	-	1	1	1	-	1
b. Cibodas Village						
I. Village trader** :						
Frequency of buying from farmers***						
- always	2.0	2.1	2.0	1.9	0.0	1.6
- often	0.0	3.2	2.5	2.0	0.0	1.5
- sometimes	0.0	2.0	3.0	2.5	0.0	1.5
Payment system (%):						
- cash	33.0	7.0	0.0	7.0	0.0	9.4
- in advance	0.0	0.0	0.0	0.0	0.0	0.0
- deferred	67.0	93.0	100.0	83.0	0.0	68.6
Period of time (days) :						
- cash	-	-	-	-	-	-
- in advance	-	-	-	-	-	-
- deferred	1	2	1	2	-	1
II. Trader** from outside village						
Frequency of buying from farmers***:						
- always	0.0	2.0	0.0	2.0	0.0	1.3
- often	0.0	0.0	0.0	0.0	0.0	0.0
- sometimes	1.0	2.0	2.0	1.0	0.0	1.3
Payment system (%):						
- cash	50.0	0.0	0.0	50.0	0.0	20.0
- in advance	0.0	0.0	0.0	0.0	0.0	0.0
- deferred	50.0	0.0	0.0	50.0	0.0	20.0
Period of time (days) :						
- cash	-	-	-	-	-	-
- in advance	-	-	-	-	-	-
- deferred	1	-	-	1	-	1

Source: Field survey, 2005.

Notes: * Average of five categories (tomato, cauliflower, beans, cabbage and others).

** Trader includes collector, commissioner, supplier, wholesaler etc.

*** 'Always' means number of traders farmers sell their products to every time. 'Often' means number of traders farmers often sell their products to but not every time. 'Sometimes' means number of traders farmers sell their products to sometimes.

6.4.2 Marketing of vegetables

Each vegetable has different characteristics in terms of marketing, including the marketing channel and price. In detail, the marketing of popular vegetables in Lembang; such as cabbage, cauliflower and tomato can be explained as follows:

Marketing of cabbage

The marketing channel of cabbage begins with farmers (producers) who sell the cabbage to village collectors or directly to wholesalers. The sales process starts by making a price agreement between farmers and traders/collectors. After purchasing the produce from the farmers, collectors then sell the cabbage to wholesalers, suppliers and wholesalers in *Pasar Induk* Caringin, Bandung, *Pasar Induk* Cibitung, Bekasi or retailers in *Pasar* Lembang (local market in Lembang). At the wholesale level, the cabbage has been cleaned, the outer leafy part of the cabbage (the broken ones) has been removed and, consequently, the weight of the produce loses 10 per cent from the initial purchase.

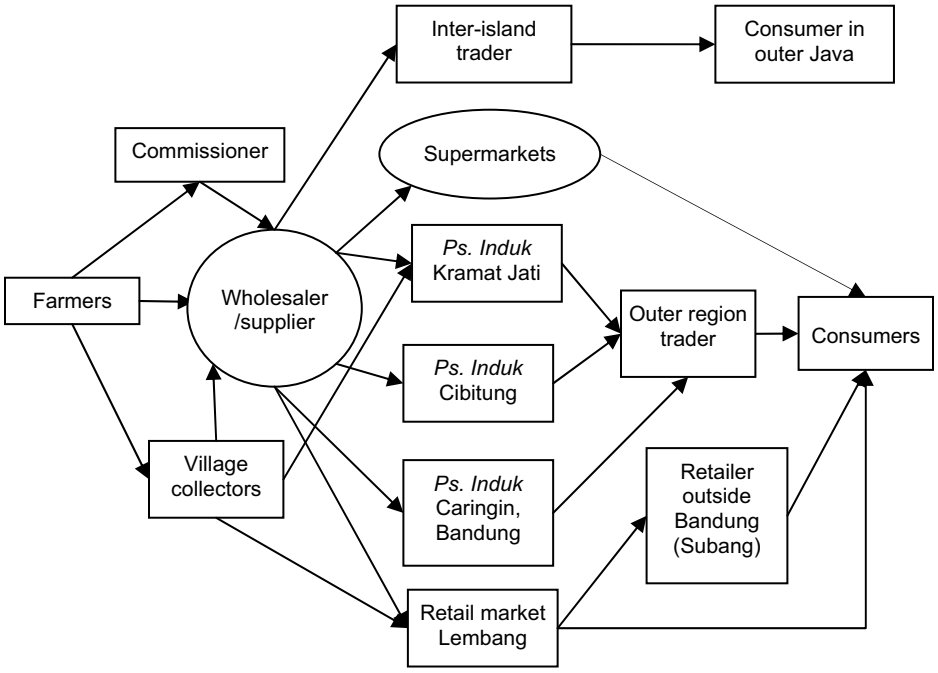
Wholesalers or suppliers who purchase high quality cabbage will market it to supermarkets in Jakarta. Other wholesalers distribute the produce off of Java Island, like to Pontianak, West Kalimantan and Bangka Belitung (East Sumatra), through inter-island traders. From wholesalers/suppliers, cabbage is distributed through several channels; such as supermarkets, retailers in traditional markets, peddlers and *warungs* (small shop)/stalls, as well as to consumers. The marketing channel for cabbage can be seen in detail in Figure 6.4. On average, each collector or village trader's purchasing and sales volume is around 100-300 kilograms per day.

The farm gate price of cabbage is around Rp 500-700/kg; or Rp 613/kg on average. Collectors then sell at a price of around Rp 800-850/kg; or Rp 912/kg on average. The profit margin of cabbage from farmer to collector is Rp163/kg (Table 6.3). The marketing margin at this level is quite high because the marketing cost is relatively low. The ratio of profit margin to marketing cost is 119.85 per cent, which means that for each Rp 100 of marketing cost, collectors gain a profit margin of Rp 119.85/kg. Farmers receive 67.21 per cent of the collector's price, assuming that the produce on both sides is equivalent in quality. The different between the farm gate price and the collector's price is small. The payment system used is a 1-day deferred payment.

Wholesalers, known by local farmers as packing traders (*pengepakan*), are traders who market a large volume of cabbage and distribute it to several markets, such as: *pasar induk*, retail market, supermarket or to other wholesalers/suppliers. Wholesalers sell the produce after sorting, grading and packing. The average volume of cabbage marketed by a

wholesaler is 4-5 tons per week and the average purchase price is Rp 840/kg and selling price is Rp 1,530/kg.

Figure 6.4 Marketing channel for cabbage from farmers in Lembang, West Java



Source: Field survey, 2005.

Wholesalers also distribute cabbage outside of Java, such as to Pontianak, West Kalimantan. In this case, wholesalers distribute directly to Pontianak or work together with inter-island traders. If wholesalers work together with inter-island traders, the wholesalers from Lembang deliver the cabbage to Tanjung Priok Port, Jakarta and inter-island traders then carry it away from Java. For inter-island trading, the quality of cabbage is important and the traded product should be Grade A (high quality product). The average profit margin of wholesalers is Rp 386.00/kg, higher than the profit margin of the village collector. The price ratio between wholesalers and farmers is 40.07, which means that farmers only receive 40.07 per cent of the wholesale price, assuming that the products on both sides are equivalent in quality. The payment system is deferred over 15-30 days.

Suppliers are market institutions that are of the same level as wholesalers; only distributing the best quality cabbage to supermarkets. As an example: CV PS in Langensari

supplies the best quality cabbage to Carrefour, Clubstore and *Naga* Supermarket in Jakarta. The average daily order is 175 kg of cabbage, with 60 per cent for Carrefour; 20 per cent for Clubstore and 20 per cent for *Naga* Supermarket. Profit is more than 50 per cent of the purchase price (Rp 2,750/kg). Based on supplier data, the marketing profit margin at this level is Rp 301.75/kg of cabbage, which is lower than the wholesaler's (non-supplier) margin, but higher than village collector's margin. The profit margin of the supermarkets is very high because the retail price of cabbage in the supermarket is high (Rp 3,850/kg). The ratio of farmers gate price to supplier is 22.29 (Table 6.4).

Marketing produce to *Pasar Induk* is done directly by wholesalers or village collectors. In *Pasar Induk* Caringin, Bandung, cabbage from Lembang only occupies a small portion, most cabbage originates from Pangalengan, Bandung. The payment system in *Pasar Induk* Caringin is deferred payment. It is paid after all cabbage is sold. The price of cabbage in *Pasar Induk* Caringin fluctuates based on supply and demand. The price falls in times of abundant supply and a lack of buyers. The average purchase price in *Pasar Induk* Caringin is Rp 1,000/kg and sales price is Rp 1,300/kg. After deducting the marketing cost (Rp 229/kg), the profit margin in *Pasar Induk* Caringin is Rp 71/kg.

Cabbage marketing margin in *Pasar Induk* Caringin is relatively low compared with other market institutions because the number of cabbage traders and volume of cabbage in *Pasar Induk* Caringin is abundant. Therefore, there is tight competition among traders in *Pasar Induk* Caringin and the sales price is relatively low. This does not create problems as long as the business has continuity. The ratio of farm gate price to the price at *Pasar Induk* Caringin is 61.30 per cent.

Cabbage traded in *Pasar Induk* Caringin is of mixed quality, from the highest quality down to the lowest. Seven tons of cabbage per day is traded by wholesalers in *Pasar Induk* Caringin. The marketing channel for cabbage from *Pasar Induk* Caringin varies. Most buyers are traders from outside Bandung, such as Bekasi, Subang, Serang and Cibitung in West Java; as well as Batam and Lampung in Sumatra. There is also a trader from Lembang who purchases cabbage from *Pasar Induk* Caringin.

The marketing conditions of *Pasar Induk* Caringin are the same as the marketing conditions in *Pasar Induk* Kramat Jati (PIKJ), Jakarta. Cabbage from Lembang in PIKJ accounts for only 10 per cent, the rest comes from East Java (Malang), Tanjungsari (Sumedang, West Java), Medan (North Sumatra) and Padang (West Sumatra). On any given day, the average amount of cabbage traded by sample traders in PIKJ is 1 ton. The average purchasing price of cabbage for wholesalers in PIKJ is Rp 1,800/kg. After

deducting the marketing cost of Rp 225.67/kg, traders in *PI* earn Rp 74.33/kg profit. The mechanism of trading is almost the same as at *PI* Caringin. Most cabbage from *PIKJ* is traded to local traders around Jakarta, such as *Pasar* Jembatan Dua*, Pasar* Karang Anyar and *Pasar* Kebayoran. The ratio of marketing price of farmers to traders in PIKJ is 29.19.

The purchase price of retailers in *Pasar* Panorama (a traditional market), Lembang is Rp 1,500/kg, and the sales price is Rp 2,500/kg. With a marketing cost of Rp 360/kg, the retailer receives Rp 640/kg in profit. The ratio of farm gate price to retailer price is 24.52. Therefore, farmers only receive 24.52 per cent of the price which is paid by consumers. If marketing is efficient the share of farmers should be higher.

A brief explanation of a marketing chain in a modern supermarket like Hero Supermarket, Bandung is as follows. Cabbage is supplied by certain suppliers. Each supermarket usually purchases small amounts but many kinds of vegetables. For example, some supermarkets can only absorb 2 kilograms of cabbage per day. The purchase price from suppliers is Rp 4,200/kg and the payment system differed over 15 days. The total cost spent by the supermarket is Rp 422.8/kg and the profit is Rp 327.2/kg. This is quite high, almost the same as the margin level for wholesalers and suppliers. At this level the share of the farmers is even smaller than at the level of retailers in the traditional markets, namely 12.38 per cent.

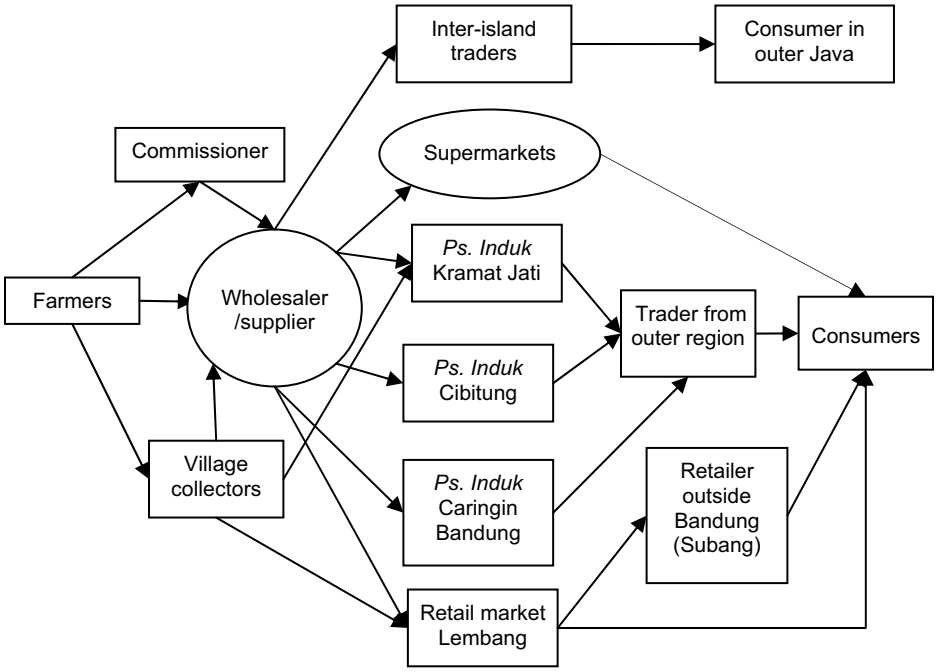
Marketing of cauliflower

The marketing channel for cauliflower is almost the same as for cabbage. Village collectors or commissioners purchase the produce from farmers and resell to wholesalers, suppliers or traders in the central market and to retail markets in Lembang. A commissioner is the agent who helps farmers sell their produce. Commissioners collect the farm produce (without buying) and bring/sell it to the market. After the produce has been sold, the money goes to the farmers minus a commission fee. In several cases, farmers can directly sell to wholesalers, suppliers or the retail markets. Before a transaction, the price has to be decided by farmers and traders. At the level of wholesaler, the produce has been processed by removing the outer part of leaf and the weight loss is around 10-20 per cent. Wholesalers or suppliers distribute the cauliflower to the supermarkets, traders from outer regions or islands, retail markets and local traders (Figure 6.5). The highest quality is sent to the supermarkets. To reach consumers, cauliflower passes a long marketing channel.

High quality cauliflower is sent to wholesalers/suppliers and the lower quality cauliflower is sold to retail markets in Lembang. The price of cauliflower is higher than cabbage. Farm gate price is around Rp 800-900/kg; or Rp 837/kg on average. Collectors

sell to wholesalers at Rp 1,100-1,289/kg; or Rp 1,160/kg on average. The profit margin of collectors is Rp 121/kg (Table 6.3). At this level, the margin is quite high because marketing costs are low. The ratio of profit margin to cost is 59.90. The payment system at this level is almost the same for all vegetable produce, namely a deferred payment over one to three days.

Figure 6.5 Marketing channel for cauliflower from farmers in Lembang, West Java



Source: Field survey, 2005.

Each collector can sell 100-400 kg of cauliflower per day, while a wholesaler sells 1-5 tons per day. The average wholesaler purchase price is Rp 1,217/kg and sales price is Rp 3,500/kg. The average profit margin of wholesalers is Rp 1,699/kg; higher than the margin of village collectors. The sales price at the wholesaler level (Rp 3,500/kg) is higher than the village collectors. One of the reasons is because the handling costs of wholesalers are higher than for collectors. Produce is packed at the wholesaler level and some produce yet to be sorted and graded at the farmer and collector levels, is finally sorted and graded at the wholesaler level. At the wholesaler level the farmers' price ratio is 23.91. The payment system is a deferred payment over one to three days, however, for wholesalers in *Pasar Induk* payments are made after all the produce is sold.

A supplier is a market institution that has the same level as wholesaler, only distributing the best quality cauliflower to supermarkets. As an example, CV PS in Langensari supplies the best quality cauliflower to Carrefour, Clubstore and *Naga* Supermarket in Jakarta. The average daily order is 175 kg of cauliflower, with the share of 60 per cent for Carrefour; 20 per cent for Clubstore and 20 per cent for *Naga* Supermarket. Based on supplier data, the marketing profit margin at this level is Rp 698.58 for each kilogram of cauliflower; lower than the wholesaler (non-supplier) margin but higher than the village collector's margin. The profit margin of the supermarkets is very high because the selling price of cauliflower at the supermarkets is high (Rp 9,550/kg). The ratio of farm gate price to supplier is 8.76 (Table 6.4).

Another marketing channel of cauliflower is *Pasar Induk*. Only a small portion of cauliflower from Lembang enters *Pasar Induk* Caringin; most cauliflower in *Pasar Induk* Caringin originates from other villages outside Lembang. The payment system used by the wholesaler of *Pasar* Caringin is a deferred payment after all produce is sold.

The price of cauliflower fluctuates depending on: (i) volume of supply in *Pasar Induk*; and (ii) number of buyers. If only a few buyers come the price will drop. The average purchasing price of cauliflower in *PI* Caringin is Rp 1,600/kg and sales price is Rp 2,167/kg. The total marketing cost is Rp 462/kg, therefore, the profit generated by *Pasar Induk* traders is Rp 105/kg. This is relatively low compared to the profit of other trader because there are a number of cauliflower traders and competition among them is tight. They stated, however, that the small profits are sufficient if they are earned continuously. The share of farmers is 52.31 per cent from the selling price of traders in *PI* Caringin, which is low compared to cabbage.

Three kinds of cauliflower quality are traded in *Pasar Induk*: leafless (*gundul*); leaves cut short (*potongan pendek*); and uncut leaves (*potongan panjang*). There are 7 tons of cauliflower traded per day. Cauliflower is distributed from *Pasar Induk* to various locations, to traders from outside Bandung (Bekasi, Subang, Serang, Cibitung and as far as Batam and Lampung) and even to Lembang retail market.

Table 6.3 Marketing margin on the various market institutions for cabbage, cauliflower and tomato in Lembang, Bandung, 2005

Items	Market institutions						
	Collectors	Wholesaler	Supplier	P.I.* Caringin	P.I.* Kr.Jati	Retailer	Supermarket
Cabbage							
- Buying price (Rp/kg)	613	840	2 750	1 000	1 800	1 500	4 200
- Marketing cost (Rp/kg)	136	304	798.25	229	225.67	360	422.80
- Selling price (Rp/kg)	912	1 530	3 850	1 300	2 100	2 500	4 950
- Profit (Rp/kg)	163	386	301.75	71	74.33	640	327.20
- Ratio profit/cost	119.85	126.97	37.80	31.00	32.94	177.78	77.39
Cauliflower							
- Buying price (Rp/kg)	837	1 217	3 250	1 600	1 400	2 000	8 100
- Marketing cost (Rp/kg)	202	584	1 251.32	462	239.67	895	830.40
- Selling price (Rp/kg)	1 160	3 500	5 200	2 167	1 800	3 500	9 550
- Profit (Rp/kg)	121	1 699	698.58	105	160.33	605	619.60
- Ratio profit/cost	59.90	290.92	55.84	22.73	66.90	67.60	74.61
Tomato							
- Buying price (Rp/kg)	913	1 500	2 400	-	1 500	2 000	-
- Marketing cost (Rp/kg)	139	437	713	-	64.65	495	-
- Selling price (Rp/kg)	1 131	2 313	3 600	-	1 800	2 600	-
- Profit (Rp/kg)	79	376	497	-	235.35	105	-
- Ratio profit/cost	56.83	86.04	68.30	-	364.04	21.21	-

Source: Field survey, 2005.
Note: * P.I. = *Pasar Induk* (central market).

Table 6.4 Ratio of farmers selling price and market institutions selling price, Lembang, Bandung, 2005

Description	Market institutions						
	Collectors	Wholesalers	Suppliers	P.I.* Caringin	P.I.* Kr.Jati	Retailers	Supermarket
Cabbage	67.21	40.07	22.29	61.30	29.19	24.52	12.38
Cauliflower	72.16	23.91	16.10	52.31	46.50	23.91	8.76
Tomato	80.73	39.47	25.36	-	50.72	35.15	-

Source: Field survey, 2005.
Note: The commodities on respective traders are assumed to be equivalent in quality with the products of farmers.
* P.I. = *Pasar Induk*.

The volume of cauliflower which is traded by sample traders in *Pasar Induk* Kramat Jati (PIKJ), Jakarta is smaller than in *Pasar Induk* Caringin; only 1 ton per day. The average purchase price is Rp 1,400/kg and sales price is Rp 1,800/kg. After deducting the marketing cost of Rp 239.67/kg, the trader's profit is Rp 160.33/kg, which is larger than the profit of traders in *PI* Caringin. Cauliflower in *PI* Kramat Jati is distributed to a limited area, namely to retail markets around Jakarta such as *Pasar* Jembatan Dua, *Pasar* Karang Anyar and *Pasar* Kebayoran. The ratio of farm gate price to sales price in PIKJ is 46.50.

At the retailer level, the purchasing price of cauliflower is Rp 2,000/kg in *PI* Caringin and retailers sell to the retail market Lembang at Rp 3,500/kg. Buyers in *Pasar* Panorama, Lembang are consumers and other retailers from Subang. The marketing margin is Rp 1,500/kg. After deducting the marketing cost of Rp 895/kg, the profit of retailers is Rp 605/kg. At this level, the payment system is cash and the ratio of farm gate price to retailer price is 23.91 per cent. Cauliflower farmers receive less than half the price paid by consumers.

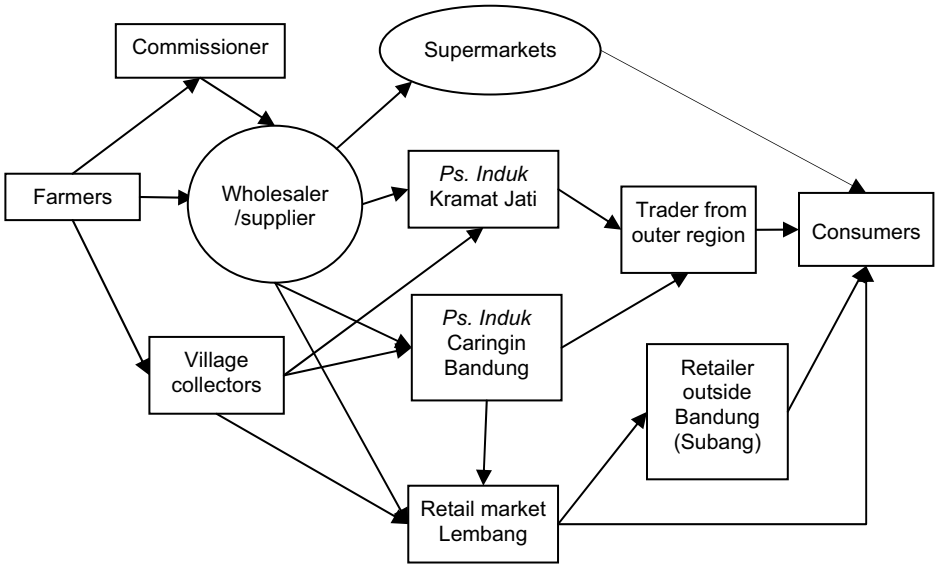
Supermarkets are retail markets selling high quality products. Their market segment is high-society consumers because the price paid for products is very high. In this market, supply is from certain suppliers, who continuously supply high quality products at a certain volume. In the case of cauliflower, the volume of trading at each supermarket is sometimes only 2 kg/day. The payment system is deferred over 15 days. The purchasing price of supermarkets from suppliers is Rp 8,100/kg and the sales price is Rp 9,550/kg. The marketing cost of supermarkets is Rp 830.4/kg, therefore profit is Rp 619.60/kg. This is quite high; the same level as supplier but lower than the profit of wholesalers. At this level, the share of farmers is the smallest compared to other market institutions (8.76 per cent).

Marketing of tomato

The marketing channel for tomato begins with the farmers as producers who sell their tomatoes to village collectors or directly to wholesalers. The selling process commences by making a price agreement between farmers and traders/collectors. Collectors then sell to wholesalers, suppliers and wholesaler from *Pasar Induk* Caringin, Bandung, *Pasar Induk* Cibitung, Bekasi or retailers from *Pasar* Lembang. At the levels of wholesalers, suppliers, traders in *Pasar Induk* and retailers in Lembang, the tomatoes are sorted if not yet done so by farmers. Tomatoes are separated based on size, maturity and purity. In *Pasar Induk* tomato is graded based on quality: high quality, medium quality and low quality. The weight of the tomato after sorting and grading is 5-10 per cent less than when purchased from the farmers.

Wholesalers or suppliers who purchase high quality tomato distribute it to supermarkets in Jakarta. Other wholesalers distribute the produce to *Pasar Induk* Kramat Jati and *Pasar Induk* Caringin. Tomato from Lembang is not distributed to the outer islands like cabbage and cauliflower. After the wholesalers, tomato is distributed through several channels such as retailers in traditional markets, peddlers and *warungs* to reach consumers. The marketing channel of tomato in detail can be seen in Figure 6.6.

Figure 6.6 Marketing channel for tomato from farmers in Lembang, West Java



Source: Field survey, 2005.

On average, collectors and village traders have a purchasing and selling volume of around 50-250 kg/day. In the case of tomato, farmers usually sell directly to retail markets in Lembang or peddlers after sorting. The price of tomato at farm gate is around Rp 600-1,200/kg; or Rp 913/kg on average. Collectors sell at a price of around Rp 850-1,325/kg; or Rp 1,131/kg on average. The marketing margin of tomato from farmers to collectors is Rp 79/kg (Table 6.4). The marketing margin at this level is quite low because the farm gate price is high due to limited supply in Lembang, while the selling price is relatively low. The ratio of profit margin to marketing cost is 56.83 per cent, which means that for each Rp 100 of marketing cost, collectors generate a profit margin of Rp 56.83/kg. Farmers receive 80.73

per cent of the collector's price (Table 6.4). The difference between the farm gate price and collector price is small. The payment system is a 1-day deferred payment.

Wholesalers and local packing traders (*pengepakan*) market large volumes of produce and distribute tomatoes to several markets, such as *pasar induk,* retail markets, supermarkets and other wholesalers/suppliers. The average volume of tomato marketed by wholesalers is 5 tons per week. The average purchasing price is Rp 1,500/kg and selling price Rp 2,313/kg.

Wholesalers also deliver tomato to *Pasar Induk* Kramat Jati and Caringin but most is distributed to *PI* Kramat Jati. Before delivery to *Pasar Induk*, the tomatoes are packed using wood boxes of volume 40-50 kg/box. The quality of the tomatoes for *Pasar Induk* is medium to high. The rest is sold to the retail market in Lembang. The average profit of wholesalers is Rp 376/kg, higher than the profit of village collector because the sales price at the wholesaler level is high (Rp 2,313/kg). The price ratio between wholesalers and farmers is 39.7. The payment system for tomatoes at the supplier level is deferred payment over 15 days.

A supplier is a market institution at the same level as a wholesaler, only distributing the best quality tomato to supermarkets. As an example, CV PS in Langensari supplies the best quality tomato to Carrefour, Clubstore and *Naga* Supermarket in Jakarta. In this case, suppliers purchase sorted and graded produce. Packing for supermarkets is carried out by the suppliers. On average the daily order is 100 kg, with 60 per cent for Carrefour; 20 per cent for Clubstore and 20 per cent for *Naga* Supermarket. Based on supplier data, the marketing profit at this level is Rp 497/kg, which is higher than wholesaler (non-supplier) profit and village collector's profit. Supplier profit is very high because the selling price of tomatoes is high (Rp 3,600/kg). The ratio of farm gate price to supplier is 25.36 (Table 6.4)

Marketing produce to *Pasar Induk* is done directly by wholesalers and village collectors. In *Pasar Induk* Kramat Jati tomatoes from Lembang only occupy a small portion; most of the tomatoes come from Cipanas, Garut. The payment system in *Pasar Induk* (*PI*) is a deferred payment paid after all tomatoes are sold. The price of tomato in *PI* fluctuates based on supply and demand or buyer numbers. On average, 5 tons of tomato is traded per day in *Pasar Induk* Kramat Jati. The average purchase price in *PI* is Rp 1,500/kg and selling price is Rp 1,800/kg. After deducting the marketing cost (Rp 64.65/kg) the profit margin in *PI Kramat Jati* is Rp 235.35/kg.

In *Pasar Induk*, tomatoes of varying quality are traded, from super or best quality to medium quality. Buyers of tomato in *Pasar Induk* Kramat Jati come from several regions

such as traders from Bekasi, Subang, Serang, Cibitung, markets in around Jakarta and retailers from *Pasar* Lembang. The price ratio between the farm gate price and traders in *Pasar Induk* is 50.72.

At the retailer level, the purchasing price is Rp 2,000/kg and the produce is sold to consumers and other traders from Subang at Rp 2,600/kg. The cost of marketing is Rp 495/kg, which leaves Rp 105/kg as profit. At this level, the payment system is cash. The ratio of farm gate price to retail price is 35.15. Therefore, farmers receive only 35.15 per cent of the price that is paid by consumers, which is because the marketing channel is quite lengthy. A short marketing channel would give greater share to farmers, and consequently, farmers would have more incentive to grow tomato.

6.5 Conclusions

1. The monthly price development of vegetables shows that price of cabbage tends to fluctuate every month; the price of tomato is even more volatile than cabbage but cauliflower is relatively stable. The price of vegetables (cabbage and tomato) rises at the beginning of the dry season (March-May) as the volume of supply drops. Conversely, the prices of cabbage and tomato fall to reach their lowest slump in the rainy season (August-February) as supply is abundant. The price of cauliflower is relatively stable because demand is limited and the area planted is also limited.
2. The price of vegetables affect vegetable farmers' income, especially when the prices drop while the cost of inputs remains stable or even rises. Such price fluctuations can be resolved by diversifying the farm or cropping pattern to maintain stable supply based on demand. Furthermore, market price information supports farmers in production planning.
3. In the marketing of vegetable products at the research sites, a lot of marketing institutions are involved including, village collectors/commissioners, wholesalers, suppliers, traders in *Pasar Induk* and retailers. From farmers to consumers the chain is long and complicated, therefore, farmers only receive a small share of the price for their produce which is paid by consumers, i.e. the price is not transmitted equally to the farmers.
4. The highest profit or margin for cabbage and cauliflower marketing is gained by suppliers and supermarkets; and for tomato by *Pasar Induk* traders. At this level of trader, the ability to raise the quality of the product in terms of sorting, grading and packing enables them to receive higher profits compared to other traders. The

lowest share given to farmers is when their produce is sold to supermarkets, despite the sales price of these products being very high.

5. To increase farmer share, the marketing channel must be shortened or farmers must get involved in the marketing activities. Shortening the marketing channel is achievable through partnerships with traders, marketing the product together in the farmer groups, seeking access to suppliers and supermarkets or by processing the produce before selling.
6. The problem of farmers accessing supermarkets is the continuity of supply in terms of quantity and quality. The demand from supermarkets is small in quantity but very high in quality. However, the largest constraint to be overcome by the farmers is the payment system, which is a deferred system with the delay of around 15 days.
7. Recently, farmers have begun marketing the product individually and, as a result, their bargaining position has become very weak. The role of farmer groups is limited in the marketing of the produce. The long distance from the production centre to consumption centre raises the transportation costs, damage sustained and loss. Even though such costs are paid by traders, the traders then burden the cost on the farmers and consumers.
8. Therefore, developing or strengthening the farmer institutions that are able to access the vegetable market is necessary. It is expected that the marketing system for vegetables will be more efficient and farmers can generate more profit. In this case, the role of government in developing credit at low interest rates to underpin farmers' capital and continuously support the development of farm business is crucial, especially in helping farmers enter modern markets.

7. Integration of Vegetable Production and Marketing in Highland Areas
(Case Study in Lembang, Bandung, West Java)

Henny Mayrowani and Adang Agustian[*]

Abstract

The development of market institutions, especially modern markets, has not directly raised farmer income even though the prices of produce in modern markets are relatively high. Farmers still face price fluctuations, especially during the harvest season. Furthermore, traders, who have access to market institutions, generate more income due to the higher value of produce in modern markets. Against this backdrop, is it possible for farmers to become involved in marketing activities, for example post-harvest activities (sorting, grading, packing, etc.), to give value added to the produce and possibly access modern markets? Consequently, farmers will receive price incentives for such activities. The objective of this chapter is to analyse post-harvest activities from the farmers' perspective, as one aspect of marketing activities, for vegetable produce and its price incentive. The study was conducted in Langensari and Cibodas villages, Lembang, Bandung in 2005. Data was collected through surveys of farmers and traders and the analysis is descriptive. The results of the research are that: (i) most farmers are actually involved in sorting, grading and cleaning activities; representing respectively 80 per cent, 50 per cent and 55 per cent of respondents in Langensari and 90 per cent, 30 per cent and 45 per cent in Cibodas. However, farmers are rarely involved in packing activities; (ii) farmers receive a price incentive from such activities; (iii) traders in Langensari and Cibodas prefer to buy handled produce from farmers; and (iv) market access has several prerequisites to be met by farmers, such as high quality produce, continued supply in quantity and quality, and acceptance of the deferred payment system (7-15 days or more). The deferred payment system is troublesome for farmers. Notwithstanding, one way to boost market access, especially to modern markets, is by managing farms in farmer groups. Under such groups produce can be diversified based on market demand or through developing partnerships with traders/suppliers.

Keywords: production, vegetable, market, post harvest.

[*] ICASEPS, Bogor, Indonesia.

7.1 Introduction

Trade liberalization provides both opportunities and challenges in terms of the development of horticulture because there are no more trade barriers among countries. However, this will become a problem if national horticultural produces are not competitive. Therefore, boosting national production should be underpinned by raising the competitiveness and efficiency of horticultural businesses (Agustian *et al.*, 2005).

There are some prerequisites to the entry level of global trade in horticultural produce. Strict quality requirements are not only necessary for world trade but also for domestic trade in terms of modern supermarkets and hypermarkets. Consequently, farmers wishing to enter this market are required to produce top quality produce based on market demand, and traders/suppliers also must ensure high quality produce for the market. Farmers unable to grow high quality produce are only able to sell at low prices to traditional markets.

A study for Market Asia (2004) of Indonesian horticultural produce shows that horticultural development policy has succeeded in raising production, however, not in line with the dynamics of market demand from various market institutions, especially in terms of produce quality. Ergo, horticultural farm produce is not yet market demand oriented. Farmers have only augmented production in terms of quantity without considering quality, shape and size or appearance based on market demand and consumer preferences. This implies that farmers are hitherto unable to accommodate the dynamic requirements of the horticultural produce market.

Market institutions for agricultural produce have been widely developed consisting of farmers, collectors, wholesalers and retailers (Kuma'at, 1992). They work at traditional and modern markets as well as for industry (PSP IPB and Bapebti, 1995). Several studies have shown that marketing costs in Indonesia are quite high and the share among the marketing agents/institutions remains unequal; the share of traders being higher than farmers. Therefore, the development of modern markets has not directly given any benefits to farmers, even though their produce is sold at higher prices in supermarkets. Farmers still face price volatility during the harvest season.

Maliati (USESE Foundation, 2002) stressed that the development of various modern markets is expected to help farmers in the marketing of produce at higher prices compared to other markets. In fact, it was found that farmers still face price fluctuations in the harvest season and traders still receive high shares because they have access to modern markets. There are numerous requirements that must be met to enter modern markets, which is one

of the reasons farmers find it so difficult. Farmers have enough difficulty just taking part in transactions with suppliers who distribute the vegetables to supermarkets. The question is how the farmers can access the various markets, especially modern markets, suppliers and exporters? Opportunities for the farmers to enter such markets lie in managing the quality of the produce, not only the quantity. Quality produce is possible through the use of high quality seeds and good cultivation practices as well as engaging in post-harvest activities, such as sorting, grading, cleaning and packing.

Recently, has it been possible for farmers to handle produce (sorting, grading, cleaning and packing) to improve quality? Are such activities reaping the rewards in terms of price incentives? This study has the objective of analysing the possibility of farmer involvement in marketing activities in terms of sorting, grading, cleaning and packing and, therefore, the possibility of commending higher prices for their produce.

7.2 Methods

The study was conducted in Langensari and Cibodas villages, Lembang sub-district, Bandung district in September 2005. The respondents are vegetable farmers and traders; 20 farmers in Langensari and 20 farmers in Cibodas. Traders include collectors and suppliers to supermarket; six traders in Langensari and five traders in Cibodas.

Data was analysed using descriptive qualitative methods. Primary data is presented in the form of analytical tables and the analysis enriched with qualitative information from the field.

7.3 Results

7.3.1 Handling vegetable commodities and the subsequent price incentive

The results of the survey concerned with farmer post-harvest activities are presented in Table 7.1. Sorting is undertaken by most of the respondents (80 per cent) in Langensari. Produce is sorted by farmers to separate spoiled produce or bad quality produce from the good quality produce. It is quite normal for this activity to be done by farmers. Regarding the source of knowledge for the sorting, 25 per cent of respondents answered that it is based on experience, 25 per cent replied information from traders and 15 per cent admitted it was from field extension workers. Most farmers (60 per cent) have never received formal sorting training from field extension workers, but informally field extension workers do explain the method if asked. Fifty per cent of respondents who sort their produce said that sorting was carried out for the produce to be sold at certain markets. Such activities raise the price of

the produce by Rp 200/kg, and the farmers are satisfied with this additional price. The reason farmers gave for not sorting their produce was lack of sorting knowledge (20 per cent) and lack of assurance that sorted produce will indeed receive higher prices (35 per cent).

Fifty-five per cent of respondents grade their produce. Grading involves grouping the produce based on quality or size. Farmers have to learn the different methods for grading from traders (35 per cent) because extension workers have never formally explained the methods (stated by 75 per cent of respondents). Most grading is done for certain markets (60 per cent). Furthermore, most farmers (58 per cent) grade their produce for wholesalers and 25 per cent grade for the central market. The majority of respondents are satisfied with the additional Rp 300/kg for grading activities. Several farmers do not grade their produce because of a lack of knowledge and no assurance the produce will fetch higher prices through grading.

Packing is not popular among farmers; it is usually done by traders or suppliers. The reasons for this are a lack of knowledge regarding standards and also the various methods of packing. Produce is washed and cleaned by 55 per cent of respondents in Langensari based on experience because this activity is relatively straightforward. Cleaning and washing is based on demand from certain markets and farmers seem satisfied with the additional Rp 263/kg.

In Langensari and Cibodas, sorting activity is popular and done by almost all respondents. In Cibodas, sorting is specifically for produces sold to wholesalers and *Pasar Induk*, with a price incentive of Rp 210/kg. Grading is only undertaken by 30 per cent of respondents in Cibodas but they are satisfied with the price incentive of Rp 233/kg. Cleaning and washing is done by 45 per cent of respondents giving a price incentive of Rp 263/kg.

It is interesting to note that, despite the very low number (just 5 per cent), packing is done in Cibodas. Based on experience, farmers pack the produce based on the orders of the supplier. The farmers are satisfied with the additional Rp 500/kg for packing.

Table 7.1 Farmer perception of post-harvest handling of horticultural produce before marketing in Lembang, Bandung, 2005

Description	Activities in Langensari				Activities in Cibodas			
	Sort.	Grad.	Pack.	Clean.	Sort.	Grad.	Pack.	Clean.
Post-harvest activities done by the farmers - all respondents (%)	80	55	0	55	90	30	5	45
Source of knowledge of activities - all respondents (%)								
- Learn by themselves	35	10	0	90	30	25	5	45
- Traders	25	35	0	10	0	5	0	0
- Extension workers	15	5	0	0	0	0	0	0
- Traders and learn by themselves	0	0	0	0	70	0	0	0
- No comment	25	50	0	0	0	70	95	55
Received information of post-harvest activities from extension workers - all respondents (%)								
- Yes	40	75	0	0	75	10	0	0
- No	60	25	100	100	25	90	100	100
Post-harvest activities done for specific customers - respondents who do post-harvest activities (%)								
- Yes	50	60	0	25	60	30	100	40
- No	50	40	0	75	40	70	0	60
Post-harvest activities done for: - respondents who answered yes for Q4 (%)								
- Collectors	30	8	0	0	20	0	0	0
- Wholesalers	50	59	0	100	50	20	0	40
- Suppliers	20	8	0	0	0	0	100	0
- Central Market	0	25	0	0	30	10	0	0
- No comment	0	0	0	0	0	70	0	60
Farmer opinion on price incentives of post-harvest activities - all the respondents (%)								
- Yes	55	50	0	35	100	25	100	40
- No	45	50	0	65	0	75	0	60
Average price difference for post-harvest activities (Rp/kg)	200	300	0	263	210	233	500	263
Farmers satisfied with price incentive for post-harvest activities - all the respondents (%)	60	45	0	40	55	35	100	45
Additional cost expended for post-harvest activities - all the respondents (%)	25	20	0	25	15	5	0	0
Reason for not applying post-harvest activities - respondents who don't do activities (%)								
- Don't know the method	0	20	90	15	10	20	65	15
- Don't know the standards	0	15	100	15	5	25	75	15
- Don't have knowledge	0	15	85	15	10	25	70	15
- There is no information from extension workers	20	40	85	40	15	65	75	40
- There is no price incentive	35	55	80	50	15	60	75	40

Source: Field survey, 2005.

7.3.2 Response of the traders in terms of farmer post-harvest activities

The response of traders when questioned about post-harvest activities is shown in Table 7.2. In Langensari, only 33.33 per cent of respondent traders bought vegetable produce after handling (sorting, cleaning and grading) by farmers and 16.67 per cent bought pre-packed produce. Most traders (more than 65 per cent) buy handled produce from collectors or other small traders.

Table 7.2 Response of the traders towards post-harvest activities for vegetable marketing in Lembang, Bandung, 2005

Description	Langensari	Cibodas
Ratio of respondents who buy handled produces		
Commodity produced by farmers (%):		
- Commodity has been cleaned	33.33	60.00
- Commodity has been sorted	33.33	80.00
- Commodity has been graded	33.33	20.00
- Commodity has been packed	0.00	20.00
Commodity from non-farmers (%):		
- Commodity has been cleaned	83.33	60.00
- Commodity has been sorted	66.67	80.00
- Commodity has been graded	83.33	20.00
- Commodity has been packed	16.67	20.00
Preferences of trader in buying the produce (%):		
- Without handling	33.33	20.00
- With handling	66.67	80.00
Trader opinion of price incentives (%):		
- Handling creates price incentives	50.00	80.00
- Handling does not create price incentives	50.00	20.00
Average price incentive of handling commodity (Rp/kg):		
- Commodity has been cleaned	233.33	250
- Commodity has been sorted	200.00	650
- Commodity has been graded	233.33	200
- Commodity has been packed	0.00	500

Source: Field survey, 2005.

In fact, traders in Langensari (66.67 per cent) prefer to buy handled commodities as it facilitates further processing. Fifty per cent of traders said that buying handled produce from previous traders or farmers gives a price incentive of as much as Rp 200/kg to Rp 233.33/kg. In Cibodas, the percentage of traders preferring to buy handled produce from farmers is larger than in Langensari (80 per cent for sorted produce) with a higher price incentive of between Rp 200/kg and Rp 650/kg.

Table 7.3 shows that 67 to 83 per cent of traders in Langensari are satisfied with the quality of the purchased produce, and in Cibodas the percentage is 40 to 80 per cent. Thirty-three per cent (potato) and 50 per cent (cabbage) of traders in Langensari purchase the best quality, with the remaining traders purchasing non-graded produce. In Cibodas, 40 per cent purchase high quality produce and 60 per cent non-grade produce.

Table 7.3 Response of traders in terms of purchasing produce in Lembang, Bandung, 2005

Description	Langensari	Cibodas
Satisfaction with handled produce (%)		
- Cleaned produce	67	40
- Sorted produce	83	80
- Graded produce	67	60
- Packed produce	-	-
Response of trader on grade of purchased produce (%)		
- Grade A (best quality)	33 (Potato) 50 (Cabbage)	40 (Cabbage)
- Non-graded	50 (Cabbage) 67 (Potato)	60 (Cabbage)

Source: Field survey, 2005.

7.3.3 Farmer perception of the requirements to enter the vegetable market

Several requirements are necessary to gain access to certain markets, such as suppliers and supermarkets, including volume, quality, quantity, the payment system and others. Table 7.4 shows the perception of farmers on the requirements to enter the vegetable market, especially modern markets. The main requirements entail highest quality, continuity of supply and acceptance of delayed payment.

Actually, demand from supermarkets and suppliers for certain produce is very limited in quantity but produce must be of the highest quality. This is the main factor constraining farmers from marketing their produce to supermarkets. Farmers must be able to continually supply the produce meeting such criteria, which is very problematic for farmers. During the harvest season, farmers tend to sell all their produce to wholesalers in the central market or to collectors because it is guaranteed that all of the produce can be sold. The selling price at supermarkets is very high but farmers do not agree with the payment system. Farmers need cash to fund the next season, while the payment systems in supermarkets use deferred payments of 7-15 days. Though the ratio of farmers who acknowledged the payment system as a constraint is smaller than for the other requirements, it deserves attention if farmers' access to supermarkets is to be improved.

Recently, one of the criteria for high quality produce is the chemical residue content. Table 7.5 shows the response of farmers on reducing the application of chemical pesticides. In this case, farmers in Cibodas have responded better to the call for less pesticide. Farmers in Cibodas have minimized the application of chemical inputs on their farms (90 per cent) because of a government programme on pest control and the exorbitant price of pesticide. However, according to most of the farmers (80 per cent), demand for organic produce remains very limited.

Table 7.4 Farmer perception of the requirements to enter various vegetable markets in Lembang, Bandung, 2005

Market and requirements	Farmers' perception (%)	
	Langensari	Cibodas
Supermarket		
High quality	85	80
Continuity of supply	45	0
Delayed payment system	20	0
Quantity as a request	30	20
Supplier		
High quality	85	100
Continuity of supply	45	0
Delayed payment system	20	0
Quantity as a request	20	0

Source: Field survey, 2005.

Table 7.5 Response of farmers to reducing the application of pesticide in Lembang, Bandung, 2005

Description	Farmers' response (%)	
	Langensari	Cibodas
Reducing the application of pesticide on vegetable farm:		
- Yes	70	95
- No	30	5
Method of reducing the residue of pesticides in vegetables:		
- Reducing the application	65	90
- Washing the produce before marketing it	20	10
- Other: Government programme on pest control (SLPHT)	20	0
Received extension service on reducing pesticide residue:		
- Yes	75	95
- No	25	5
Received demand for low pesticide residue produce:		
- Yes	15	20
- No	85	80

Note: Supplier is a trader who sells vegetables to modern markets, e.g. supermarkets.

7.3.4 Trader perception of the purchasing sources and considerations when buying vegetables

As shown in Table 7.6, most traders directly purchase vegetables from farmers.

The quality of the produce is the first consideration when purchasing vegetables agreed 50 per cent of respondents in Langensari. Some respondents stated that they seriously pay attention to the quality of the produce, especially if the source is another trader. Though the present study has shown that most surveyed traders purchase handled produce (Table 7.2), traders used to buy produce from the farmers 'unhandled' under the *tebasan* (selling crops to traders before harvest) system. Under the *tebasan* system produce

is purchased directly from the field; harvesting is done by the buyer. In Cibodas, the only source of vegetable produce is farmers (100 per cent) and most traders (80 per cent) consider quality when purchasing the vegetables. Factors to be considered in deciding good quality produce include size/shape, colour, maturity and purity. Good quality produce generates more profit and is easier to sell.

Table 7.6 Trader perception of purchasing vegetables in Lembang, Bandung, 2005

Description	Percentage (No. of traders)	
	Langensari	Cibodas
Source (Cabbage)		
Farmers	63.39	100.00
Collectors	36.61	0.00
Wholesalers	0.00	0.00
Suppliers	0.00	0.00
Market	0.00	0.00
Other	0.00	0.00
Purchased considering quality of produce.	50.00	80.00
Considerations of purchase:		
Size/shape	50.00	80.00
Colour/appearance	50.00	40.00
Maturity	33.33	40.00
Purity	33.33	80.00
Other	0.00	10.00

Source: Field survey, 2005.
Note: Wholesaler is a large-scale trader who buys vegetables primarily from other traders.

7.3.5 Farmer constraints in marketing their vegetables (quality, continuity, volume, price and the payment system)

As described previously, farmers are confronted by a panoply of difficulties preventing entry to the supermarkets. In Langensari and Cibodas, to meet the range of quality requirements is nearly impossible because the gulf in farm produce quality grown in one harvest season is usually very wide due to the low production technologies (Table 7.7). The high quality produce suitable for supermarkets is very limited, therefore, perhaps produce of lower quality should also be sold. It is difficult for farmers to grow a commodity which meets the quality demands of supermarkets since farmers lack the appropriate technologies and funds. Therefore, most farmers typically grow vegetables based on demand from the common market.

Cibodas village and Langensari village represent a vegetable production centre in Lembang, which have different characteristics in producing vegetables. In Langensari, most production is sold to wholesalers, inter-island traders and *Pasar Induk*. Farmers plant common varieties to exploit large-scale production without any treatments to grow superior quality. In Cibodas, most farmers cultivate high quality and specific commodities but on a

smaller scale, for example several varieties of tomato are grown and beans are produced using specific treatments to control maturity and a uniform size. Therefore, in fulfilling the demand for high quality produce, most farmers in Cibodas no longer have a problem of quality.

Maintaining continuity at a specific volume remains an issue for the farmers (75 per cent in Langensari and 85 per cent in Cibodas), even though supermarket prices are double those paid at the common markets. The payment system for supermarkets is still an impediment to farmers (85-100 per cent). An alternative way of solving this conundrum would be to manage farmer groups. Farmer groups can advise a programme of planting as well as cropping patterns to maintain the harvest and, concomitantly, satisfy demand from modern markets, ensuring continuity of supply. Some farmers (0-30 per cent) concurred that such a programme would help them meet the demands of quality and continuity necessary to transact with supermarkets. In addition, agricultural diversification, in particular non-farm businesses, should be developed. Farmers do not only depend on income they receive from the farm they have other sources of income too. Therefore, deferred payments for their farm produce should not distort farm capital or daily household expenditure.

Table 7.7 Farmer constraints to entering modern markets in Lembang, Bandung, 2005

Description	Farmers (%)	
	Langensari	Cibodas
Quality:		
- Difficult to fulfil	75.00	25.00
- No problem	20.00	45.00
- Could be fulfilled with production programme	5.00	30.00
Continuity:		
- Difficult to fulfil	75.00	85.00
- No problem	20.00	0.00
- Could be fulfilled with production programme	5.00	0.00
- No answer	0.00	15.00
Volume:		
- Demand is too small	55.00	65.00
- Difficult to meet the requested volume	45.00	5.00
- No answer	0.00	30.00
Price :		
- Price is higher than other traders	65.00	35.00
- No answer	35.00	65.00
Payment :		
- Term of payment too long	100.00	85.00
- No answer	0.00	15.00
Solution through farmers group		
- Yes	80.00	85.00
- No	20.00	15.00

Source: Field survey, 2005.

7.3.6 Accessibility of farmers to market institutions and partnerships in agri-business

Accessibility

Several vegetable market institutions exist at the research sites and play an important role in distributing farm produce, especially horticultural produce, to consumers in many places (Kuma'at, 1992). The institutions include farmers as the producer, village collectors, wholesalers, suppliers, retailers in traditional markets, etc. The market institutions assist the farmers in distributing their produce to consumers, however, the margin of traders is relatively high, which impinges on farmer profits.

Vegetable market institutions continue to develop in parallel with the development of world trade. Modern market institutions have developed, such as Hero, Superindo, Carrefour, Clubstore, and Ranch Market, which are growing supermarket chains in Indonesia, and as a consequences demand for high quality vegetables has also developed. The modern market would seem to boost farmer income due to their high retail prices compared to traditional markets, however, this is false (Maliati, 2002). Farmers as producers still face price volatility at harvest time but, conversely, traders are beginning to enjoy additional income through the development of the supermarket. The results of IPB (1990; 1995) show that in terms of vegetable marketing, farmer price share is only 34-74.5 per cent of the price at the wholesaler level. The highest profit margin is taken by the wholesaler, with retailers taking a smaller share than the wholesaler.

Based on the survey results conducted in Lembang, the entry barriers faced by farmers to modern market/suppliers are: (i) demand for vegetables is very limited in quantity and also requires continuity of supply; (ii) the payment system is not appropriate for the farmers; a delay of payment can be crippling for farmers; and (iii) farmers can not regularly meet the quality requirements.

Alternative solutions to such constraints include farm diversification to reduce risk as well as revolving credit at low interest rates to bolster farmer capital and partnerships. The development of partnerships does not only refer to farm activities but should also apply to farmers' attitudes and misconceptions regarding honouring partnership agreements.

Partnership

Partnerships can be seen as increasing interdependency among economic actors in economic activities. In terms of economic rationale, interdependency and co-operation can be characterized as: (i) symmetrical, meaning that both economic actors reap the benefits of co-operation; (ii) neutral, meaning that the profits from co-operation are only gained by one

of the actors; and (iii) exploitative, meaning one party exploits a partner to take the profits. Kasryno and Pranadji (1994) said that partnership in the agricultural sector plays a positive role but remains under developed as an activator of agricultural development.

In the context of this study, partnerships between farmers and traders have not developed yet. In fact, partnerships between farmers and traders have existed in the past but were dissolved due to farmers abusing the agreement. For example, respondents admitted that farmers sell their produce not to the contracted partner but to other markets when prices are very high. Subsequently, the partnership dissolves without any significant impact on farm development.

The study draws attention to the beginning of partnerships between vegetable suppliers and the farmers at the research site. Even though this activity remains limited, as a pioneer of partnerships, it must develop and extend to other areas. A supplier at the research site now co-operates with four local farmers, who are relatives of the supplier. This point is important, because co-operation should be built on understanding and loyalty to each other based on an agreement of partnership.

Under this co-operation scheme, the supplier provides credit for seeds and post harvest, the produce is sold to the supplier at the quantity and quality ordered. The selling price was decided through the agreement of both parties. To maintain continuity, the planting system and planting area for each commodity is planned. Consequently, produce is harvested based on need and is always available to meet demand. It seems that this partnership is working smoothly and both parties are gaining benefits. In the long term, it is possible that such partnerships develop widely and effectively to boost vegetable farmers' income.

7.4 Conclusions

1. With the development of vegetable markets, especially the expansion of the modern market, farmers are required to develop competitiveness in their produce. With the emergence of the modern market, it was expected that farmers' produce would be high-value if sold in the supermarkets. However, the problem remains how to raise the competitiveness of produce, in this case, boosting the quality of produce.
2. Usually, most post-harvest handling of farm produce is undertaken by traders, meaning the price incentive is earned by the traders and farmers do not reap any benefits from market development. One of the solutions to raise farmer income is

to involve the farmers in marketing activities, in this case post-harvest handling to increase the quality. Consequently, farmers would receive the price incentives from such activities.

3. At the research site most farmers sort the produce before selling. However, grading and cleaning is only practised by half of the respondents because it is only done when selling to certain markets. Most farmers do not pack their produce; the packing activities are handled by the traders.
4. Sorting, grading and cleaning vegetable produce unlocks a price incentive to the farmers. Farmers can sell the produce at higher prices compared to the old *tebasan* system, namely without any post-harvest management. For the farmers who do not process the produce, the reasons they give are because they are unsure of the method or are not convinced the activities will actually earn them a price incentive.
5. The study shows that traders prefer to purchase processed commodities, whether it be from the farmers or other traders, because it simplifies further processing. Therefore, there is an opportunity for farmers to process the produce before they market it. Farmers are able to integrate their production and marketing activities to generate more income from their farm production.
6. Despite the possibility of integrating their activities, entry barriers to the supermarkets still exist. Farmers find it difficult to meet the requirements imposed by supermarkets. Furthermore, demand from supermarkets is very small in quantity but high in quality and the continuity of supply as well as the deferred payment system are not easy to overcome.
7. Alternative solutions to such problems include: (i) managing farmer groups so farmers can plan a programme to arrange the harvest to satisfy demand from the supermarkets; (ii) diversifying their farm businesses to overcome the constraints of the payment system; (iii) allocating a revolving fund at low interest rates to support fund high quality production; and (iv) encouraging partnerships between traders or suppliers and farmers.

8. Concluding Remarks

Tomohide Sugino[*]

8.1 Implications of the study and recommendations

The field experiment study has shown that the profits generated from crop rotation to prevent clubroot are higher than continuous cabbage mono-cropping in the long run, which means that the technology has enough economic feasibility for further dissemination. Actually, farmers have shown strong interest in the application of the technology on their fields. Shifting to more effective cropping patterns to prevent the disease was observed in the village where dissemination activities were implemented. In the follow-up interview survey to evaluate farmer perception of the technology, the farmers gave relatively high scores to the technology in terms of visibility of effect, the low risk and high profitability. However, the farmers' knowledge remains insufficient, highlighted by the fact that the cropping patterns used in the fields are not necessarily the best ones from the standpoint of curbing clubroot.

The analysis of farm household income structure has shown that the households surveyed receive more than 60 per cent of their total income from vegetable farming and their per capita income is well above the minimum income of rural Indonesian households: here recognized as the national poverty line (Rp 129,108 per capita per month, as of February 2005). In spite of the importance of vegetable farming to the economy of farm households, the profits earned from vegetable farming are unstable, primarily due to volatility in the farm gate price of the produce.

Analysis of marketing channels, marketing margins and farmers' share in the marketing of vegetable products has revealed that the marketing channel of vegetable produce is long and relatively complicated. Also, that the widest marketing margin is taken by wholesaler/supplier and supermarket; while the share of the farmers is relatively low. To increase farmer share, it is suggested that shortening the marketing channel and involving the farmers in marketing activities should be promoted.

Analysing farmers' perspectives of post-harvest activities has shown that (i) most vegetable farmers in the study areas are involved in post-harvest activities such as sorting, grading and handling but packing for transactions with supermarkets is rarely undertaken by the farmers; (ii) farmers receive price incentives from post-harvest activities; (iii) traders

[*] JIRCAS (During the study period, assigned as Project Leader of AGRIDIV, UNESCAP-CAPSA).

prefer to buy handled products from farmers rather than produce with no post-harvest treatment; and (iv) to gain access to supermarkets, several requirement should be fulfilled by farmers, such as: high quality produce, continuous supply of quantity and quality, acceptance of the deferred payment system (7-15 days or more), though such a payment system is difficult for resource poor farmers to accept.

The study by UNESCAP-CAPSA about the impact of emerging supermarket showed that the fast growing establishment of modern markets in urban areas in Indonesia is not directly affecting the traditional marketing chain of FFV (fresh fruit and vegetables) distributed to traditional markets. The rapidly growing number of modern market outlets should be considered as additional market opportunity for FFV. Production centres continue their activities as usual although some efforts have been made by suppliers to consolidate FFV production collected from the farmers for sustainable distribution. Suppliers or intermediate traders (locals or inter-regional) who do business with modern markets are the most influential marketing agents dealing with quality and continuity of FFV distribution, however, in terms of quantity, traditional markets are the prime destination of production centres. The development and investment strategy for greater Jakarta should build on the-across-the-board approach, including both wet markets and where feasible from the surrounding demand, new local wholesale markets.

As a conclusion of the study, we would like to present several issues to be considered in policy implementation in the area to improve crop production and the welfare of small-scale vegetable farmers.

8.1.1 Continuous dissemination efforts

Crop rotation is very simple, cheap, environmentally friendly and effective in preventing soil borne diseases. In the wake of demonstrations in the field experiments and dissemination activities, more farmers at the study site began to practise crop rotation, which is less vulnerable to clubroot disease. However, the farmers' understanding of the technology remains insufficient. Therefore, continuous efforts to disseminate adequate technological information should be taken. The major constraint factor of dissemination is lack of budget and human resources in extension organizations. In Lembang sub-district, only three members of staff are assigned to dissemination activities in the region, which is far from ideal. Moreover, agricultural extension is not effective due to weak linkages between the agricultural programme and the real situation in the field (Kadir *et al*., 2003). Since financial constraints in government are difficult to resolve in the short term, alternative approaches to complement the lack of personnel should be provided. Closer communication between

researchers, extension workers, farmers and other stakeholders may be one option to solve the problem. To this end, the farmers meetings and local workshop in this study were warmly welcomed by the participants and they seem to have contributed to strengthen linkages among them. The function of AIAT should be bolstered, since the major function of AIAT is an intermediately body between research and extension, which conducts assessments of the feasibility of developed technologies before they are transferred to the extension system.

8.1.2 Provision of market information to farmers

The profit of crop rotation highly depends on vegetable prices. The market prices of vegetables fluctuate widely even over short periods. Therefore, market information is critical for farmers to select the kinds of crops to be planted in their fields. This is more important for the farmers who have introduced crop-rotation technologies. Though crop rotation has better profitability on a long-term basis, the alternative crop should carefully be selected as its profit is usually less than clubroot susceptible crops like cabbage. During the field experiments, beans, maize and potato were selected as alternative crops. However, not only these crops but also various other crops can be effective in mitigating clubroot damage, as is shown in Figure 3.7. Price information is essential for farmers to decide on their cropping pattern.

Since 1979, Indonesia has been developing a vegetable market information service (MIS) to provide daily price information to farmers and traders through radio programmes broadcast to the entire country every evening. However, farmers and small assembly traders usually obtain price information through more informal means: from colleagues, friends and traders, or by observing transactions at the assembly market(s), if it is nearby (Darmawan and Pasandaran, 2005). Such a situation is also observed in the present study. If current official price information does not meet farmers' demands, it should be modified to provide more practical information.

8.1.3 Collective activities for farmers

As the study has shown, the share of vegetable farm gate price in the retail price at supermarkets (9-12 per cent) is smaller than that of other retailers (24-35 per cent). This reflects the higher quality of the commodities sold in the supermarket on one side. However, it also shows the higher transaction costs or margins of middleman. Most farmers sell vegetables to the village collectors, few farmers sell their product directly to the suppliers that provide vegetables exclusively to supermarkets, and no farmers deal directly with supermarkets. Therefore, if farmers can sell vegetables directly to supermarkets or shortcut a part of the market chain, there is more possibility of farmers enjoying better returns.

The study has shown that individual farmers cannot meet the standards required to transact with supermarkets such as high quality, continuity of supply and delayed payments. The largest impediment is the stability of supply since a farmer only owns a small plot of land (0.30-0.33 hectares per households) and it is difficult to provide certain products on a long-term basis.

If small-scale farmers can organize into groups and the group can co-ordinate a production plan for member farmers, it is much easier to meet the conditions. In the surveyed village, one formative example of collective activity was found, which includes several farmers holding agreements with vegetable suppliers to co-ordinate stabilized vegetable production. Policy support to such groups would be an effective way of encouraging farmers to organize groups that can contribute to stable supply and higher income.

8.1.4 Diversifying activities and access to credit

One of the other solutions to overcome the constraints of transacting with supermarkets is through diversified farm household activities, which reduce risk and strengthen the farmers' capital and partnerships. If farmers can diverse their activities through agro-processing, integration between production and marketing, higher profits can be expected that enable farmers to accept the deferred payments made by supermarkets. In the study areas, only one farmer was found who carries out packing by himself for transactions with suppliers who sell the produce to supermarkets. The incentive for this packing (Rp 650/kg) is much higher than other activities such as sorting and grading (Rp 200-250/kg). This fact shows the integration between production and marketing would provide many benefit to farmers.

On the other hand, greater access to credit is another alternative. The farmer groups could apply for credit to purchase inputs from traders. Currently, the formal credit scheme focuses on major cereal production and vegetable farmers enjoy fewer opportunities to access credit. If an appropriate credit service was provided to farmers to meet their daily needs, farmers could stomach the deferred payments more easily.

8.1.5 A systematic approach to market participants

The two new markets supplying Jakarta have been established with the support of the provincial government; this means that now there is a role for the local governments of the districts surrounding Jakarta. Saying that is one thing, effectuating it is an entirely different story, because greater Jakarta comprises quite a number of districts and sub-districts, and obviously these need to plan their future together.

Well connecting rural and urban infrastructure (roads, water, electricity and communications) is of course the key to the future. Detailed local analysis will be necessary

to make this possible and develop plans. It is recommended to use the same methodology that large retail companies use in sourcing and distribution, spatial modelling, creating time – distance and cost grids. It should be noted and recognized that the ready knowledge of traders and drivers in Indonesia (and elsewhere) is made up from the same data. A systematic approach would be beneficial to all market participants.

Something should be done to improve the wet markets. It seems wise that the government of Jakarta and the nearby cities consider to provide a space in the wet markets for the procurement of FFV by retailers and restaurants, which usually occur after 10:00 pm till early in the morning.

9. References

Agustian A. *et al*., 2005. *Analisis Berbagai Bentuk Kelembagaan Pemasaran dan Dampaknya terhadap Kinerja Usaha Komoditas Sayuran dan Buah* (Marketing Institution Analysis and Its Impact on FFV Performance), Pusat Penelitian dan Pengembangan Sosial Ekonomi Pertanian, Research Report, Bogor.

Akaike, Y., 1992. *Effects of Sweet Corn Cultivation in the Field of Severe Outbreak of Cabbage Clubroot in Highland Area. New Technology in Kanto-Tokai Agriculture* (in Japanese).

Anonymous, 2005. *Kebijakan Umum Sistem Produksi dan Agribisinis Hortikultura* (General Information about Production System and Agribusiness of Horticulture). Unpublished.

Arie, T. *et al*., 1987. "Biological control of fusarium wilt of bottle bourd by mix-cropping with welsh onion or Chinese chive inoculated with pseudomonas gladioli", *Annual Phytopath, Society Japan 53* (in Japanese with English summary).

Bottema, J.W.T. *et al.,* 1989. "Potato in Indonesia: prospects for medium altitude production", *CGPRT Monograph series no. 21*, CGPRT Centre, Bogor.

Bottema, J.W.T. and Altemeier, K., 1989. "Western Java in development perspective", *International Workshop on Indonesian Studies No. 4*, Royal Institute of Linguistics and Anthropology, Leiden, the Netherlands.

BPP Lembang, 2003. *Laporan BPP Lembang* (Report of Agricultural Extension Services Unit in Lembang), Bandung, West Java, Indonesia.

BPS, 2003. *Statistik Indonesia 2002* (Statistical Yearbook of Indonesia 2002), Central Bureau of Statistics, Jakarta, Indonesia.

Christensen, J., 2005. *Clubroot of Crucifers*, Department of Plant Pathology, University of Nebraska-Lincoln, USA, http://nu-distance.unl.edu/homer/disease/Hort/Crucifer/CrClbRoot.html.

Darmawan, D. and Pasandaran, E., 2005. *Dynamics of Vegetables in Asia: Indonesia,* http://www.avrdc.org/pdf/dynamics/Indonesia.pdf.

Dinas Pertanian Kabupaten Bandung, 2004. *Laporan Tahunan Dinas Pertanian Kabupaten Bandung* (Annual Report of Agricultural Office Bandung District), Bandung, West Java, Indonesia.

Dinas Pertanian Tanaman Pangan Jawa Barat, 2003. *Lampiran Laporan Tahunan Dinas Pertanian Tanaman Pangan Jawa Barat* (Annual Report of Agricultural Office West

Java Province), Bandung, West Java, Indonesia.

FAO, 2006. *FAOSTAT*, http://faostat.fao.org/.

Ferrari, M. F., 1994. "20 years of horticulture in Indonesia: the vegetable subsector", *Working Paper Series no. 15*, CGPRT Centre, Bogor.

Hayami *et al.,* 1991. "Marketing innovation for vegetables: conditions of diversification in upland farming", *CGPRT Monograph Series no. 25*, CGPRT Centre, Bogor.

HHS and USDA, 2005. *Dietary Guidelines for Americans 2005*, US Department of Health and Human Services (HHS) and US Department of Agriculture (USDA), Washington, D.C., USA, http://www.health.gov/dietaryguidelines/dga2005/ document/pdf/dga2005.pdf.

Hori, M., 1986. "Disease of Chinese cabbage", *in Handbook of Crop Disease,* Yokendo, Tokyo, Japan.

IIRR (International Institute for Rural Reconstruction), 2000. *Going to Scale: Can We Bring More Benefits to More People More Quickly?* IIRR Workshop, Silang, the Philippines.

Kadir, I. *et al*., 2003. "Integration of agricultural research and extension (country paper of Indonesia)", *Report of the APO Study Meeting on Integration of Agricultural Research and Extension*, Philippines, 18-22 March 2002.

Kasryno dan Pranadji, 1994. *Kemitraan Saat Ini dan Dimasa Datang di Sektor Pertanian, Komoditi Sayur-Mayur di Jawa Barat* (Partnership in Agricultural Sector, Now and for the Future, Case of Vegetables Commodity in West Java), Badan Litbang Pertanian, Bogor, Indonesia.

Kuma'at, R., 1992. "Sistem pemasaran sayuran dataran tinggi di provinsi Sulawesi Utara", *Thesis MS – FPS IPB*, Bogor Agricultural University (IPB), Bogor, Indonesia.

Kuma'at, R., 1992. "Sistem pemasaran sayuran dataran tinggi" (Highland Vegetable Marketing System), *Thesis MS – IPB*, Bogor Agricultural University (IPB), Bogor, Indonesia.

Kusuma *et al*., 1980. "Price information service for vegetables in West Java, effects and impacts; findings of a survey conducted with 254 producers", *Agricultural Market Information Service, Publication no 8,* Indonesian-German Technical Cooperation Project ATA/85/86, Jakarta.

Maliati, 2002. *Kelembagaan Pemasaran Pertanian: Permasalahan, Tantangan dan Alternatif Solusinya* (Agricultural Market Institution: Problems, Challenges and its Alternative Solutions), Jakarta, Indonesia: USESE Foundation.

Menter, H. *et al.,* 2004. "Scaling up", *in* Douglas Pachico, Fujisaka, S. (eds.), *Scaling Up and Out: Achieving Widespread Impact through Agricultural Research*, *CIAT*

Publication no. 340 (Economics and impact series 3), Centro Internacional de Agricultura Tropical (CIAT), Cali, Colombia.

Mubyarto, 1989. *Pengantar Ekonomi Pertanian* (Introduction of Agricultural Economy), 3rd edition, LP3ES, Jakarta, Indonesia.

PSP IPB-Bapelti, 1995. *Studi Kelayakan Pembentukan Pasar Lelang Komoditi Sayuran di Jawa Barat* (Feasibility Study on the Development of Vegetable Auction Market in West Java), IPB, Bogor, Indonesia.

Reardon, T. 2004. "The Rise of supermarkets in Indonesia: challenges and opportunities for smallholder farmers", *in* Natawidjaja, R.S., T.I. Noor, T. Perdana, and D. Supyandi: *Case Studies: The Impact of Supermarket Growth on Agricultural Market Development.* Development Alternative Inc. and Center for Agricultural Policy and Agribusiness Studies, Padjajaran University, Bandung.

Saptana, E.L. *et al*., 2005. *Pengembangan Model Kelembagaan Kemitraan Usaha yang Berdayasaing di Kawasan Sentra Produksi Hortikultura* (Institutional Model Development of Business Competitive Partnership at Horticultural Production Centers), Research Report, Pusat Penelitian dan Pengembangan Sosial Ekonomi Pertanian, Bogor.

Study of Market Asia, 2004. *Research on Market in Asia*, www. Marketasia.com. 2004.

Sutrisno, 2000. *Potensi Sayur Mayur di Indonesia* (Vegetable Potential in Indonesia), Makalah Workshop Revitalisasi Sistem Distribusi dalam Upaya Meningkatkan Pemasaran Hortikultura, Jakarta, Indonesia.

Suzuki, K. *et al*., 1992. "Some properties of germination-stimulating factor from plant for resting spores of plasmodiophora brassicae", *Bulletin of Hokkaido Annual Phytopath, Society Japan 58* (in English with Japanese summary).

TIM IPB, 1990. *Prospek Pengembangan Pasar Induk Sayuran Dalam Pengembangan Wilayah DKI Jakarta* (Prospect of the Development of Vegetable Central Market in Regional Development of DKI Jakarta), IPB (Sosio-Economic Department), Bogor, Indonesia.

Watanabe, K. and Iwase, I., 1997. "Suppress of club root of Chinese cabbage by cultivation and plowing-in radish resistant variety 'kozena' " *Res. Prompt rep. (Kanto-Tokai agric.* - in Japanese).

Watanabe, K. *et al.*, 1999. "Selection of club root resistant Chinese cabbage varieties 'T741' and utilization", *Res. Prompt rep. (Kanto-Tokai agric., 1998* - in Japanese*).*

World Bank Report, 2007. *Horticultural Producers and Supermarket Development in*

Indonesia, World Bank Report.

Yamada, K. *et al*., 1997. “Cultivation method to suppress club root of Chinese cabbage using trap crop”, *Res. Prompt rep. (Kanto-Tokai agric., 1996* - in Japanese*).*

Yamada, M. and Nakagawa, I., 1998. “The crop rotation to suppress all kinds of nematodes to attack radish and taro plant in Kanto district”, *New Technology in Kanto-Tokai Agric. (1997* - in Japanese*).*

Yamada, M. *et al*., 2005. “Control of cabbage clubroot disease by employing one-year crop rotations with three vegetable combinations in West Java highlands of Indonesia”, *in* Osamu K. (ed.), *Evaluation of Vegetable-based Farming Systems and Improvement of Vegetable and Fruit Cultivation in Highland Regions in West Java, Indonesia, JIRCAS Working Report No. 43,* Tsukuba, Japan: Japan International Research Center for Agricultural Sciences.

Appendices

Appendix 1 Annual average per capita consumption of selected vegetables of urban population, 1987-2006

Year	Total expnd * (monthly) (Rp)	Consumption (Kg)													
		Spinach	Swamp cabbage	Cabbage	Chinese cabbage	Darker Coloured Mustard Greens	Beans	String bean	Tomato	Carrot	Unripe corn	Onion	Garlic	Chilies	Green chili
1987	33 413	5.512	5.356	2.288	1.456	0	1.3	3.536	1.638	0.988	0	2.246	0.328	1.316	0.182
1990	44 029	4.628	5.044	1.768	1.3	0	1.092	3.432	1.518	0.884	0	2.101	0.354	1.472	0.208
1993	64 063	4.94	4.836	1.768	1.352	0	1.04	3.796	1.882	1.04	0	2.158	0.473	1.394	0.198
1996	100 639	4.108	4.056	1.716	0.676	1.144	1.144	3.016	1.732	1.092	0.146	2.127	0.619	1.258	0.208
1999	180 500	4.056	4.68	1.456	0.728	1.04	0.78	2.808	1.659	0.988	0.112	1.638	0.842	1.139	0.161
2002	273 294	4.576	4.836	1.872	0.728	1.248	0.936	3.328	1.872	1.352	0.224	2.34	1.238	1.654	0.26
2003	304 751	5.356	5.356	1.664	0.624	1.196	1.04	3.12	1.888	0.988	0.229	2.272	1.248	1.550	0.255
2004	319 220	4.784	4.992	1.612	0.624	1.196	1.04	3.016	1.841	1.196	0.182	2.298	1.321	1.534	0.250
2005	350 196	4.16	4.472	1.456	0.676	1.196	0.936	3.328	1.903	1.196	0.244	2.444	1.368	1.768	0.265
2006	393 157	4.628	5.096	1.508	0.78	1.3	0.884	3.588	1.357	1.3	0.151	2.163	1.17	1.534	0.26

Source: Expenditure for Consumption of Indonesia, National Socio-Economic Survey.
Note: * Expnd = expenditure.

Appendix 2 Annual average per capita consumption of selected fruit of the urban population, 1987-2006

Year	Total expenditures (monthly) (Rp)	Consumption (Kg)										
		Orange	Mango	Apple	*Rambutan*	Lanzon	Durian	Pineapple	Banana	Water-melon	Melon	Tomato
1987	33 413	1.3	0.832	0.26	3.38	1.924	1.612	0.728	10.608	0.26	0	0.208
1990	44 029	1.664	0.26	0.312	6.24	2.028	1.456	0.78	9.672	0.468	0	0.312
1993	64 063	1.716	0.468	0.52	4.94	0.208	0.676	0.728	10.192	0.884	0	0.26
1996	100 639	2.34	2.288	1.404	3.224	0.26	0.572	0.676	6.812	1.196	0.312	0.26
1999	180 500	1.872	0.26	0.312	2.6	0.052	0.156	0.468	6.864	0.624	0.104	0.26
2002	273 294	3.016	0.312	1.04	8.06	2.548	0.988	0.312	6.5	1.196	0.624	0.26
2003	304 751	3.744	2.808	0.988	5.928	1.04	1.82	0.312	6.136	1.56	1.04	0.312
2004	319 220	4.004	0.728	1.144	8.008	1.04	1.196	0.312	5.824	1.196	0.572	0.26
2005	350 196	3.64	0.52	0.988	9.62	2.548	1.612	0.208	5.928	1.144	0.312	0.208
2006	393 157	4.212	0.26	0.936	5.824	0.728	0.936	0.26	6.136	0.832	0.26	0.104

Source: Expenditure for Consumption of Indonesia, National Socio-Economic Survey.

Appendix 3 Consumption of vegetables in kg/capita/year, projections to the year 2000 based on time trends

Year	FBS [a]	Projection	Survey [b]	Estimation	Projection
1976	11.77				
1977	11.95				
1978	12.88		31.81		
1979	12.07			33.94	
1980	12.94		33.39		
1981	12.35		37.78		
1982	11.55			38.11	
1983	17.34			39.50	
1984	17.07		42.36		
1985	18.59			42.28	
1986	22.01			43.67	
1987	21.11		48.39		
1988	20.55			46.46	
1989	23.72			47.85	
1990	17.12		46.08		
1991		22.45			50.63
1992		23.08			52.02
1993		23.71			53.41
1994		24.35			54.80
1995		24.98			56.19
1996		25.61			57.58
1997		26.24			58.97
1998		26.88			60.37
1999		27.51			61.76
2000		28.14			63.15

Source: Biro Pusat Statistik.

Notes: [a] Food Balance Sheet, Indonesian Ministry of Agriculture.
[b] Surveyed: SUSENAS 1978, 1980, 1981, 1984, 1987, 1990.