Development of a Good Agricultural Practice to improve food safety and product quality in Indonesian vegetable production

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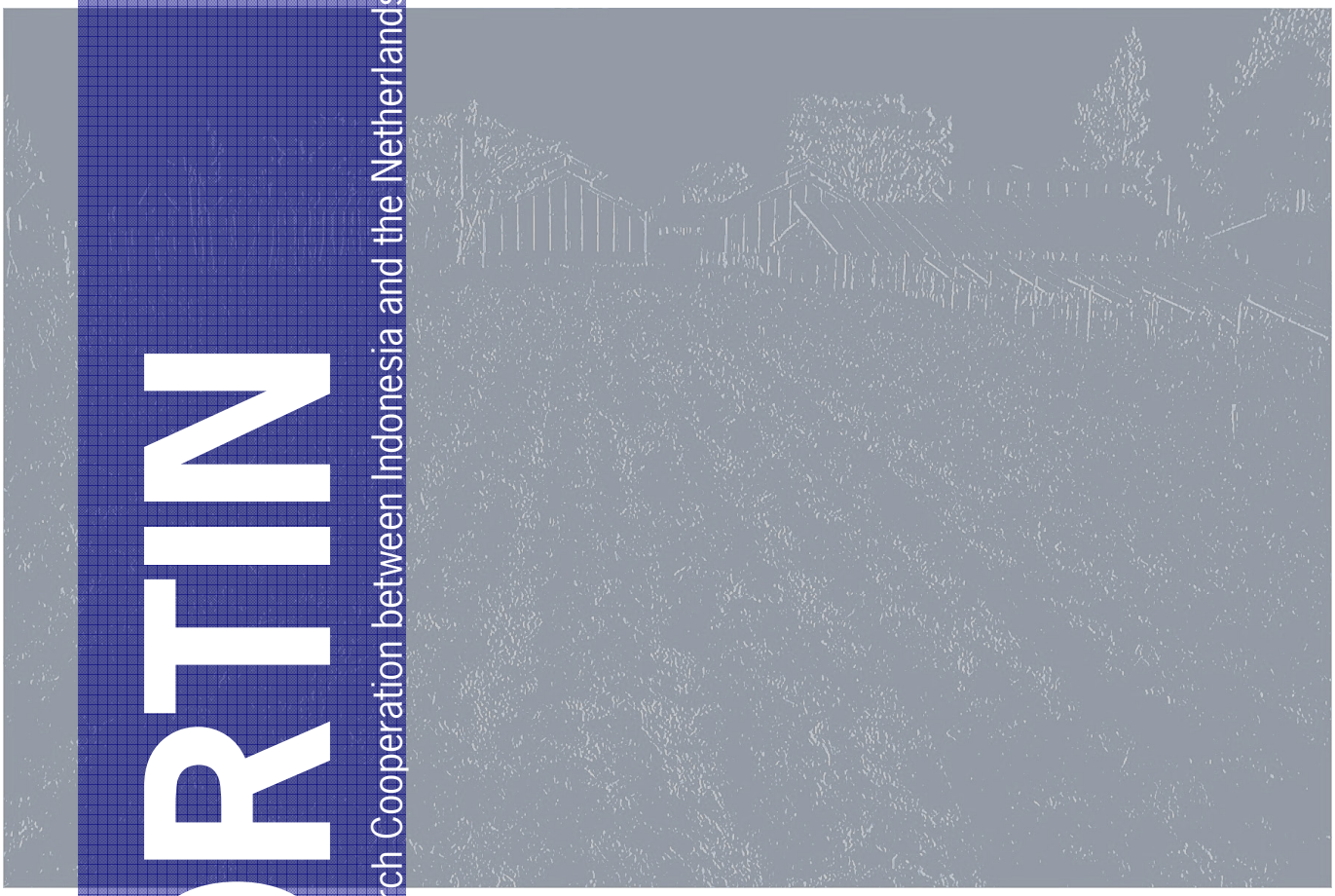

HORTIN

Horticultural Research Cooperation between Indonesia and the Netherlands

Research Report 03 2006

WAGENINGEN UR
For quality of life

Development of a Good Agricultural Practice to improve food safety and product quality in Indonesian vegetable production

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Wageningen
November 2006

The HORTIN Research Programme

HORTIN

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Formal partners are the Indonesian Agency for Agricultural Research and Development (IAARD, Indonesia), and the Directorate of Knowledge Dissemination (LNV-DWK, the Netherlands). The programme is covered by an Administrative Arrangement.

On the Indonesian side, the programme is carried out by four horticultural institutes under IAARD-ICHORD: the Indonesian Vegetable Research Institute (**IVEGRI**) in Lembang, the Indonesian Ornamental Crops Research Institute (**IOCRI**) in Segunung, the Indonesian Fruit Research Institute (**IFRURI**) in Solok, West Sumatra, and the Citrus and Subtropical Horticulture Research Station (**CISTROPHRES**) in Batu. In the Netherlands PRI (Plant Research International) and PPO (Applied Plant Research) are the principal partners.

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The programme is aimed at joint research, knowledge transfer and implementation of results together with the Indonesian and Dutch private sector. A number of projects are getting financial support from SenterNovem (agency of the Dutch Ministry of Economic Affairs).

The HORTIN Research Programme

If you think you could contribute to the goals of HORTIN in any way, please contact the Programme management.

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Preface

The HORTIN (Horticultural Research Cooperation between Indonesia and the Netherlands) programme was started in 2003 and ended in 2006. One of the projects in HORTIN, QUALITY, focuses on food safety and quality management in Indonesian vegetable production systems. The project aims are the development and testing of a certifiable protocol for the improvement of safe production and product quality of vegetables in Indonesia. The project is of great importance to Indonesia because the requirements on standardisation, quality and food safety in the international market place are becoming more and more important.
International standards, like the Codex Alimentarius, are important references for countries to make their own laws to protect the health of consumers and to stimulate fair trade practices. Besides the public standards, important trade parties developed private standards in order to safeguard food safety and product quality like SQF 1000-2000 and Eurep-GAP. The national standard, Indonesia's SNI, is not widely recognised. Food safety of fresh products is not taken into account yet and a control system for food safety is still absent in Indonesia. Therefore, agricultural products of Indonesia will have difficulties to compete with foreign products. Foreign products have easy access to the local Indonesian markets.

The collaborative research project consisted of a number of activities. One of the first activities was to describe the vegetable supply chain and the perception of supply chain parties of food safety and quality assurance. The second activity was the risk assessment of food safety related processes on the farm (physical, microbiological and chemical). After the risk assessment a GAP protocol was drawn up, based on the bottlenecks of the risk assessment and the ambitions of the Indonesian Government on certification. The GAP protocol (Hortin-GAP) was tested by 14 farmers and supply chain parties. The farmers were enthusiastic about the project and they all completed the test.
Knowledge transfer was also an aspect in the collaborative research project, an IVEGRI researcher was trained in the Netherlands on Good Agricultural Practice. During the term of the project, a number of courses were given to IVEGRI researchers. Fifteen researchers, which included the whole Indonesian project team, attended the courses. The courses were intensive and included theory, practice and company visits.

The following people and partners contributed to the success of the project, and we would like to thank all parties who were involved in this project. From Indonesia these are IAARD, ICHORD as financiers, researchers from IVEGRI represented by Azis Azirin Asandhi, Witono Adiyoga, Laksanawati Dibyantoro, Nurhartuti, Ineu Sulastrini, CSA represented by Syukur Iwantoro, Sri Sulasmi, Dewi Novia, participating farmers represented by Edik Yuhanda, Usman, Engkos Kosasih, Lily Charly, Bunyamun Marsus, Asep Deden, Solehudin, Ajad Sudrajad, Deden Sudrajad, Utep Rahmat, Dadang Rukmana, Didin Sukarya, Ali Musonif, Asep W. Gunawan, traders represented by CV Mandiri, Makro, Hero, Carefour. From the Netherlands these are: the Ministry of Agriculture Nature and Food Quality as financier, the Dutch Agricultural Counsellor Frans Claassen for his suggestions and network, researchers from PPO represented by Herman Schoorlemmer and Marcel van der Voort. For their participation in the Hazard Analysis and/or training Maike te Riele and Michiel Drok of CAH Dronten, Joop van der Roest of RIKILT and agricultural expatriate Jan Schoneveld.
Thanks to you all.

Azis A. Asandhi
Indonesian project leader

Herman Schoorlemmer
Dutch project leader

Summary

HORTIN is a collaborative research programme between Indonesia and The Netherlands on strategic and applied research in horticulture. HORTIN-Quality is one of the projects in this programme. The project aimed to develop and test a certifiable protocol for the improvement of safe production and product quality of vegetables in Indonesia. The project is of great importance to Indonesia, because of growing awareness about food safety problems in Indonesia and the requirements on standardisation, quality and food safety in the international market place.

The HORTIN-Quality project was conducted over four years, from 2003-2006. The six main activities were:

- training of Indonesian researchers on quality management, chain developments and quality managements systems;
- analysis of the supply chain of vegetables in West Java and analysis of attitude, perception and ambitions of chain participants about food safety and quality. This activity is realised by literature research and a survey;
- identification of hazards in the Indonesian vegetable supply chain based on HACCP-principles;
- development of a protocol for Good Agricultural Practice (HORTIN-GAP) to control the food safety bottlenecks based on the results of the former two activities and a participatory workshop with farmers and traders;
- organisation of a field test with farmers during a cropping season. In general the Indonesian farmers have little or no experience with record keeping and most farmers still use the calendar system for spraying their crops. So besides the application of the protocol special attention was paid to recording and pesticide residues;
- monitoring and evaluation to control the process of development and testing and to learn about the experiences of farmers, traders and project members.

The survey showed for the majority of actors in the vegetable supply chain in Indonesia, food safety is not really a major issue. In fact they do not receive complaints from their clients about food safety. If they get complaints it is about the outer quality and about price. But there is a starting awareness about the problem of food safety.
A majority of the respondents in the survey expect food safety will become of more importance during the next 5 years. They mention there should be more food safety checks. They also see the benefits of a food safety system but expect it will be complicated for them.

Based on a hazard analysis with a HACCP team and a workshop with a group of Indonesian vegetable farmers some conclusions could be derived about the food safety bottlenecks in production of vegetables. One of the bottlenecks is the lack of hygienic awareness and procedures. Another element is the residue of pesticides on the products. Within Indonesian vegetable growing the calendar system is still common use. The use of the calendar system can cause excessive use of pesticides. The common practice of intercropping and use of different planting times through each other gives difficulties to respect the official expiracy time (pre-harvest interval). So residues are found on crops while the spraying was meant for another crop. An important element is, farmers have limited knowledge of rules and regulation on admission of pesticides. Access to official information is a problem. This can result in purchase of illegal pesticides or wrong use of allowed pesticides.
There are some reasons to expect risks occur, for example by making use of polluted water, but the limited access to testing (laboratory) facilities makes a number of these assumptions can not be determined or invalidated by farmers.

During this project a Good Agricultural Practice is developed in close cooperation with Indonesian farmers, trade companies and government. This Hortin-GAP has a close relation to international standards like HACCP and Eurep-GAP and fits into the ambitions of the Indonesian government (Direktorat Mutu dan Standardisasi) about a certification system for Indonesian Agricultural Products (Si Sakti-system). The GAP is tested by 14 farmers during a cropping season. The test showed the GAP with checklist and derived registration forms is useful and applicable for common Indonesian farmers. The test results of the Hortin-GAP show that the farmers are able to reach 'Prime 3'-certification requirements of the 'Si Sakti'-system. 'Prime 3' is the basic level (Good Pesticide Practice).
Record keeping, which was thought to be the biggest obstacle, proved to be not such a big problem. The test resulted in some practical recommendations for improvement of the forms. A few improvements of the checklist and

forms are necessary. A very problematic issue for a trustful and controllable GAP in Indonesia is the insufficient regulation, access to information and labelling of pesticides. The residue test showed farmers make use of pesticides for crops without any idea of official admission and international MRL standards.
Characteristic for the growing awareness on food safety issues in Indonesia was the very positive motivation of farmers to participate in the test. Farmers hoped they could be among the first group of farmers who will be certified.

Based on results and conclusions of this project and on discussions and experiences during the realization some recommendations can be derived for government, private sector and research to realize a successful introduction of Good Agricultural Practices in Indonesia.
Recommendations for the government are among others to speed up the process of implementation of the official 'Si Sakti'-certification where Hortin-GAP will be a part of. Special attention is needed for the organization of the audits. The lack of information/communication regarding pesticide admission and labeling, which came up during the test, requires immediate attention of the government. Without that information there is no way food safety can be guaranteed in line with international standards.
Recommendations for the private sector are to work on awareness of the problem. The supermarkets can stimulate increased food safety and product quality by incentives for certified growers and traders.
An important element is the improvement of the whole chain performance. If Indonesian growers want to have access to markets with a higher price level (export, supermarkets) than introduction of a GAP must go hand in hand with improvement of product quality, presentation and handling.
A recommendation for research is to work on risk assessment and prevention. A number of assumptions concerning food safety in Indonesia can not be determined or invalidated yet. From the experience of the Hortin-GAP test, refreshing of IPM knowledge is still needed. Farmer networks are an excellent way to improve the performance of farmers and increase knowledge transfer from researcher to farmers. A last recommendation for research is to develop integrated concepts in close relation with private sector. The private sector is not unwilling to improve food safety, but fears complicated systems with high costs. It is important to develop control measures for food safety in close relation with the private sector to secure practical applicability. The approach of this project with surveys, a field test and some workshops is a good example which caused enthusiasm in the private sector.

1. Introduction

1.1 Background

The production and marketing of vegetables under high quality standards has become an important issue in Indonesia. Quality perception has changed from product and production orientated to consumer orientated concepts. Through implementing quality management principles an entrepreneur tries to meet consumer demands. The market asks for tailor-made, traceable products and reliable suppliers. At the same time production of safe food is a major consumer concern. Product quality and food safety control have become basic trade conditions in, e.g., the European Union but also in the emerging economies of South East Asia. The WHO has classified Indonesia as one of several countries in South East Asia where food safety is inadequate. Most food-borne illnesses result from inappropriate food hygiene and food handling practices, which could be avoided. With a systematic approach vegetable growers and supply chains can meet the required product quality and food safety standards. Food safety (prevention of food-borne illnesses) and production quality (increased shelf-life and improved texture, flavour and colour) can be controlled in the vegetable supply chain by developing and implementing in-company or chain food safety and quality programmes. The most frequently used programmes to enhance food safety and quality fall into three categories: Good Agricultural Practices (GAPs), sanitation and Hazard Analysis Critical Control Points (HACCP) programmes. HACCP programmes specifically reduce food safety risks, while GAPs and sanitation are “prerequisite” programmes towards a HACCP approach.

1.2 Project Hortin-Quality

HORTIN is a collaborative programme of Indonesia and the Netherlands on strategic and applied research in horticulture for the years 2003-2006. The HORTIN programme is financed by the Ministries of Agriculture of Indonesia and the Netherlands. Executing agencies are the Indonesian Center for Horticultural Research and Development (ICHORD) in Indonesia, Plant Research International (PRI) and Applied Plant Research (PPO) in The Netherlands. HORTIN aims at stimulating development through research in public–private partnerships. It is a genuine partnership, which matches the research and agribusiness priorities of both countries. By doing so, it stimulates private-private partnerships, attracts donors, and so assures the transfer of knowledge to practice.
HORTIN-Quality is one of the projects of this programme. The HORTIN-Quality project was set up to initiate the development of food safety and quality management in vegetable production systems in Indonesia and to develop a protocol for vegetable growers to control food safety and quality risks. Important conditions for successful development and implementation were defined:

- with the protocol, the main food safety risks at production level must be controlled;
- there must be a close relationship of the protocol with international public and private standards, like HACCP and EUREP-GAP to add to the value of the protocol in the perspective of (international) trade;
- development must be organised in close relationship with ambitions and activities of the Indonesian government in relation to food safety;
- the protocol must be useful and applicable for Indonesian farmers with an average agricultural education and a representative (average) farm size, for which involvement of farmers and traders in the project was seen as necessary condition.

The initial effort focussed on the West Java vegetable production region and its supply chain, since this region is considered to be the largest supplier for the biggest domestic vegetable markets.

1.3 Methodology

The Hortin-Quality project was conducted over four years, from 2003-2006. The six main activities were:

- Training of Indonesian researchers: training and company visits were organised on chain developments, quality management systems like HACCP, ISO 9001 and Eurep-GAP as a starting point for a fruitful cooperation.
- Supply chain perception of food safety and quality management: It is a basic condition that all parties involved in the supply chain of vegetables recognise that the responsibility for food safety is primarily a task of those who produce. In this phase an analysis was made of the supply chain of vegetables (participants, processes, and process steps) and of the attitude, perception and ambitions of participants in the supply chain about food safety and quality. This activity took the form of literature research and surveys in West Java.
- Identification of hazards: To develop food safety and quality management systems for the vegetable production systems in Indonesia, it is necessary to identify the status of food safety and quality management in the Indonesian vegetable supply chain, for which HACCP principles were used. A brainstorming session with a HACCP team and results based on literature research provided insight into hazards in vegetable production.
- Development of a protocol: The results of the last-mentioned activities provided the basis of a protocol to control food safety bottlenecks and stimulate transparency in the vegetable system. A draft was improved further by participatory workshops involving all stakeholders or all participants in the vegetable supply chain.
- Test of the protocol in practice: To gain insight into practical bottlenecks and potentials for implementation a field test was organised with farmers during a cropping season. In general, Indonesian farmers have little or no experience with record keeping and most farmers still use the calendar system for spraying their crops. Besides application of the protocol, special attention was therefore paid to recording and pesticide residues.
- Monitoring and evaluation: Development of the protocol by two research institutes from different countries, in close cooperation with growers and stakeholders from government and the supply chain can be seen as a process. During this process new ideas come up as result of the participation of different stakeholders, all with their own motives and knowledge. To control this process and to make use of the inputs of these stakeholders special attention was paid to process monitoring and evaluation.

1.4 Structure of the report

This report describes the approach and main results of the project. It can be useful for those involved in strengthening food safety and product quality in the emerging economies of South East Asia. Chapter 2 describes the Indonesian vegetable supply chain and gives the results of a survey into the perception of food safety issues of several stakeholders in this chain.
Chapter 3 starts with general information about developments in food safety and control systems. Next, the results of a hazard analysis in accordance with a HACCP approach are given for a representative vegetable farm in West Java. Chapter 4 shows the development of the Hortin-GAP in relation to ambitions of the Indonesian Government. Chapter 5 deals in detail with the approach and results of the field test of Hortin-GAP with farmers, including the results of residue analyses. Chapter 6 describes the results of the monitoring and evaluation activities. Finally, conclusions and recommendations are derived in Chapter 7.

2. Supply chain analysis

Witono Adiyoga, 2003

2.1 Description of the supply chains of prioritised vegetables

Vegetable supply chains are complex entities that serve many functions. They are institutional arrangements that link vegetable producers, processors, marketers and distributors. Vegetable supply chains are forms of industrial organisation which allow vegetable buyers and sellers who are separated by time and space to progressively add and accumulate value as products pass from one member of the chain to the next.

Vegetable supply chains are the conduits through which:

- vegetables move from producers to consumers;
- payments, credit and working capital move from vegetable consumers to producers;
- technology and advanced techniques are disseminated among vegetable producers, packagers and processors;
- ownership rights pass from vegetable producers to processors and ultimately to marketers;
- information on current customer demand and on retail level vegetable preferences pass back from retailers to producers.

Conceptually, vegetable supply chains are also economic systems which distribute benefits and which apportion risks among participants. Thus, supply chains enforce internal mechanisms and develop chain wide incentives for assuring the timely performance of production and delivery commitments. Those chains are linked and interconnected by virtue of shared information and reciprocal scheduling, product quality assurances and transaction volume commitments. Process linkages add value to agricultural products and require individual participants to co-ordinate their activities as a continuous improvement process. Costs incurred in one link in the chain are determined in significant measure by actions taken or not taken at other links in the chain. Extensive pre-planning and co-ordination are required up and down the entire chain to affect key control processes such as forecasting, purchase scheduling, manufacturing programming, sales promotion, and new markets. Those are the ideal conditions of vegetable supply chains that have been carefully developed and are functioning very well. How is the actual status of vegetable supply chains in West Java, Indonesia?

Because of its geographical location, vegetables from West Java can easily be supplied not only to local, but also to regional markets. Basically, the vegetable supply chain in West Java is an institutionalised service to bridge the movement of vegetables from producers to consumers. Governmental intervention in vegetable supply chains is mainly limited to support the availability of physical infrastructures, such as roads and markets. Vegetable trades are mainly in the hands of private enterprises. This may imply that vegetable supply chains in West Java, like in other vegetable production centres, largely operate under the forces of supply and demand.

Improving supply chains is a very important but rather neglected aspect of vegetable development in Indonesia. So far, emphasis is usually placed on increasing vegetable production, with the goal of improving farm income, the nutritional status of consumers, and its basis for rural development. There are those who hold the view that supply chain management is an adaptive set of activities to be given secondary consideration in vegetable development planning strategies with primary consideration being directed toward the expansion of vegetable production. However, markets do not necessarily develop automatically and the lack of well-functioning supply chains can increase risks and costs for farmers and other market participants. An effective supply chain system needs to be developed hand-in-hand with the development of vegetable production in order to reap the full benefits for all participants in the chain. It will contribute toward achieving some of the basic goals of agricultural development, including raising agricultural income, optimal allocation of agricultural resources, increased self-sufficiency in food and attainment of price stability.

Some typical vegetable supply chains in West Java, Indonesia that have been identified are:

1. Primary producers – transporters - rural assembly traders - inter-regional traders – transporters - wholesalers - retailers – consumers.
2. Primary producers – transporters - rural assembly traders – transporters - wholesalers - retailers - consumers.
3. Primary producers - field petty assembly traders or commission agents – transporters - rural assembly traders – transporters - wholesalers - retailers - consumers.
4. Primary producers – transporters - contract traders - rural assembly traders - retailers - consumers.
5. Primary producers - packers – transporters - retailers – consumers.

It is estimated that the first and second supply chain cover approximately 70% of the total West Javan vegetable supply. The remaining 30% is supplied through the third, fourth and fifth supply chain. A closer look at the various vegetable supply chains in West Java suggests a dominant role of rural assembly traders as bridge between producers and consumers. The vegetable volume assembled and shipped by this type of traders is ranging between 5 - 25 tons per day. In total, approximately 15 - 50 tons (minimum) and 75 - 150 tons (maximum) of vegetables are delivered from Lembang and Pangalengan to urban markets daily. Vegetables from those production centres are mostly marketed to Jakarta (the main consumption centre), and local and Bandung markets.

The supermarket sector in Indonesia has seen a rapid growth and there were over 800 supermarkets in Indonesia in 2004. Wet markets and small shops in Indonesia have seen a decline of 8% per year, while supermarkets have seen increases of 15 and 26%. It is expected that supermarket sales will account for 30% of all retail sales in Indonesia in 2006 (Vander Stichele, 2006).

The following diagram shows the elements of the regional vegetable supply chain in West Java. All arrows represent the physical flow of vegetable produce.

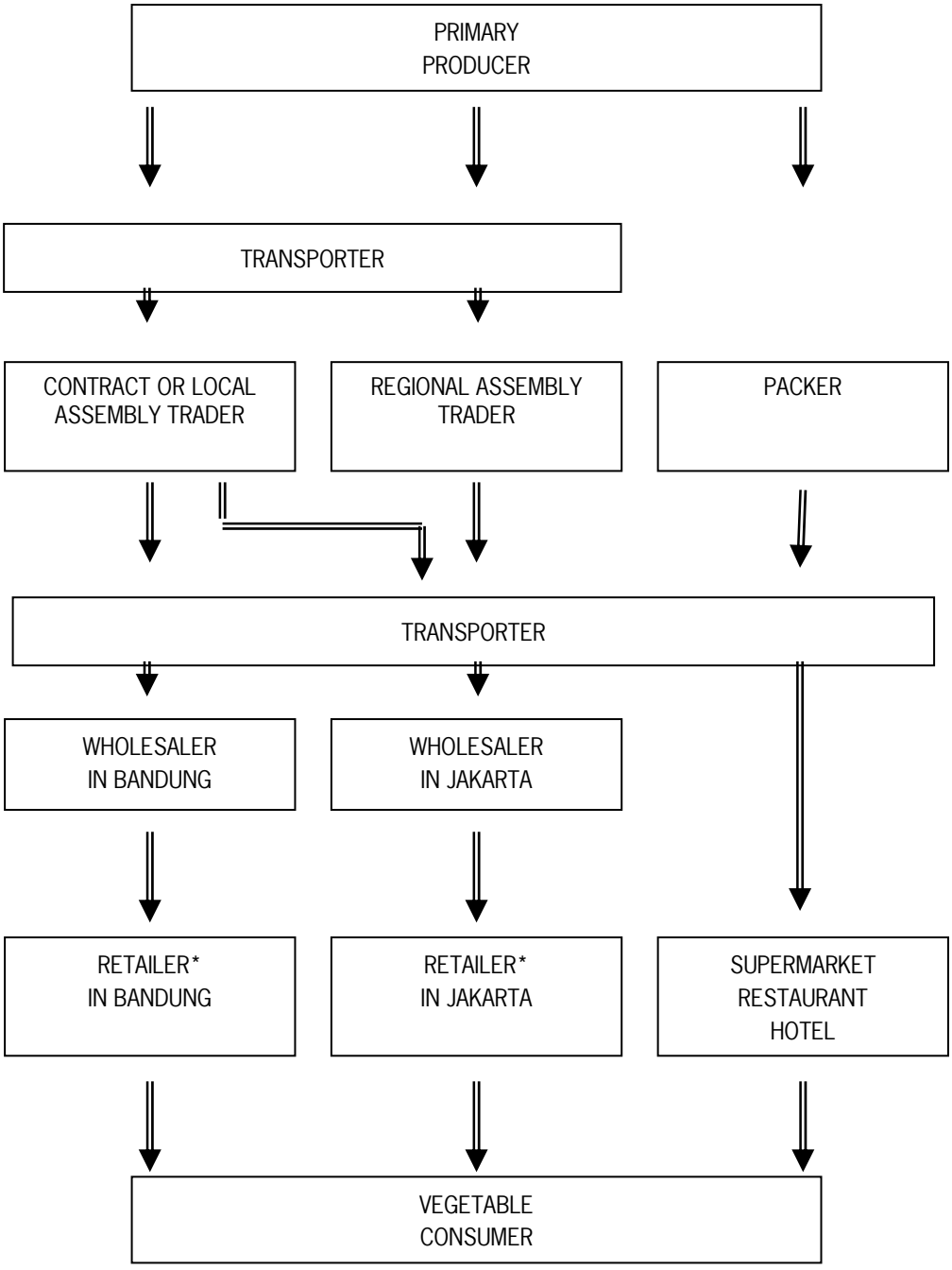

Figure 1. Elements of the vegetable supply chain in West Java, Indonesia.

* *Includes wet markets.*

Table 1 describes the major elements in the supply chain and the value they add.

Table 1. Elements of the vegetable supply chain, description and value added.

Element	Description	Value Added
Primary producer	The farmer who grows and harvests the vegetables and for some distribution channels also grades produce.	Production Harvesting Grading
Contract traders	These traders buy vegetables from farmers on a contract basis which involves negotiations for sale even before vegetables (e.g. cabbage, Chinese cabbage and cauliflower) in the field reach their optimum age for harvesting.	Harvesting Grading
Rural assembly traders	The major marketing functions of this type of trader are to assemble a relatively large volume of vegetables and ship these to distant consumption centres. They may either reside at or travel to farms to purchase, transfer, and later sell vegetables to another local. Their activities may involve the purchase of truckloads of vegetables from one or more growers and/or encompass the purchase of small lots of vegetables from several growers at the same time.	Assembling Sorting Grading Shipping
Regional/inter-regional traders	This type of trader resides outside the production centre and visits rural areas to buy vegetables, and ship them to the wholesale or retail markets. They bring their own or rented truck and go to the field for directly buying vegetables from rural assembly traders or farmers. They usually establish a prior contact with farmers or commission agents before the transaction is conducted.	Assembling Sorting Grading Shipping
Packer	The organisation that receives, sorts, grades, packs and provides short-term storage for the packed vegetables. This element also coordinates transport and in some instances holds supply contracts with the major large retailers.	QA (Quality Assurance) Grading Packaging Coordinating transport and negotiation Controlled environment short-term storage Contract supply of vegetables
Transport	The provider of transport to move produce from farm-gate to retailer. This involves moving the produce to a specified location and making delivery within a target time frame.	Shipping
Restaurant/Hotel	The organisation that converts vegetables into foods	Processing fresh vegetables into foods Marketing and distribution
Wholesaler/Market Agent	The organisation that sells produce on behalf of the grower or pack house. This usually involves short-term handling and storage of the produce. These organisations are typically servicing a wide range of clients.	Marketing & selling and distribution to retailers and the food service sector. QA Controlled environment holding storage
Retailer/Supermarket	The organisations that operate vegetable selling retail stores.	QA Consumer distribution Promotion

The general analysis of the supply chain learned that customers had specific requirements for perishables that sometimes could not be met by the existing supply structure. These requirements include high quality (freshness), food safety, a broad assortment and good in-store logistics, high availability, and last but not least, an acceptable

price. The analysis also revealed that the main problems of the existing fresh goods supply chains were the following:

- High price variability
- High losses and shrinkage
- Long order response time
- Insufficient quality control throughout the chain including shortage of refrigerated transport and storage
- A general lack of production planning and rigid or outdated production methods
- Insufficient ability to meet product specifications
- Lack of information flow throughout the whole chain
- No value added from specific trade mark strategies
- Lack of trust between stakeholders in the supply chain
- Coordination difficulties between many small suppliers
- The perception of actors in the vegetable supply chain concerning food safety

2.2.1 Survey respondents

This survey counts five major elements, with two participants from each element, in the interviewed supply chain. The distribution of respondents is summarised Table 2.

Table 2. Number of respondents of every element of the vegetable supply chain.

Element	Σ
Primary vegetable producer (the farmer who grows and harvests vegetables and who will also grade vegetables for some distribution channels)	2
Packer (the organisation that receives, sorts, grades, packs and provides short-term storage, sometimes also coordinating transport and holding supply contracts with major retailers)	2
Transporter (the provider of transport to move vegetables chain to chain, from farm-gate to retailers)	-
Assembler (the organisation that assembles vegetables from the farm-gate and sells them to the inter-regional traders or wholesalers)	1
Wholesaler (the organisation that sells vegetables in bulk to sub-wholesalers or retailers)	1
Retailer (the organisation that operates retail stores and sells vegetables to consumers)	2

2.2.2 Produce and produce/product differentiation in the supply chain

There are certain inherent characteristics of vegetable crops that make special demands on supply chains. They tend to be bulky; their weight and volume are closely related to their monetary value (especially when compared to many manufactured goods). Some crops, such as potato and shallot, retain their quality for quite some time, but leafy vegetables, such as Chinese cabbage, lettuce, cabbage and bunching onion are very perishable and will rapidly begin to decay if they are not consumed or kept in special storage. The following table shows the variation in vegetable flows along the supply chain from producer to consumer. In general, each element handles more than one vegetable crop. There is no product differentiation among chains, except from packers and retailers (supermarkets) that provide cleaner and better-packed vegetables.

Table 3. Produce differentiation in the vegetable supply chain.

Element (cases)	Produce
Primary producer 1	Tomato, cabbage, cauliflower, hot pepper and lettuce
Primary producer 2	Cabbage, red cabbage, cauliflower, lettuce, hot pepper, shallot and kale
Packer 1	Potato, cabbage, tomato, celery, cauliflower, broccoli, lettuce, Chinese cabbage, sweet pepper and kale
Packer 2	Kidney bean, tomato, Chinese cabbage, cauliflower, lettuce, potato, cabbage, pakcoy, sweet corn, cherry tomato, asparagus and broccoli
Assembler	Lettuce, cauliflower, tomato, kidney bean, zucchini, cabbage, hot pepper and parsley
Wholesaler	Potato, hot pepper and leafy vegetables
Retailer 1	Potato, kidney bean, cabbage, tomato, celery, cauliflower, broccoli, lettuce, Chinese cabbage, pakcoy, sweet corn, sweet pepper, cherry tomato, asparagus and kale
Retailer 2	Potato, kidney bean, cabbage, tomato, celery, cauliflower, broccoli, lettuce, Chinese cabbage, pakcoy, sweet corn, sweet pepper, cherry tomato, asparagus and kale

Table 4. Elements of the vegetable supply chain and their distinctive power.

Element (cases)	How do your products and/or services differ from your competitors' products and/or services?
Primary producer 1	There is no significant difference
Primary producer 2	There is no significant difference
Packer 1	Produces are carefully sorted, graded and packed based on customer demand
Packer 2	Produces are carefully sorted, graded and packed based on customer demand
Assembler	There is no significant difference
Wholesaler	There is no significant difference
Retailer 1	Produce is carefully sorted, graded and packed based on consumer demand
Retailer 2	Produce is carefully sorted, graded and packed based on consumer demand

2.2.3 Price setting in the supply chain

One of the more difficult marketing decisions is, knowing when to accept a price and when to wait for something better. In vegetable supply chains, most crops are traded and prices agreed through individual negotiation; this is a simple bargaining process between individual buyers and sellers for each transaction. In its pure form, with equal market power and equal information for the participants, it is the implicit procedure of the competitive market model. Formal rules are usually not in place. Sellers would like to sell their produce at the highest possible price, but no one knows when this price will be offered (since the buyers try to obtain the lowest possible price). No marketing strategy can ensure the highest possible price. A market strategy that attempts to achieve an acceptable price has a better chance of success than one that aims for the highest price. Therefore, sellers must know what price level is consistent with an acceptable profit for the total operation. Careful attention to market trends will help each element to decide whether to accept a price or to wait for something better. The following table shows how each element in the supply chain sets the price of its produce.

Table 5. Price setting in the vegetable supply chain.

Element (cases)	In general, how do you set the price of your produce?
Primary producer 1	The price is set after considering (a) unit cost of production or break-even point (b) profit margin, and (c) market price information
Primary producer 2	The price is set after considering (a) unit cost of production or break-even point (b) profit margin, and (c) market price information
Packer 1	The price is set mostly through prior agreement or contract
Packer 2	The price is set mostly through prior agreement or contract
Assembler	The price is set after considering (a) buying price per unit of produce (b) profit margin, and (c) market price information.
Wholesaler	The price is set after considering (a) buying price per unit of produce (b) profit margin, and (c) market price information
Retailer 1	The price is set based on market survey among other supermarkets and wet markets, which is then followed by a short-term contract
Retailer 2	The price is set based on market survey among other supermarkets and wet markets, which is then followed by short-term contract

2.2.4 Outlets, share and promotion for each element in the supply chain

Tables 6-8 show the list of outlets, share of vegetables for each outlet, and the way each element promotes its produce, respectively. Except for wholesalers and retailers, each element has at least two market outlets. Especially for packers, the number of outlets is relatively high, but the transaction volume with each outlet is relatively small. Produce promotion is mainly carried out by bringing samples to buyers or by publishing flyers, leaflets and brochures.

Table 6. Elements of the vegetable supply chain and number of outlets and orientation.

Element (cases)	Number of outlets	Local and/or export	List of outlets
Primary producer 1	2	Local	Assembler Packer
Primary producer 2	2	Local	Assembler Packer
Packer 1	4	Local	Alpha Group Makro Matahari Group Kemchicks
Packer 2	5	Local	Supermarkets Airline caterer (Garuda) Hotel Restaurants Mini-markets
Assembler	3	Local	Kramat Jati Wholesale Market Mayestik Market, Jakarta Packers
Wholesaler	1	Local	Retailers
Retailer 1 Meruya, Ciputat, Alam Sutra, Cibitung, Kelapa Gading, Pasar Rebo, Bandung	1	Local	Consumers
Retailer 2 Jakarta, Bogor, Tanggerang, Bekasi, Bandung	1	Local	Consumers

Table 7. Elements of the vegetable supply chain, products and sales.

Element (cases)	Product	Shares (%)
Primary producer 1	Cabbage	100% to assembler
	Hot pepper	100% to assembler
	Lettuce	60% to assembler and 40% to packer
	Tomato	70% to assembler and 30% to packer
	Cauliflower	70% to assembler and 30% to packer
Primary producer 2	Red cabbage	100% to packer
	Lettuce	100% to packer
	Cauliflower	100% to packer
	Kale	100% to packer
	Hot pepper	100% to assembler
	Cabbage	100% to assembler
	Shallot	100% to assembler
Packer 1	Potato	25% of all types of vegetables are distributed to:
	Cabbage	Alpha Group
	Tomato	Makro
	Celery	Matahari Group
	Cauliflower	Kemchicks
	Broccoli	
	Lettuce	
	Chin. cabbage	
	Sweet pepper	
	Kale	
Packer 2	Kidney bean	25% to hotel, 75% to supermarket
	Tomato	25% to hotel, 75% to supermarket
	Chin. cabbage	25% to hotel, 75% to supermarket
	Cauliflower	50% to hotel, 50% to supermarket
	Lettuce	40% to caterer, 60% to supermarket
	Potato	100% to supermarket
	Cabbage	25% to hotel, 75% to supermarket
	Pakcoy	100% to supermarket
	Sweet corn	100% to supermarket
	Cherry tomato	100% to supermarket
	Asparagus	100% to supermarket
	Broccoli	100% to supermarket
Assembler	Lettuce	All types of vegetables are distributed as follow:
	Cauliflower	75% to Kramat Jati
	Tomato	10% to packers
	Kidney bean	15% to Mayestik
	Zucchini	
	Cabbage	
	Hot pepper	
	Parsley	
Wholesaler	Potato	100% to retailers
	Hot pepper	
	Leafy vegetables	
Retailer 1	All vegetables	100% to consumers
Retailer 2	All vegetables	100% to consumers

Table 8. Elements of the vegetable supply chain and promotional activities.

Element (cases)	In general, how do you promote your products and/or services?
Primary producer 1	Bring sample to packers
Primary producer 2	Bring sample to packers
Packer 1	Bring sample to supermarket, hotel, caterer and restaurant
Packer 2	Bring sample to supermarket, hotel, caterer and restaurant
Assembler	Bring sample to packers
Wholesaler	–
Retailer 1	Publish leaflets, brochures and advertisement
Retailer 2	Publish leaflets, brochures and advertisement

2.2.5 Perceived concerns of buyers (applicable for all elements) and suppliers (not applicable for grower/producers) with regard to some aspects of food safety

For product related aspects, producers perceive that most of the listed aspects are important from the buyers' perspective. One producer perceives that shelf life or storage life is unimportant since most vegetable produce is immediately consumed (fresh or processed). Outer product quality sometimes becomes a problem and producers suggest agronomic improvements, such as balanced fertilisation and use of plastic mulch as possible solutions. Meanwhile, adjustments in planting time and planting location are proposed to anticipate the problem of price fluctuation.

For company related aspects, producers perceive that except quality of machinery/modernity and the availability of registration/documentation about the production process (traceability), all other aspects are important from the buyers' perspective. Some aspects that will become more important in the next 5 years as considered by producers are price, attention to food safety and attention to environment (pollution).

Table 9. Aspects of product quality and food safety of Producer 1.

Element (cases)	Category	Aspect	Important (yes/no)	Problem (yes/no)	Possible solution
Producer 1	Product	Internal product quality (taste, ingredients)	Yes	No	
		Outer product quality (spots, colour, shape, etc.)	Yes	Yes	Agronomic improvements
		Hygiene (no pieces of plastic, glass, splinters, etc. mixed in the product)	Yes	No	
		Shelf life or storage life	No	No	
		Price	Yes	Yes	Planting time adjustment
	Your company	Quality of machinery/modernity	No	No	
		Attention to environment (pollution)	Yes	No	
		Attention to food safety	Yes	No	
		Availability of registration/ documentation about the production process, traceability	No	No	
		Flexibility (specific demands, availability of product, on-time delivery)	Yes	No	
		Communication	Yes	No	
		Reputation/name	Yes	No	
	Which of the above mentioned demands or expectations will become more important and significant for your company in the next 5 years?		Attention to food safety Attention to environment (pollution)		

Table 10. Aspects of product quality and food safety of Producer 2.

Element (cases)	Category	Aspect	Important (yes/no)	Problem (yes/no)	Possible solution
Producer 2	Product	Internal product quality (taste, ingredients)	Yes	No	
		Outer product quality (spots, colour, shape, etc.)	Yes	Yes	Agronomic improvements (balanced fertilisation, use of plastic mulch)
		Hygiene (no pieces of plastic, glass, splinters, etc. mixed in the product)	Yes	No	
		Shelf life or storage life	Yes	No	
		Price	Yes	Yes	Planting time and planting location adjustment
	Your company	Quality of machinery/modernity	Don't know	Don't know	
		Attention to environment (pollution)	Don't know	Don't know	
		Attention to food safety	Don't know	Don't know	
		Availability of registration/ documentation about the production process, traceability	Don't know	Don't know	
		Flexibility (specific demands, availability of product, on-time delivery)	Yes	No	
		Communication	Yes	No	
		Reputation/name	Yes	No	
	Which of the above mentioned demands or expectations will become more important and significant for your company in the next 5 years?		Prices are getting more unstable Attention to environment (pollution)		

For product category, packers perceive that all of the listed aspects are important from the buyers' and suppliers' perspective. The problem of outer product quality may be solved by tighter selection on produce received. Improvements of storage facilities could prolong the shelf life of vegetable produce. Meanwhile, contract pricing is suggested as a method for anticipating price fluctuations.
For company category, all listed aspects, except traceability, are considered important. Better sanitation, better agronomic treatments, better scheduling and delivery system, and better promotion are suggested as solutions if there are problems as regards attention to environment (pollution), attention to food safety, flexibility (specific demands, availability of product, on-time delivery), and reputation/name, respectively. In the next five years, packers predict that there will be an increasing demand for improved product quality, attention to food safety and flexibility.

Table 11. Aspects of product quality and food safety of Packer 1.

Element (cases)	Category	Aspect	Important (yes/no)	Problem (yes/no)	Possible solution
Packer 1	Product	Internal product quality (taste, ingredients)	Yes	No	
		Outer product quality (spots, colour, shape, etc.)	Yes	Yes	Tighter selection on produce received
		Hygiene (no pieces of plastic, glass, splinters, etc. mixed in the product)	Yes	No	
		Shelf life or storage life	Yes	No	
		Price	Yes	No	
	Your company	Quality of machinery/modernity	Yes	No	
		Attention to environment (pollution)	Yes	No	
		Attention to food safety	Yes	No	
		Availability of registration/ documentation about the production process, traceability	No	No	
		Flexibility (specific demands, availability of product, on-time delivery)	Yes	No	
		Communication	Yes	No	
		Reputation/name	Yes	No	
	Which of the above mentioned demands or expectations will become more important and significant for your company in the next 5 years?		Attention to food safety Flexibility (specific demands, availability of product, on-time delivery)		

Table 12. Aspects of product quality and food safety of Packer 2.

Element (cases)	**Category**	**Aspect**	**Important (yes/no)**	**Problem (yes/no)**	**Possible solution**
Packer 2	Product	Internal product quality (taste, ingredients)	Yes	No	
		Outer product quality (spots, colour, shape, etc.)	Yes	Yes	Tighter selection on produce received
		Hygiene (no pieces of plastic, glass, splinters, etc. mixed in the product)	Yes	No	
		Shelf life or storage life	Yes	Yes	Facility improvement
		Price	Yes	Yes	Contract pricing
	Your company	Quality of machinery/modernity	Yes	No	
		Attention to environment (pollution)	Yes	Yes	Better sanitation in the packing area
		Attention to food safety	Yes	Yes	Better treatments from the start (production)
		Availability of registration/ documentation about the production process, traceability	No	No	
		Flexibility (specific demands, availability of product, on-time delivery)	Yes	Yes	Better scheduling and improvement of delivery system
		Communication	Yes	No	
		Reputation/name	Yes	No	Better promotion
	Which of the above mentioned demands or expectations will become more important and significant for your company in the next 5 years?		Increasing demand on improved produce quality		

For product category, assemblers and wholesalers perceive that all listed aspects are important from buyers' and suppliers' perspectives. Better sorting of produce received, faster delivery and improved market information are suggested as solutions if there are problems as regards outer product quality, shelf life and price, respectively. For company category, all listed aspects are considered important. Improved cultivation practices, better sanitation and maintaining supply continuity and improving delivery system are suggested as solutions if there are problems as regards attention to environment (pollution), attention to food safety and flexibility, respectively. In the next five years, assemblers and wholesalers predict that the demand for attention to food safety and flexibility (specific demands, availability of product, on-time delivery) will become more significant.

Table 13. Aspects of product quality and food safety of Assembler.

Element (cases)	Category	Aspect	Important (yes/no)	Problem (yes/no)	Possible solution
Assembler	Product	Internal product quality (taste, ingredients)	Yes	No	
		Outer product quality (spots, colour, shape, etc.)	Yes	Yes	Better sorting of produce received
		Hygiene (no pieces of plastic, glass, splinters, etc. mixed in the product)	Yes	No	
		Shelf life or storage life	Yes	Yes	Faster delivery
		Price	Yes	Yes	Improved market information
	Your company	Quality of machinery/modernity	Yes	No	
		Attention to environment (pollution)	Yes	Yes	Improved cultural practices
		Attention to food safety	Yes	Yes	Better sanitation
		Availability of registration/ documentation about the production process, traceability	Yes	No	
		Flexibility (specific demands, availability of product, on-time delivery)	Yes	Yes	Maintaining supply continuity and improving delivery system
		Communication	Yes	No	
		Reputation/name	Yes	No	
	Which of the above mentioned demands or expectations will become more important and significant for your company in the next 5 years?		Attention to food safety Flexibility (specific demands, availability of product, on-time delivery)		

Table 14. Aspects of product quality and food safety of Wholesaler.

Element (cases)	Category	Aspect	Important (yes/no)	Problem (yes/no)	Possible solution
Wholesaler	Product	Internal product quality (taste, ingredients)	Yes	No	
		Outer product quality (spots, colour, shape, etc.)	Yes	No	
		Hygiene (no pieces of plastic, glass, splinters, etc. mixed in the product)	Yes	Yes	Better sorting and cleaning of produce received
		Shelf life or storage life	Yes	Yes	Guarantee the dryness of produce and improve storage facilities
		Price	Yes	Yes	Improve market information
	Your company	Quality of machinery/modernity	Yes	No	
		Attention to environment (pollution)	Yes	Yes	Improved cultural practices
		Attention to food safety	Yes	Yes	Better sanitation
		Availability of registration/ documentation about the production process, traceability	Yes	No	
		Flexibility (specific demands, availability of product, on-time delivery)	Yes	Yes	Maintaining supply continuity
		Communication	Yes	No	
		Reputation/name	Yes	No	
	Which of the above mentioned demands or expectations will become more important and significant for your company in the next 5 years?		Attention to food safety Flexibility (specific demands, availability of product, on-time delivery)		

For product category, retailers (supermarkets) perceive that all listed aspects are important from buyers' and suppliers' perspectives. Better sorting and cleaning of produce received, improving storage facilities and improving market information are suggested as solutions as regards the aspects hygiene, shelf life and price, respectively. For company category, retailers consider all listed aspects as important from the perspective of buyers and suppliers. Maintaining supply continuity and improving delivery systems are suggested as solutions if flexibility becomes a problem. In the next five years, retailers predict that the demand for attention to environment, attention to food safety, and flexibility (specific demands, availability of product, on-time delivery) will become more significant.

Table 15. Aspects of product quality and food safety of Retailer.

Element (cases)	Category	Aspect	Important (yes/no)	Problem (yes/no)	Possible solution
Retailer	Product	Internal product quality (taste, ingredients)	Yes	No	
		Outer product quality (spots, colour, shape, etc.)	Yes	No	
		Hygiene (no pieces of plastic, glass, splinters, etc. mixed in the product)	Yes	Yes	Better sorting and cleaning of produce received
		Shelf life or storage life	Yes	Yes	Improve storage facilities
		Price	Yes	Yes	Improve market information
	Your company	Quality of machinery/modernity	Yes	No	
		Attention to environment (pollution)	Yes	No	
		Attention to food safety	Yes	No	
		Availability of registration/ documentation about the production process, traceability	Yes	No	
		Flexibility (specific demands, availability of product, on-time delivery)	Yes	Yes	Maintain supply continuity and improve delivery system
		Communication	Yes	No	
		Reputation/name	Yes	No	
	Which of the above mentioned demands or expectations will become more important and significant for your company in the next 5 years?		Attention to food safety Attention to environment Flexibility (specific demands, availability of product, on-time delivery)		

2.2.6 Awareness of the importance of food safety

2.2.6.1 Awareness and responsibility

Even though they do not comprehend the meaning yet, most respondents state that they have heard the term food safety. Furthermore, all elements, except assembler and wholesaler, even think that food safety is becoming one of their responsibilities.

Table 16. Awareness and responsibility as regards food safety of the different elements of the vegetable supply chain.

Element	Have you ever heard the term food safety?	Do you think quality assurance, in terms of food safety, is becoming one of your responsibilities?
Primary producer 1	No	Yes, but it is going to be very difficult since the main concern at present is still to increase production
Primary producer 2	Yes	Yes, since producer is also aware that pesticide is basically a poison
Packer 1	Yes	Yes, but it is mostly the responsibility of the producer
Packer 2	Yes	Yes, it is one of our responsibilities
Assembler	No	No response
Wholesaler	Yes	No, it is basically the responsibility of producer and assembler
Retailer 1	Yes	Yes
Retailer 2	Yes	Yes

2.2.6.2 Complaints on food safety risks and actions to prevent them

None of the elements in the supply chain have ever had complaints on chemical residues and foreign material (physical risk) problems. There are few complaints about (micro) biological problems (worms in produce delivered yesterday or some produce rotten or damaged) that have been experienced by most elements in the vegetable supply chain, but these are considered insignificant. Some actions taken to avoid food safety problems are to stop spraying crops with pesticides at least 3-7 days before harvest, use of pesticides only if necessary, picking selective pesticides, and thoroughly clean, wash, sort the produce.

Table 17. Complaints of food safety per element of the vegetable supply chain.

Element	Complaints on			If few or always, what kind?
	Chemical residues (maximum residue levels)	Microbiological problems (bacteria, salmonella, etc.)	Material problems (pieces of plastic, glass, etc.)	
Producer 1	Never	Few	Never	Worms in produce delivered yesterday
Producer 2	Never	Never	Never	
Packer 1	Never	Never	Never	
Packer 2	Never	Few	Never	Some produce is rotten
Assembler	Never	Few	Never	Some produce is rotten
Wholesaler	Never	Few	Never	Some produce is rotten or damaged
Retailer 1	Never	Few	Never	Some produce is rotten or damaged
Retailer 2	Never	Few	Never	Some produce is rotten or damaged

Table 18. Preventive actions related to food safety per element of the vegetable supply chain.

Element	Could you tell me what procedures, if any, you carry out to avoid food safety problems?
Producer 1	Stop spraying the plants with pesticides at least one week before harvest
Producer 2	Use pesticides if necessary and pick selective pesticides
Packer 1	Some selected vegetables, such as tomato, potato, sweet pepper and celery, are carefully washed and wiped by dry cloth
Packer 2	Produce should be completely dry before delivery Asking suppliers to stop spraying the plants with pesticides at least three days before harvest Thoroughly cleaning, washing, sorting the produce
Assembler	Re-sorting the produce received from producers
Wholesaler	Received produce should be clean and dry Thoroughly re-sorting the produce received Clean the kiosk
Retailer 1	Thoroughly cleaning, sorting and selecting the produce
Retailer 2	Thoroughly cleaning, sorting and selecting the produce

2.2.6.3 Main benefits and prioritisation in implementing a food safety system

Improving customer confidence in product safety and quality, and preventing food poisoning are perceived as the two most important benefits in implementing a food safety programme. They are then followed by its benefit in reducing the number of complaints, its use as a legal defence against complaints, and its use as a useful business management discipline. Since specific regulations/legislation on vegetable/food safety is not available yet, compliance with regulations/legislation is perceived as the least important benefit.

The perception regarding the prioritisation of food safety implementation among the chain is still mixed. The answer from about half of the interviewees that food safety is a major priority in their business/organisation should be carefully interpreted. They may provide such response because they just heard from the interviewer about the benefits of implementing food safety procedures and the danger or harm of not implementing such procedures. Based on field observation, it may be wiser to conclude that food safety is basically still a minor priority for most businesses in the supply chain.

Table 19. Perceived benefits of a food safety system per element of the vegetable supply chain.

Element	Main benefits to your business/organisation of implementing a food safety system					
	Improves customer confidence in product safety and quality	Prevents food poisoning	Is a legal defence against complaints	Reduces the number of complaints	Complies with regulations/ legislation	Useful business management discipline
Producer 1	√	√	√	√		
Producer 2	√	√		√	√	
Packer 1	√	√	√			√
Packer 2	√	√	√	√		√
Assembler	√	√	√	√		√
Wholesaler	√	√		√		√
Retailer 1	√	√	√	√		√
Retailer 2	√	√	√	√		√

Table 20: Perceived priority of a food safety system per element of the vegetable supply chain

Element	Would you say that food safety is a major priority, a minor priority or not a priority for your business/organisation?		
	Major priority	Minor priority	Not a priority
Producer 1		√	
Producer 2			√
Packer 1		√	
Packer 2	√		
Assembler		√	
Wholesaler	√		
Retailer 1	√		
Retailer 2	√		

2.2.6.4 Support, standardisation and legislation of food safety procedures/systems

All elements in the supply chain perceive that their business/organisation is supportive with regard to the implementation of food safety procedures. They even perceive that the procedures should be standardised. Nonetheless, not all elements agree that the procedures should be legislated.

Table 21. Attitude towards implementation and legislation regarding food safety per element of the vegetable supply chain.

Element	How supportive or unsupportive is your business/organisation regarding the implementation of food safety procedures/system?				Do you think food safety procedures should be standardised?	Do you think food safety procedures should be legislated?
	Very supportive	Supportive	Not very supportive	Not at all supportive		
Producer 1		√			Yes	Yes
Producer 2		√			Yes	Yes
Packer 1		√			Yes	Yes
Packer 2		√			Yes	Yes
Assembler		√			Yes	Not sure
Wholesaler		√			Yes	Not sure
Retailer 1		√			Yes	Yes
Retailer 2		√			Yes	Yes

2.2.6.5 General perception of some aspects/statements regarding food safety

Table 22 is basically self-explanatory. The table indicates that most elements in the supply chain agree with the following statements:

- Food safety is too complicated
- They can see the benefits of a food safety system
- There is real incentive for having a food safety system
- There are no technical/non-technical problems in communicating food safety issues to staff
- It costs too much to have a proper food safety system in place
- Food safety is not really a major priority
- There should be more food safety checks by the authorities

Table 22. General perception of food safety per element of the vegetable supply chain.

	Producer 1	Producer 2	Packer 1	Packer 2	Assembler	Wholesaler	Retailer 1	Retailer 2	Σ		
									Agree	Dis-agree	Don't know
I do not really know what food safety is	Agree	Dis-agree	Dis-agree	Agree	Agree	Agree	Dis-agree	Dis-agree	4	4	-
Food safety is too complicated	Agree	Agree	Agree	Agree	Agree	Agree	Dis-agree	Dis-agree	6	2	-
I do not have the time for food safety issues	Dis-agree	Dis-agree	Agree	Agree	Agree	Agree	Dis-agree	Dis-agree	4	4	-
Food safety is not really a business priority	Agree	Agree	Agree	Dis-agree	Dis-agree	Dis-agree	Agree	Dis-agree	4	4	-
I can't see the benefits of a food safety system	Dis-agree	Dis-agree	Dis-agree	Dis-agree	Dis-agree	Dis-agree	Dis-agree	Dis-agree	-	8	-
There is no real incentive for having a food safety system	Don't know	Agree	Agree	Dis-agree	Dis-agree	Dis-agree	Dis-agree	Dis-agree	2	5	1
There are technical/ non-technical problems in communicating food safety issues to staff	Agree	Agree	Dis-agree	Dis-agree	Dis-agree	Dis-agree	Agree	Dis-agree	3	5	-
It costs too much to have a proper food safety system in place	Agree	Agree	Agree	Agree	Agree	Agree	Dis-agree	Dis-agree	6	2	-
Food safety is not really a major priority	Agree	Agree	Agree	Dis-agree	Agree	Dis-agree	Agree	Dis-agree	5	3	-
There should be more food safety checks by the authorities	Agree	Agree	Agree	Dis-agree	Don't know	Agree	Agree	Agree	6	1	1

2.2.6.6 Willingness to participate in a project for developing a protocol for supervising product quality and food safety

All elements are basically interested to participate in a project for developing a protocol for supervising product quality and food safety. However, most of them still need more information and learning about food safety before they make a decision to participate.

Table 23. Willingness to participate in a project regarding product quality and food safety per element of the vegetable supply chain.

Element (cases)	Are you interested to be involved in a project for developing a protocol for supervising product quality and food safety?
Primary producer 1	Interested, but they could not decide yet whether they could participate in a panel testing group since they have a very tight schedule
Primary producer 2	Interested, but they need more information and learning about food safety before they decide to participate
Packer 1	Interested, but the decision to participate should be made by the head-office
Packer 2	Interested, since it could provide additional knowledge and eventually it may benefit the business
Assembler	Interested, but they need more information and learning about food safety before they decide to participate
Wholesaler	Depends on the response of other wholesalers
Retailer 1	Interested, since it could provide additional knowledge and eventually it may benefit the business
Retailer 2	Interested, but they need more information and learning about food safety before they decide to participate

2.3 Conclusions

Based on this small survey among 2 growers, 2 packers, 1 assembler, 1 wholesaler and 2 retailers an indication can be given of the perception of stakeholders in the vegetable supply chain in West Java about the importance of food safety.
A number of aspects concerning food safety and product quality are important in the perception of the respondents. Most respondents indicate that they have little or no problems with the aspects mentioned on food safety or product quality.
In fact they receive no complaints from their clients about chemical residues of physical risks. The only complaints made are microbiological problems, with rotten or damaged crops. Based on this information it could be assumed that complaints are only made when after visual inspection, rotten or damaged crops are found. Chemical residues on crops are not detectable by visual inspection, which could explain the lack of complaints made.
Preventive actions are carried out to prevent food safety risks. The preventive actions mentioned strengthen the assumption that a lack of knowledge on food safety risks exists in the Indonesian vegetable supply chain. The basic knowledge and awareness regarding the importance of food safety may already be present (especially for supermarkets). This awareness has not been translated into improvements within the supply chain. There are no incentives (e.g. price premium) and pressures (consumer demands/complaints) to do so. The majority of the respondents expect food safety to become more important over the next 5 years.
The following conclusions can be derived from the answers of the majority of the respondents:

- Food safety is too complicated
- They can see the benefits of a food safety system
- It costs too much to have a proper food safety system in place
- Food safety is not really a major priority
- There should be more food safety checks by the authorities

3. Hazard analysis

Marcel van der Voort & Herman Schoorlemmer

Food safety is of growing concern to parties all over the world. Incidents with contaminated food increase the awareness of consumers, governments and supply chain organisations. Therefore, different parties are working on standards and guidelines to increase food safety, on an international as well as a local scale (Paragraph 3.1). Paragraph 3.2 gives a brief description of the international developments and organisations involved in food safety issues, regulations and directives of the European Union. Paragraph 3.3 gives a brief introduction on food safety assurance systems and enumerates private standards for food safety in the food supply chain. Paragraph 3.4 presents the approach and results of a Hazard Analysis for the production of tomatoes and cabbage in West Java based on the HACCP method.

3.1 Food safety regulations

3.1.1 General food safety aspects

Food safety can be described as the guarantee that food has no negative effects on the health of the consumer, when the product is processed, cooked and eaten. The purpose and way of consumption of the product should be taken into account.
Food safety is part of the quality of food. Quality means that the product meets consumer expectations. Food safety is considered a minimum standard, which is not negotiable. Other quality features are, for example, flavour, smell, colour and taste.

Food safety risks can be divided into:
- (micro)biological risks,
- chemical risks,
- physical risks.

Biological contaminants are, e.g., fungi, yeasts and bacteria. Most micro-organisms are useful for the preservation of life. A minority is pathogenic or poisonous. Contamination can take place during growth, storage, processing, sale or preparation of the food or raw material.

Chemical contamination is the absence of unusual (chemical) substances in the food. The presence of these substances can be the result of the production process at the places where the product has been present. There is a difference between supplements and contaminants. Supplements are substances that are added to the food for technical reasons, such as enzymes, anti-oxidants or substances that enhance colour or taste. Contaminants are substances that are not deliberately added to the product, such as pesticides and dioxins.

Physical contamination is caused by glass, metal, plastic or other materials which accidentally came in contact with the product. This contamination can occur during harvest, processing or transport (AgriHolland, 2004).

3.1.2 Codex Alimentarius

Since 1961 steps have been taken to establish a Codex Alimentarius. The Codex Alimentarius is the product of a long evolutionary process involving a wide cross-section of the global community. The Codex Alimentarius Commission was created in 1963 by FAO (Food and Agriculture Organisation of the UN) and WHO (World Health Organisation) to develop food standards, guidelines and related texts such as codes of practice under the Joint FAO/WHO Food Standards Programme. The main purposes of this Programme are protecting health of the consumers, ensuring fair trade practices in the food trade and promoting co-ordination of all food standards work

undertaken by international governmental and non-governmental organisations. The member states of the United Nations participate voluntarily in the Codex Alimentarius. The Codex limits are not binding, but there is a growing interest for the Codex Alimentarius, because of the rise in global trade and consumer concern for food safety. The World Trade Organisation (WTO) has decided that the decisions of the Codex will be taken as reference points in trade disputes. Therefore, the use of different national limits is only possible if this is demonstrable necessary because of the higher exposure or sensitivity of the population or if a stricter safety policy is applied across the borders.
For all parties in the food chain the General Committee on Food Hygiene has set out the principles of the Hazard Analysis and Critical Control Point (HACCP) system. The HACCP system is designed to identify specific hazards and measures for their control to ensure the safety of food. HACCP is a tool to assess hazards and establish control systems that focus on prevention rather than relying mainly on end-product testing. This means that the steps in growing and processing of agricultural products are assessed separately. As well as enhancing food safety, implementation of HACCP can provide other significant benefits, which are better knowledge of the own organisation and prevention methods. In addition, the application of HACCP systems can aid inspection by regulatory authorities and promote international trade by increasing confidence in food safety (FAO, 1998 & 2005).

3.1.3 Europe

Within the European Union a set of directives and regulations is in place on residue limits, and stipulating how compliance with these limits must be monitored in the different Member States. In doing so, maximum possible use is made of the knowledge, experience and recommendations contained in the Codex.
The General Food Law (GFL - Regulation 178/2002/EC) and the European Food Safety Authority (EFSA) were established in January 2005. EU Member States implement the General Food Law (GFL) regulations in their own national legislation. More information on directives and regulations on food safety of the European Union can be found on the internet: http://europa.eu.int/comm/food/index_en.html; information on the European Food Safety Authority is given under www.efsa.eu.int.
The General Food Law brings some obligations to the food chain. The food chain itself is primarily responsible for producing safe food. The same obligations are set for the feed chain. To support and complement this responsibility the European Member States have food authorities to control and inspect food safety. The European Food Safety Authority (EFSA) is co-ordinator and support of the national authorities. The national authorities will inspect whether food products meet the MRL (Maximum Residue Levels) and other requirements, like labelling.
Another important aspect of the food chain is traceability. The food chain must know the origin of the product on the principle of 'one step back – one step forward'. The principle is a minimum requirement. Traceability is described as the ability to trace and follow food, feed and ingredients through all stages of production, processing and distribution.

3.2 Food safety standards

Companies all over the world draw up standards to impose on suppliers. These standards contain rules and obligations for the companies involved and are additional to national and international legislation.
Countries have a number of reasons to promote food safety management systems in a business environment:

- To motivate the food processing industries for adoption of food safety and quality assurance mechanisms
- To prepare them to face global competition in international post-WTO trade
- To enable guaranteed quality and hygiene standards
- To enhance product acceptance by overseas buyers
- To keep the industry technologically up-to-date with international best practices

(APEDA, 2004)

Companies also have a number of reasons to implement management systems. The implementation and certification of a management system helps an organisation achieve continuous performance improvement. Use of a proven management system, combined with ongoing external validation, enables the organisation to continually renew its

mission, strategies, operations and service levels. The benefits of certification are: increased market opportunities as customers will see the organisation as more effective and better organised, cost savings, improved staff responsibility, commitment and motivation, stronger reputation (BSi Management Systems, 2006).
The control of food safety in a business environment is generally achieved by implementing food safety management systems, such as HACCP and pre-requisite systems such as Good Manufacturing Practice (GMP) and Good Hygiene Practice (GHP).
Good Practices involve guidelines that are aimed at assuring minimum acceptable standards and conditions for processing and storage of products. Moreover, Good Practices can have a national or international recognition. Specifically for the agricultural sector Good Agricultural Practices are drawn up.
Hazard Analysis Critical Control Points (HACCP) is a systematic approach to the identification, evaluation and controls of those steps in food manufacturing that are critical to product safety. It is an analytical tool that enables management to introduce and maintain a cost-effective, ongoing food safety programme. The basic objective of the HACCP concept is assuring production of safe food by prevention instead of by quality inspection (Luning *et al.*, 2002).
The ISO 9000 series is a set of quality standards published by the International Organisation for Standardisation (ISO). ISO 9000 is a process-orientated standard. The ISO 9000 standard focuses on improving and maintaining the total quality of the organisation involved.
As mentioned in Paragraph 3.1, food safety is part of the quality of the product. Product quality, together with the service level provided by the company as a whole, determines Total Quality. This, in relation to the quality assurance systems, is shown in Figure 2.

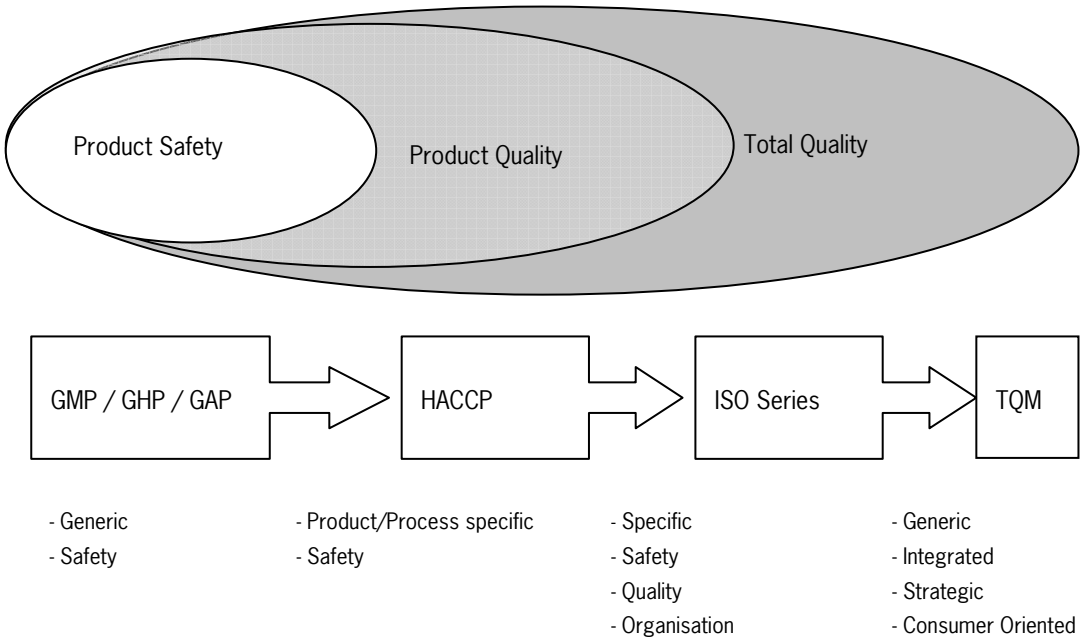

Figure 2. An Integrated approach for Quality Assurance, concepts and tools (Jongen, 1998).

EUREP-GAP
In Europe the Good Agricultural Practice (GAP) protocol of the FAO (Food and Agriculture Organisation of the United Nations) is translated into the EUREP-GAP. The normative document for certification, "EUREPGAP Fruits and Vegetables", has been developed by a European group of representatives from all stages in the fruit and vegetable sector with the support from producer organisations outside the EU. The Euro-Retailer Produce Working Group (EUREP) started as an initiative by retailers in 1997. The current version of the EUREP-GAP document and procedures has been agreed upon by partners from the entire food chain for fruits and vegetables after a wide consultation phase over three years.

EUREP-GAP has been developed especially for primary producers. It is based on Good Agricultural Practice and includes IPM (Integrated Pest Management) and ICM (Integrated Crop Management) principles. These principles should prove essential for working towards sustainable agricultural production.
The EUREP-GAP principles are drawn up for the following sectors:

- Fruit & Vegetables
- Flowers & Ornamentals
- Integrated Farm Management
- Integrated Aqua Culture Assurance
- (Green) Coffee

The EUREP-GAP requirements make a grower apply Good Agricultural Practice on his farm. The requirements are divided into general requirements, like traceability, record keeping, complaint handling and internal audits. In addition to the general requirements there are requirements on growing and on social and environmental issues. The social and environmental issues cover requirements on waste and pollution, recycling, reuse and worker health, safety and welfare.
The EUREP-GAP documents and/or background information on EUREP can be downloaded from the EUREP website (http://www.eurep.org).

HACCP

In the 1960s, the Pillsbury Corporation developed the HACCP control system with NASA to ensure food safety for the first manned space missions. They required food with a high quality level to prevent possible illness or injury in space.
The HACCP system and guidelines for its application were defined by the Codex Alimentarius Commission in the Codex Alimentarius Code of Practice. This Commission implements the Joint Food and Agriculture Organisation (FAO) of the United Nations and World Health Organisation (WHO) Food Standards Programme.
The HACCP approach enables the food industry to identify and asses risks in the production process. These risks, which may lead to unsafe situations, are dealt with systematically. Introduction of the HACCP standard in a company requires effort and expert knowledge. Knowledge on process control in the food industry and knowledge of regulations on food safety are essential. This knowledge can be described as system knowledge (how to set up a quality system?) and process control knowledge (how do processes in the preparation of food work?).
The benefits of using HACCP are: better understanding of food operation, flexible management framework, more focused control, facilitates trade/markets, demonstrable improvements in food safety. Using HACCP also has its barriers: perceived complexity and bureaucracy, lack of knowledge and training, lack of simple, authoritative information, enforcement difficulties, awareness and motivation (HACCP or HICCUP, Seminar, 13th May 2002, Highfield).

ISO 22000:2005

The ISO 22000:2005 standard specifies requirements for a food safety management system and came into effect in May 2005. ISO 22000 is based on ISO 9000 which describes the basic principles of quality management and specifies the terms for quality management. ISO 9000 requires a company to comply with the demand of the client and applicable legislation. Because of the strong focus on the client and his needs and expectations, ISO 9000 helps to work on customer satisfaction. The system encourages the company to identify the client's wishes and to use these to analyse the production process. The quality management system supports the possibility of continual improvement. This can have a positive effect on client satisfaction.
An organisation in the food chain needs to demonstrate its ability to control food safety hazards in order to ensure that food is safe at the time of human consumption. The ISO 22000 standard is applicable to all organisations, regardless of size, that are involved in any part of the food chain. The organisation wants to implement systems that consistently provide safe products. ISO 22000 should enable an organisation:

- To plan, implement, operate, maintain and update a food safety management system aimed at providing products that, according to their intended use, are safe for the consumer.
- To demonstrate compliance with applicable statutory and regulatory food safety requirements.
- To evaluate and assess customer requirements and demonstrate conformity with those mutually agreed customer requirements that relate to food safety, in order to enhance customer satisfaction.

- To effectively communicate food safety issues to their suppliers, customers and relevant interested parties in the food chain.
- To ensure that the organisation conforms to its stated food safety policy.
- To demonstrate such conformity to relevant interested parties.
- To seek certification or registration of its food safety management system by an external organisation, or make a self-assessment of self-declaration of conformity to ISO 22000:2005.

ISO 22000:2005 is a combination of three main elements; management system (similar to ISO 9000), HACCP and General hygiene rules or Pre-requisite programmes. More information on the ISO 22000:2005 standard is available on the website of the International Organisation for Standardisation (ISO) www.iso.org.

Safe Quality Food
A relatively new standard is Safe Quality Food (SQF). This standard has been developed in Australia and is a combination of ISO 9000 and HACCP (based on the Codex Alimentarius principles). The SQF standard is applicable to all segments of the food chain. The SQF standard varies according to the nature of the business. The SQF 1000 standard is suitable for the primary sector and small, low risk processing and commercial companies; the SQF 2000 standard is suitable for larger processing and commercial companies, while SQF 3000 is being developed for retail trading.
The SQF Institute, a division of the Food Marketing Institute in Washington, is owner and administrator of the quality standard. The related checklists, guidelines and other information are available on the SQF Institute website (http://www.sqfi.com/).

3.2.1 Interrelations between GMP, GHP and HACCP

GMP (Good Manufacturing Practise) is concerned with the precautions needed to ensure adherence to specific quality requirements and can include food safety aspects, suitability aspects, and other quality matters. GHP (Good Hygiene Practice) is the part of GMP concerned with the precautions needed to ensure appropriate hygiene. Hygiene includes microbiological as well as hygienic suitability such as general hygiene and product spoilage. HACCP is the management tool linking together all safety-related measures into one single management system. So, pre-requisite programmes, hygienic processing measures (hurdles, treatments, etc.) and HACCP programmes all together constitute GHP. It is important to understand the differences between food safety and food suitability. Safety requirements only relate to hazards that are affecting human health and depend on the intended use of the food (Heggum, 2001).
Quality assurance activities often lead to structural interference in the organisation and/or technology. The type of interference depends on the objective of quality assurance (e.g. to guarantee product safety, supply, service quality, etc.). As a matter of fact, introduction and implementation of a quality system is not a simple procedure. It requires insight in relevant managerial processes (Luning *et al.*, 2002).

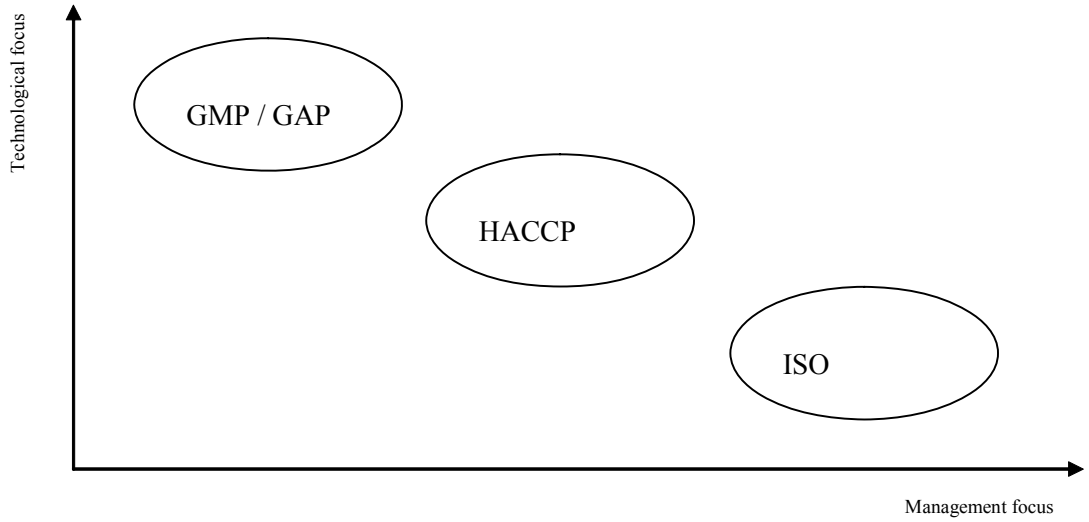

Figure 3. Common Quality Assurance systems schematically mapped on their technology and management focus (Luning, 2002).

3.3 Hazard Analysis for the production of tomatoes and white cabbage in West Java

Development of food safety and quality management systems for vegetable production systems in Indonesia requires identification of their food safety and quality management status. The HACCP principles were taken as starting point for assessment of the food safety situation in the Indonesian vegetable supply chain,. Paragraph 3.4.1 describes the hazard analysis approach. Paragraphs 3.4.2 to 3.4.9 give the results of the first six steps of the HACCP approach. Paragraph 3.4.10 describes the conclusions as regards risk control in the Indonesian vegetable supply chain (especially for primary production). The critical control points are translated into the Hortin-GAP checklist (Appendix 1), which will be the product of this research project.

3.3.1 The HACCP approach

The guidelines for application of the HACCP systems of the Codex Alimentarius commission were used as reference. The guidelines consist of the following twelve tasks, which form a logic sequence for application. The first six tasks are elaborated in this report. The other six tasks are covered in the protocol and forms.
The HACCP-principles are becoming increasingly important in relation to food safety, which is of growing concern to people all over the world. HACCP has proved to be a good system to deal with food safety issues in a company. Implementation of HACCP principles starts with the steps stated in the Codex Alimentarius. The logic sequence for application of HACCP is stated below. The sequence has been taken from the Guidelines for application of the HACCP system (FAO/WHO food standards, CAC/RCP 1 – Annex). The principles of the HACCP system are mentioned as reference besides the HACCP steps.

1. Assemble HACCP team
2. Describe product
3. Identify intended use
4. Construct flow diagram
5. On-site confirmation of flow diagram
6. List all potential hazards associated with each step, conduct a hazard analysis, and consider any measures to control identified hazards
   (Principle 1 - Conduct a hazard analysis)

7. Determine Critical Control Points
   (Principle 2 - Determine the critical control points (CCPs))
8. Establish Critical Limits for each CCP
   (Principle 3 - Establish critical limit(s))
9. Establish a monitoring system for each CCP
   (Principle 4 - Establish a system to monitor control of the CCP)
10. Establish corrective actions
    (Principle 5 - Establish the corrective action to be taken when monitoring indicates that a particular CCP is not under control)
11. Establish verification procedures
    (Principle 6 - Establish procedures for verification to confirm that the HACCP system is working effectively)
12. Establish documentation and record keeping
    (Principle 7 - Establish documentation concerning all procedures and records appropriate to these principles and their application)

The first six steps will be carried out in this research project; steps 7 to 12 will not be carried out since these are more suitable for food safety in a business environment. Therefore, the first six steps of the hazard analysis were performed to determine the potential risks in the Indonesian vegetable supply chain. The hazard analysis will be used to make sure all potential hazards are covered by the elements of Hortin-GAP. The first six steps, as in the logic sequence of application of the HACCP principles, are elaborated below.

1. **Assemble HACCP team**
   The food operation should assure that the appropriate product-specific knowledge and expertise is available for the development of an effective HACCP plan. Optimally, this may be accomplished by assembling a multidisciplinary team. Where such expertise is not available on site, expert advice should be obtained from other sources, such as trade and industry associations, independent experts, regulatory authorities, HACCP literature and HACCP guidance (including sector-specific HACCP guides). It may be possible that a well-trained individual with access to such guidance is able to implement HACCP in-house. The scope of the HACCP plan should be identified. The scope should describe which segment of the food chain is involved and the general classes of hazards to be addressed (e.g. does it cover all classes of hazards or only selected classes).
2. **Describe product**
   A full description of the product should be drawn up, including relevant safety information such as: composition, physical/chemical structure (including A_w, pH, etc.) microbial/static treatments (e.g. heat-treatment, freezing, brining, smoking, etc.), packaging, durability and storage conditions and method of distribution. Within businesses with multiple products, for example, catering operations, it may be effective to group products with similar characteristics or processing steps, for the purpose of development of the HACCP plan.
3. **Identify intended use**
   The intended use should be based on the expected uses of the product by the end user or consumer. In specific cases, vulnerable groups of the population, e.g. institutional feeding, babies and elderly, may have to be considered.
4. **Construct flow diagram**
   The flow diagram should be constructed by the HACCP team. The flow diagram should cover all steps in the operation for a specific product. The same flow diagram may be used for a number of products that are manufactured using similar processing steps. When applying HACCP to a given operation, consideration should be given to steps preceding and following the specific operation.
5. **On-site verification of flow diagram**
   Steps must be taken to confirm the processing operation against the flow diagram during all stages and hours of operation and amend the flow diagram where appropriate. The confirmation of the flow diagram should be performed by a person or persons with sufficient knowledge of the processing operation.
6. **List all potential hazard(s) associated with each step, conduct a hazard analysis, and consider any measures to control identified hazards**
   The HACCP team should list all hazards that may reasonably be expected to occur at each step according to the scope from primary production, processing, manufacture, and distribution until the point of consumption.

The HACCP team should next conduct a hazard analysis to identify for the HACCP plan, which hazards are of such a nature that their elimination or reduction to acceptable levels is essential to production of a safe food. In conducting the hazard analysis, wherever possible the following should be included:

- the likely occurrence of hazards and severity of their adverse health effects;
- the qualitative and/or quantitative evaluation of the presence of hazards;
- survival or multiplication of micro-organisms of concern;
- production or persistence in foods of toxins, chemical or physical agents; and,
- conditions leading to above.

Consideration should be given to what control measures, if any exist, can be applied for each hazard. More than one control measure may be required to control a specific hazard(s) and more than one hazard may be controlled by a specified control measure.

3.3.2 Assembling HACCP-team

A general hazard analysis of the Indonesian vegetable supply chain was drawn up by IVEGRI. This general hazard analysis was developed by a team of experts (the HACCP team). The remarks made by the HACCP team were discussed with the IVEGRI team member. The findings and comments on the Hazard Analysis Table are addressed in this paragraph. The HACCP process steps are used as reference.
The HACCP team consists of:

Person	Organisation	Expertise
Mr. Witono Adiyoga	IVEGRI	Agro economist
Mrs. Maike te Riele	CAH Dronten, The Netherlands	Consultant food safety and quality management systems
Mr. Michiel Drok	CAH Dronten, The Netherlands	Consultant plant breeding and biotechnology
Mr. Joop van der Roest	RIKILT, The Netherlands	Researcher food safety
Mr. Jan Schoneveld		Cropping specialist and agricultural expatriate from Indonesia
Mr. Herman Schoorlemmer	PPO, The Netherlands	Researcher Farm Management
Mr. Marcel van der Voort	PPO, The Netherlands	Researcher Farm Management

3.3.3 Describe product

The products involved are white cabbage and tomatoes. There is no standard for the grading and sorting of fresh produce in Indonesia (personal note Dr. W. Adiyoga). There is only a Standard National Indonesia (SNI) for exporting tomatoes and not for white cabbage. Because no product quality standard is known to the HACCP team, the option is to refer to the UN-ECE (Economic Commission for Europe) standards for fresh products. The 'International Standardisation of Fruit and Vegetables (tomatoes/cabbage)' is taken as product description; these are the standards tomatoes FFV-36 and headed cabbage FFV-09 which have been adopted by a great number of countries around the world.

3.3.4 Identify use

The identified use is the sale of the product to the trader or packer. Estimates show that in Indonesia approximately 90% of all vegetables will be sold at the wet markets and 10% in supermarkets. The hazard analysis focuses on these two markets. The product is sold intact and unprocessed.
The most common practice is for the grower to harvest his crop. It will then be graded, sorted and sometimes washed. Tomatoes are packed in crates and white cabbage in net bags for transport to the trader or packer who will also do some grading and sorting.

3.3.5 Construct a flow diagram

Instead of the flow diagram mentioned in the HACCP principles, the process is described in process steps to be expected at an Indonesian vegetable farm; these process steps are:

Planning	:	Farmers usually make a plan that may include crop/crops grown, planted area, cropping system (mono cropping or multiple cropping), cropping pattern in one year, and financing. However, it should be noted that this plan is mostly not well-documented (written down).
Buying seeds (or plants)	:	It is common for farmers to buy seedlings (tomato and cabbage), especially for small farmers (< 0.5 ha). Larger farmers usually buy seeds and establish their own seedling nursery.
Land preparation	:	Digging and turning the soil over is usually carried out by using hoes (manually).
Fertilisation	:	• Organic manure is applied once before planting. At the end of land preparation, manure is spread and mixed with the soil. • Chemical fertiliser is applied 2-3 times during crop growth (at planting, two weeks after planting, and four weeks after planting)
Planting	:	• Cabbage: seedlings are planted with common plant spacing: 37.5 cm between plants in the same row and 30 cm between rows to produce heads of around one kg. • Tomato: seedlings are planted with common plant spacing: 37.5 cm between plants in the same row and 60 cm between rows.
Irrigation	:	Water is provided whenever necessary by flooding between rows, also known as furrow irrigation.
Weed control	:	• If the weed is heavy, farmers usually use herbicides for control (rarely); herbicides are applied before planting or together with land preparation • Weeding during plant growth is carried out manually several times.
Pest and disease control	:	Most farmers are still using the calendar system (spraying two times a week) as preventive measure. For both tomato and cabbage, spraying ranges from 10 to 14 times until 1-2 weeks before harvest
Plant maintenance	:	Tomatoes require an extra step during growth. The plant requires to be tied to a picket. This work may influence plant growth. This item is therefore added to this list.
Harvesting	:	Carried out manually by picking (red or reddish tomato) or cutting (well-rounded cabbage) by hand. Cabbage is harvested in one operation; tomatoes in 4-6 times
Transport	:	Transporting produce from the field to farmer's house (by using man labour) and from farm-gate to the market (by using vehicles)
Sorting and grading	:	Separating between marketable and non-marketable produce (rotten, off-type and off-size), and classifying produce into size classes (class A, B, C), especially for tomato • Class A: 8-10 tomatoes per kg • Class B: 11-15 tomatoes per kg • Class C: > 15 tomatoes per kg
Packaging	:	Farmers or traders may carry this out when delivering the produce to the market. They usually use wooden boxes for tomato (20 kg) and net bags for cabbage (50 kg). Packers usually pack the produce in a small volume (0.25-1.00 kg for tomato) by using plastic wrap.

3.3.6 On-site verification of flow diagram

The process steps have been drawn up and reviewed by the Indonesian Vegetable Research Institute (IVEGRI). The process steps give a general indication on the activities on the Indonesian farm. The hazard analysis consists of the same process steps, thus identifying all potential hazards in each process step.

3.3.7 List all potential hazards

Table 24. Hazard Analysis Table (HACCP table).

Process	Risk number	Potential risk	Seriousness	Frequency	Risk category
General					
Product					
	1	Insect in crop	Low	Average	2 (Q)
	2	Rotten crop	Low	Low	1 (Q)
Building					
	3	Contamination with poisoned or unwanted materials in storage (C, P)	Average	Low	2 (C,P)
	4	Glass in produce by broken lights (P)	High	Low	3 (P)
	5	Broken thermometer (C,P)	High	Low	3 (C,P)
	6	Contamination by condensation on ceiling (M)	Average	Low	2 (M)
Employees					
	7	Bad hygiene of personnel. Hair, food remains, dirty clothing (M,P)	Average	Average	3 (M,P)
	8	Transfer of contagious diseases by personnel (M)	High	Average	4 (C,P)
	9	Infection or contamination by wounds on hands	High	Average	4 (CP)
Machinery					
	10	Contamination by bad hygiene of machinery	Average	Low	2 (C,P)
	11	Contamination by damage crop through bad maintenance (M, Q)	Average	Low	2 (M,Q)
	12	Leakage of grease/oil on crop (C)	High	Low	3 (C)
	13	Leakage of the cooling system (C)	High	Low	3 (C,P)
Pesticide					
	14	Pesticides from storage come into contact with crops (C)	Average	Average	3 (C, Q)
	15	Fertilisers come into contact with crop (C)	Low	Average	2 (C, Q)
	16	Manure comes into contact with the crop	Average	Low	2 (M)
	17	Using calendar system of pesticide application (C)	High	High (every two days)	4 (C, Q)
Process					
Growth plan					
	18	Renting contaminated land (C)	High	Low	3 (C)
	19	Growing crop on decontaminated land, risk of residue of pesticide (C)	Low	Low	1 (C, Q)
Cultivation					
	20	Leakage of field sprayer (C)	Low	Average	2 (C, Q)
	21	Improper nozzle (P)	Average	Low	2 (C, Q)
	22	Organic manure on plants (M)	Average	Low	3 (M)
	23	Bad quality of irrigation water (C, M)	High	High	4 (C, M)
	24	Use of wrong pesticides	Average	Average	3 (C)
Harvest					
	25	Time of harvest (pesticide)	High	Average	4 (C)
	26	Contamination by rough handling	Average	Average	3 (Q, P)
Processing					
	27	Contamination by diseases	Average	Low	2 (M,Q)
	28	Contamination by organisms	Average	Average	3 (M, Q)
	29	Dirty packaging material (C,M,P,Q)	High	Low	3 (C,P,Q)
	30	Contamination by damaged packaging material	Average	Low	2 (P,Q)
Transportation					
	31	Contamination during transportation	High	Low	3 (Q,P)
	32	Overload	Average	Average	3 (Q,P)

3.3.7.1 Explanation of the HACCP table

The columns of the Hazard Analysis Table normally consist of: Process, Risk number, Potential risk, Seriousness, Frequency, Risk category, Standard, Control instrument, Precautionary/corrective measure, Who and Instruction and Registration.

In this study no company is involved in the Hazard Analysis. The Hazard Analysis is drawn up to map the potential food safety hazards in the Indonesian vegetable supply chain and to guarantee that all potential hazards are covered by Hortin-GAP.

The first column 'Process' is divided into two parts; General and Processes. Process mentions the processes in vegetable production: Product, Building, Employees, Machinery, Pesticides, which are general risks, and Growth plan, Cultivation, Harvest, Processing and Transportation, which are process risks. The potential risks (hazards) are determined by the HACCP team. The HACCP team discussed the vegetable production of tomatoes and white cabbage, which resulted in the potential risks in the Hazard Analysis Table. The HACCP team also drew up a first indication of Seriousness, Frequency and Risk category, aspects that were then checked against relevant literature (in print and on the internet).
The HACCP table mentions potential risks that may occur in the Indonesian vegetable supply chain. The potential risk is judged for seriousness and frequency, leading to a risk category.
Seriousness represents the question: What if an event occurs? For instance, which consequences may renting contaminated land have for food safety and product quality? If this example the consequences for food safety can be very serious indeed. This means that seriousness is HIGH for item 16 and not LOW.
Frequency is the possibility that the event (for instance renting poisoned land) will occur, i.e., the chance that it happens. If there are little or no industry or other potential waste producers in the vicinity of the farm the chance is small. If not, chances will be average or high.
Seriousness and Frequency together are the Risk Category; see explanation in Table 25.

Table 25. Seriousness, Frequency and Risk category.

Seriousness	Frequency		
	Low	Average	High
Low	1	2	3
Average	2	3	4
High	3	4	4

1. No action required. You may take this item into consideration.
2. Action required. You should take precautionary measures and draw up corrective measures.
3. Action necessary. You must take precautionary measures to prevent this from happening and draw up corrective measures in case this happens.
4. You must take direct action to take precautionary measures and formulate corrective measures. These hazards are very serious and must be avoided at all costs.

The letter given for the risk category explains the nature of the risk.
(C) = Chemical risk, (M) = Microbiological risk, (P) = Physical risk and (Q) = Quality risk

3.3.8 Allocation risk category

Risk categories have been allocated by Applied Plant Research (PPO) and CAH Dronten (Agricultural University). Numbers refer to the risk numbers of Table 25 (second column). If the risk also has implications for product quality, this will be mentioned separately.

Product

1. Insects in crop
   Frequency: in general: low, possibly reaching: average. Insects (especially caterpillars) in cabbage show the tendency to eat themselves a way into the crop in which case they may be overlooked during grading. Generally, insects on older leaves (aphids and whiteflies) will be removed during the preparation of the product before selling. For tomatoes, the problem is even less serious because insects are not permanently present on the fruit without visible symptoms.
   Seriousness: Average.

Safety: Generally, accidentally eaten insects will cause no harm. Cabbage crops might suffer from aphids and caterpillars. White flies and aphids may be found on tomatoes. None of these insects pose a serious health problem when eaten. About 5% of the Americans are asthmatic and 40% of them are allergic to cockroaches via inhaling insect particles; this may also be true for other insects. http://allergies.about.com/cs/bugs/a/aa051099.htm. Problems caused by eating insects are much scarcer. Only insects that are dangerous for human health could cause a problem. None of the insects known to feed on cabbage or tomato are listed as dangerous species.
Quality: Consumers don't like to see insects in their food and growers try to do as much as possible to avoid insect infestation. In that way they combine avoidance of production loss with a better looking crop.

2. Rotten crop
   Frequency: Low: These crops are susceptible to rot by bacteria and fungi. Especially the old leaves of cabbage are prone to infection, but these will be removed during preparation for selling.
   Seriousness: Low.
   Safety: Some of the fungi are known to produce mycotoxins, especially fungi that grow under storage conditions. Mycotoxin production by the common moulds and fungi that attack growing plants is not likely.
   Quality: This is more a quality related problem. Consumers do not buy rotten products. The frequency will be low because symptoms are clearly visible and all the participants in the chain dispose of rotten produce.

Building

3. Contamination with poisoned or unwanted materials in buildings during handling and storage
   Frequency: Low: Storage is not common practice, contamination during handling is incidental.
   Seriousness: Average.
   The product is handled, sorted and graded at all stages of the supply chain, during which the produce may come into contact with contaminants. For example when agro-chemicals are also stored and mixed in the same building. The floor where crates are placed and the tables where handling takes place may be sources of contamination. Storage is not common practice. Most produce will be transported directly after grading and sorting to the next party in the supply chain. Seriousness is therefore average.

4. Glass in produce by broken lights
   Frequency: Low. Processing is mainly done in the open air or in simple barns, without lighting. The chance that this happens is therefore very low.
   Seriousness: Glass in produce is a high risk for food safety.

5. Broken thermometer
   Frequency: Low. Since there is hardly any storage in the supply chain, monitored cold storage of produce is even rarer. More advanced growers that utilise cold storage will use thermocouples for temperature monitoring.
   Seriousness: The risk for food safety is high. Most thermometers are made of glass and old thermometers are filled with mercury, which is poisonous.

6. Contamination by condensation on ceilings
   Frequency: Low. Like the previous items, there is hardly any storage, let alone cold storage of produce.
   Seriousness: The risk for food safety is average. Condensation can be a source of micro-organisms. http://www.tbdhu.com/factsheets/Mould.htm

Employees

7. Bad hygiene of personnel. Hair, food remains, dirty clothing, bare feet
   Frequency: Low to average. Because available sanitation facilities are often poor, this may occur.
   Seriousness: The risk for food safety is average. Bad hygiene can cause micro-bacterial and pathogenic contamination of produce. It can cause certain types of food poisoning. http://health.allrefer.com/health/food-poisoning-info.html. On the other hand, micro-organisms that may be naturally present on these products are not likely to cause food poisoning. When contamination occurs (e.g. *E. coli*), human activity is the first source. http://health.allrefer.com/health/food-hygiene-and-sanitation-info.html

8. Transfer of contagious diseases by personnel
   Frequency: Low to Average. Personnel may have a contagious disease without knowing this but it is also possible that they are not telling it.
   Seriousness: The risk for food safety is high. Contagious diseases can be transferred by food. In addition to the points stated in the previous chapter, transfer of human diseases such as, e.g., cholera and diarrhoea by food is possible. http://www.who.int/mediacentre/factsheets/fs237/en/

9. Infection or contamination by wounds on hands
   Frequency: Average. Wounding might be common, but infection by wounds is not very likely. It should be common practice that wounds are treated and protected by band-aid, and that personnel must wear gloves if wounded.
   Seriousness: The risk for food safety is high. Infections and contagious diseases such as *Yersinia* can be transfered by food. http://www.cfsan.fda.gov/~mow/chap5.html

Machinery

10. Contamination by bad hygiene of machinery
    Frequency: Low: There is not much use of machinery in production and processing. But if machinery is used, a risk of bad hygiene of machinery may occur.
    Seriousness: Average: For instance when the machine is cleaned with water that is infected with micro-organisms, contamination of food may occur. Cross contamination from one batch of produce to the next may also occur, without proper intermediate cleaning. In that case the second batch will not be worse than the previous. Crop remains left in the machine may start rotting and cause contamination by acting as inoculums source for the next batches of produce.

11. Contamination by damaged crop through bad maintenance
    Frequency: Low: There is not much use of machinery in production and processing. Machinery used should work properly in order to prevent damaging the crop. If not, (parts of) produce can get stuck in the machine.
    Seriousness: Average: Machine parts (like bolts or nuts) in the crop are not easily detectable (depending on size) and may lead to serious complaints.

12. Leakage of grease/oil on crop
    Frequency: Low: There is not much use of machinery in production and processing.
    Seriousness: Average to high: Grease and oil can be poisonous. If leaking does occur, this is usually in small quantities, and it would therefore take some time before this becomes visible. Because of the small quantities harm is rather limited. Use of food grade lubricants is a good solution.
    http://www.machinerylubrication.com/article_detail.asp?articleid=445&relatedbookgroup=Lubrication

13. Leakage of the cooling system
    Frequency: Low: There is hardly any cold store in the supply chain resulting in a low frequency.
    Seriousness: Average: Water-based or freon-based units are most frequently used in storage with cooling possibilities. Freon does not really pose a risk because it is volatile and disappears into the atmosphere; water may pose a risk of contamination. A good possibility to avoid risks is to use thermal fluids that are certified for use in the food business. http://www.foodproductiondaily.com/news/news-ng.asp?id=50782-thermal-fluid-passes. Regular maintenance is of course important.

Pesticides

14. Pesticides from storage come into contact with crops
    Frequency: Low to Average: Usually storage of pesticides is separated from the processing area. But it is possible that rests of pesticides, spilled on floor or workbench, come into contact with the crop.
    Seriousness: Average to High: Pesticides may be dangerous to health, especially in higher concentrations than the dose that is applied on the crop. Those higher concentrations can occur easily in areas where the chemicals are prepared for spraying, sometimes the same barn or shed where the crop is graded and handled for the first time after harvest. Of all pesticides used, the groups of nematicides and insecticides contain the most

dangerous chemicals. Many of those chemicals interact with the nervous system. The organisation of the nervous system of target-animals is comparable to that of humans; this means that the same effects can be expected.

15. Fertiliser comes in contact with crop
    Frequency: Low to Average: As for the chemicals mentioned above, usually the storage of fertiliser is separated from the processing area. But spilling can not always be avoided and the nature of the substance does not promote a sense of hazard by the farmer. Generally, spillage of fertilisers is therefore higher than spillage of pesticides.
    Seriousness: Low: Despite the fact that fertilisers contain heavy metals, the amounts are so low that harm is unlikely. http://www.cpha.net/hvymtl03.htm

16. Manure comes into contact with the crop
    Frequency: Low: In the beginning of the growing season, manure is applied to ensure good growth, but during crop growth, mineral fertiliser is applied instead of manure. Cabbage requires large amounts of nitrogen to form nice compact heads. Tomatoes respond better to potassium, more abundant in manure. Manure will be stored well away from crop handling areas. During the growing season there may be some contamination of the lower leaves of the crop by splashing of rain, but later this will be less while crops are higher. During handling and grading of the crop, the lower leaves are removed and with that any remains of manure.
    Seriousness: Average: Manure is generally seen as a possible source of disease infection. http://southwestfarmpress.com/mag/farming_farming_primer_food/. Some people even come to the conclusion that organic farming should be avoided because of the sole use of manure. http://vric.ucdavis.edu/veginfo/foodsafety/organicproduce.html

17. Using the calendar system for pesticide application
    Frequency: High: Farmers use the calendar system for disease control. This means that a farmer will spray at fixed intervals (for example every two to five days). There is some difference in the hazardousness of the individual chemicals, but acceptable daily intakes (ADIs) and corresponding MRLs have been laid down for all chemicals. For cabbage the risk is even higher because chemicals tend to leak between the leaves of the compact head which counteracts the degradation of chemicals by environmental influences (e.g. sun).
    Seriousness: High: The chance of Maximum Residue Levels (MRLs) being exceeded is high. Furthermore, the calendar system is used by almost all farmers. The risk is therefore high.

Process

Growth plan

18. Rental of contaminated land
    Frequency: Low: Most rented sites have been in agricultural use for many years. Sites that have not been in agricultural use before hold the risk that they are polluted with poisonous materials.
    Seriousness: High: Poisonous material of various origins may be spread over the land, like sewage sludge or contaminated soil. Laboratory tests should be carried out to make sure no poisonous materials are present in the soil. http://www.iatp.org/foodandhealth/library/admin/uploadedfiles/Sewage_Sludge__Food_Safety.htm

19. Growing crops on chemically sterilised soil
    Frequency: Low: Soil fumigation is not common practice in Indonesia. It is an expensive alternative for crop rotation.
    Seriousness: Low: There is a risk of pesticides residues in the soil, but because almost all soil disinfectants are volatile above 10°C, the risk that residues will be present in the crop can be neglected. http://edis.ifas.ufl.edu/NG001

Cultivation

20. Leakage of field spraying equipment
    Frequency: Average: It is common that field spraying equipment leaks. This may especially occur when a pressure system with nozzles is not used.

Seriousness: Low: Leaking of spraying equipment may potentially cause exceedance of the MRL (maximum residue level). It is not a high risk. When crops are sprayed, spraying equipment is carried over the field. Some plants may get a few drops extra, but compared to the intended dose and the used dilution, seriousness is low.

21. Improper nozzle
    Frequency: Average: This is more likely to occur without annual inspection of the spraying equipment. Small particles in the spray solution may cause obstruction of a nozzle, causing it to dysfunction or leak instead of spraying.
    Seriousness: Low: Compared to the normal application an improper nozzle has limited effect. There still is a risk of MRL exceedance.

22. Organic manure on plants
    Frequency: Low: It is common to use organic manure before planting. During the crop growing stage mineral fertiliser is used instead of organic manure because of the faster crop response.
    Seriousness: Average: Organic manure on plants may hold a micro-biological risk. See no 16, http://agsyst.wsu.edu/manure1.html and http://www.prweb.com/releases/2004/6/prweb133293.htm

23. Bad irrigation water quality
    Frequency: High: Most crops are irrigated with water from ditches or canals
    Seriousness: High: Water may contain many poisonous substances. Water from sources that are open to public use may contain poisonous substances or may be contaminated with micro-organisms. http://www.microbeworld.org/htm/cissues/waterq/wqual_2.htm
    Water from a private or public well is probably safest. River water might pose the highest risk. There are industrial facilities that use the river to dump their waste water or use river water for their industrial processes. Irrigation water is usually not sprayed on the plants, but flooded onto the field. This is an advantage because it reduces the chance that poisonous substances will come into contact with the plant.

24. Use of wrong pesticides
    It is obligatory to use pesticides that are allowed by the government agency. There is no specification as to the use of which pesticides against which disease on a specific crop. All admitted pesticides can be used against diseases or on crops for which the pesticides are not suitable. Education on pesticides use is also very limited. Farmers are not aware of the risk of using the wrong pesticides.
    Frequency: Average: Most experienced farmers will know that fungicides have no effect on weeds or nematodes, resulting in a certain selection. In case of uncommon pests or diseases, the risk of using the wrong pesticide will be higher.
    Seriousness: Average: All pesticides are approved for use in Indonesia which as such results in a certain selection. Furthermore, pesticides are always applied in diluted form, thus reducing the impact.

Harvest

25. Time of harvest (pesticide)
    Frequency: High: The safety interval is the interval between the last pesticide application and harvest. The safety interval depends on the pesticides that are used; each pesticide has its own safety interval. Farmers must comply with any known safety intervals. Sometimes it is attractive for farmers to spray the crop shortly before harvest because it assures a better crop quality during handling and transport. This will especially be the case for pesticides against which some degree of resistance has developed, reducing spraying effectiveness.
    Seriousness: Average: A shorter safety interval corresponds with a higher risk of residue on the produce. Exceedance of the MRL is then a realistic possibility, which is a food safety hazard. On the other hand, the pesticides admission policy has resulted in the most dangerous chemicals not being permitted.

26. Contamination by handling
    There are a number of ways the product can be contaminated during harvest and on-field handling. Cabbage and tomatoes can be harvested with a contaminated knife (soiling or rinsed with contaminated water), the

harvested cabbage is placed on the soil (soiling) before being placed in large wooden crates (wood splinters). And handling may also be so rough that the product is damaged.
Frequency: Average: Especially cabbage is prone to this contamination, because it is heavier and contamination has less visible effect on quality. Handling of cabbage will be rougher than handling of tomatoes because some of the contaminated leaves can always be removed afterwards.
Seriousness: Average: Soiling in general is not serious, except when organic manure or other contaminants are involved (see no 16).

Processing

27. Contamination by plant diseases
Frequency: Low: During processing there is the risk of diseases spreading by contaminated tools, machinery or other circumstances. The limited use of tools and machinery limits the risk.
Seriousness: Average: Generally, plant diseases are not harmful for humans.

28. Contamination by organisms
Frequency: Average: Insects, rodents and other organisms may contaminate produce. This may happen during storage. The entrepreneur will strive for the shortest possible storage time.
Seriousness: Average: Rodents are known for their ability to contaminate food and to carry human diseases (see also no 6).

29. Dirty packaging material
Frequency: Low: Crates are generally only used for crops. Cleaning of packaging material before use is advised. There is always the risk that chemicals or other poisonous substances are transported with the crates. In the process of re-using the crates sometimes a (chemical) treatment is applied to extend the durability of the crates (washing, impregnating).
Seriousness: High: When crates are used more than once the treatment to extend the life of the crates usually contains poisonous chemicals.

30. Contamination by damaged packaging material
Frequency: Low: Damaged wooden crates hold the risk that of splinters getting into the produce. Tomatoes are transported in nets, so damaged material will not be found in the fruits.
Seriousness: Average: If splinters are left in the outer leaves of cabbage, they can be harmful if not found during grading and processing.

Transport

31. Contamination during transport
Frequency: Low: Trucks that are also used for livestock transport are a potential hazard. Open trucks may also hold a risk. Trucks should be used for crops only or must be properly cleaned. Soiling may also occur when crates or bags are loaded and unloaded from the truck.
Seriousness: High: Microbial contamination may occur when products are transported in dirty trucks or when products are placed on the ground during loading.

32. Overload
Frequency: Average: If, e.g., net bags with white cabbages are piled up too high, the lowest cabbages will be damaged. The same goes for tomato crates, resulting in quality deterioration and crop damage, increasing the susceptibility to diseases.
Seriousness: Average: This is merely a matter of quality; this means that overloading necessitates another grading procedure and loss of product and quality.

Other useful sites:
US FDA guide to minimise microbial food safety hazards: http://www.foodsafety.gov/~dms/prodguid.html
Article on food safety issues in Indonesia (in Bahasa Indonesia):
http://www.agrimutu.com/news/tim_keamananpangan.htm

3.3.9 Conclusions

The Hazard Analysis of the HACCP team and a workshop with a group of Indonesian vegetable farmers showed up a number of structural bottlenecks in the Indonesian vegetable supply chain. These will be briefly highlighted.

- **A lack of hygienic awareness and procedures**
  A lack of knowledge of basic hygienic rules causes poor hygienic procedures throughout the supply chain. The limited awareness and procedures especially emerge in processing and handling of fresh produce.
- **Pesticide use**
  Within Indonesian vegetable growing the calendar system for spraying of pesticides is still common use; this system causes excessive use of pesticides, not only resulting in food safety problems but which may also cause environmental problems when organisms develop resistance to the pesticides. The common practice of intercropping and use of different planting times on one field causes difficulties as regards official safety intervals. This results in residues on crops of pesticides that were meant for a different crop.
  Besides, farmers have limited knowledge of rules and regulations concerning registered pesticides. There is official information, but in fact access of farmers to this information is almost impossible. This results in purchases of illegal pesticides or the wrong use of permitted pesticides. The lack of knowledge of pesticides also causes health risks. Pesticides are often applied without or with only limited protective clothing.
- **No or limited access to testing (laboratory) facilities**
  A number of assumptions cannot be (in)validated. Poor water quality is one of these assumptions. Generally, testing for MRLs, water and soil quality is not possible or very costly. These testing facilities are not or only to a limited extent available to applied research in Indonesia, not to mention farmers.
- **Poor product handling procedures**
  Fresh products are often not transported or packed as required by the characteristics of the product. For example cauliflower packed in net bags and piled up on the back of an open pickup truck. Such cauliflowers can easily be damaged or affected by the sun, which leads to a bruised and yellow cauliflower being offered to consumers.

To control the majority of the risks mentioned in this chapter, precautionary measures at farm level or during the steps of transportation, packing or processing can be taken. But a ‘final’ system ready for certification, requires organisation at national level of elements like testing facilities and the access to and control of pesticides regulations.

4. The Hortin-GAP checklist

Marcel van der Voort and Herman Schoorlemmer, 2006

4.1 Sources and conditions of Hortin-GAP

4.1.1 Conditions

Goal of the development of Hortin-GAP was a protocol for vegetable growers. Requirements were:

- The protocol should enable control of the food safety risks at production level (as stated in the hazard analysis)
- There must a close relationship of the GAP with international standards
- The GAP suits the ambitions of the Indonesian government
- The protocol must be applicable for Indonesian farmers with an average agricultural education and a representative (average) farm size
- Involvement of trade companies as a condition for embedding the scheme into the supply chain

4.1.2 HACCP and Eurep-GAP

To meet the first two conditions, the GAP is based on the HACCP analysis (Chapter 3). It was important that the GAP controls the main risks as analysed in this HACCP approach. To come up with practical measures for farmers, elements are used from the private EUREP-GAP protocol. It is increasingly used as a condition for trade. Several European but also African and Asian suppliers are Eurep-GAP certified in order to supply European or European-based supermarkets.
Research and interviews with growers learned that the Eurep-GAP requirements are not feasible in practice. Many basic requirements cannot be met by Indonesian growers. Hortin-GAP can be seen as a first and enduring step towards Eurep-GAP by Indonesian vegetable growers. Compliance with the International GAP-standards will come within reach of the Indonesian vegetable growers who comply with Hortin-GAP.

4.1.3 PSA - Pusat Standardisasi dan Akreditasi

The Pusat Standardisati dan Akreditati (PSA), or Center for Standardisation and Accreditation (CSA), has recently (2005-2006) undergone some changes. The new name is 'Direktorat Mutu dan Standardisasi'. The directorate is no longer part of the Secretariat General of the Ministry of Agriculture in Indonesia and has already designed a food safety and product quality control system. The certification system of Indonesian Agricultural Products (SI SAKTI Indonesia) is based or three levels of agricultural practice.

Table 26. Certification System (SI SAKTI).

Certification System of Indonesian Agricultural Products (SI SAKTI)				
Prime I	Compliance with HACCP system / Eurep-GAP Quality Manual			Proper documentation of Quality and Production
Prime II	Compliance with Good Agricultural Practices / Good Handling Practices		Good record keeping of Good Agriculture Practices (GAP)	
Prime III	Compliance with Good Pesticide Practices	Good record keeping for proper usage of pesticides		

During the project the development of the Hortin-GAP protocol was incorporated into the development of the 'SI SAKTI'-system, which had no Good Agricultural Practice protocol (control points). The first draft of Hortin-GAP had less far-reaching requirements than Eurep-GAP. This draft was based on the research done in cooperation with

farmers. The Eurep-GAP certification system contains a number of requirements that can hardly be demanded from Indonesian farmers. Hortin-GAP was suitable for Prime II and III certification. The current Hortin-GAP holds most of the major and minor musts of the Eurep-GAP elements, but these elements are divided into three levels (Prime I to III). Eurep-GAP only has one level of good agricultural practice. The Center for Standardisation and Accreditation of the Indonesian Ministry of Agriculture requested inclusion of all Eurep-GAP requirements into Hortin-GAP. The differences between the two certification systems are elaborated in the cross-reference matrix which can be found as the second table of Appendix 4.
Because the 'SI SAKTI'-system has three different levels, certification becomes possible when a grower complies with all Prime 3 items. This means that a grower can be certified for Prime III. In practice this means that the grower complies with slightly more than half of the Hortin-GAP checklist. For Prime II the grower complies with slightly more than 80%, and for Prime I the grower needs to comply with the complete Hortin-GAP checklist.
For Eurep-GAP Indonesian growers had to comply with all major musts and 95% of the minor musts. The SI SAKTI system has been developed with a certain growth of the farmer in mind. The grower starts with Prime 3 and is able to grow towards Prime 1, which equals private certification for the Eurep-GAP standard. The local governments will carry out certification of the growers for Prime 3 and 2. Private certification bodies will be asked to carry out certification for Prime 1, which in practice means certification for Eurep-GAP. The most significant difference between Eurep-GAP and Hortin-GAP is that social and environmental requirements of Eurep-GAP are not incorporated into Hortin-GAP, which focuses primarily on Good Agricultural Practice.
Implementation of Hortin-GAP into the 'SI SAKTI'-system signifies the institutional embedding of this project.

4.2 Development of Hortin-GAP in cooperation with stakeholders

To meet the last two conditions mentioned at the start of paragraph 4.1.1, development took place in close cooperation with growers and trade companies.
Researchers of PPO and IVEGRI prepared a draft GAP based on the HACCP analysis, the chain analysis (Chapter 2) and Eurep-GAP. This draft GAP contained a checklist and several registration forms. It was discussed during a workshop in Lembang, Indonesia, October 2004 (Mission Report MR-17, 2004).
The 18 participants of the workshop (growers, traders, governmental employees, researchers) discussed in groups about necessity and applicability of the checklist and registration forms of the draft GAP.
The workshop discussions resulted in improvements in the GAP.
To stimulate involvement and to learn about practical application the GAP was tested in practice in 2005. During the test the main activities were focused at:

- Preparation of the test
- Kick-off meeting with all participants
- The test at farm level
- Closing meeting with all participants

Chapters 5 and 6 describe the test and its evaluation in detail.

4.3 Hortin-GAP

The final Hortin-GAP was improved after the test by Indonesian vegetable growers and contains a checklist and supporting documents. These supporting documents are:

- a fertiliser inventory list;
- a pesticides inventory list;
- a field registration list;
- a purchase list;
- a sales list.

These documents, together with the Hortin-GAP checklist, make up the certification system (SI SAKTI).
All documents are included in Appendix 2.

5. Field test of Hortin-GAP

Azis A. Asandhi, Witono Adiyoga, Laksanawati Dibyantoro, Inue Sulastrini & Nurhartuti

This chapter describes the approach and results of a field test of Hortin-GAP. The test was conducted from May 2005 up to November 2005 in Bandung Regency. Fourteen farmers were involved in this field test of the Hortin-GAP protocol.

5.1 Preparation of Hortin-GAP test

5.1.1 Goal and approach of the test

Goal of the test was to learn about practical application of Hortin-GAP by farmers. Anticipating the level of the farmers, the project team decided to test the farmers on their ability to fulfil level 2 or 3 (Prime 2 or 3) of the 'SI SAKTI'-system (Good Agricultural Practice and Good Pesticide Practice). In general, Indonesian farmers have little or no experience with record keeping and most farmers still use the calendar system for spraying their crops. So besides the application of the checklist two parameters were observed:

1. Are all documents completed by participants?
2. Pesticide residue monitoring by testing the product produced by participants for residue levels.

The main activities to realise the test were:

Activities	Goal	Institution involved	Output
Preparation Hortin-GAP test	Planning test and recruitment participants	IVEGRI and PPO	List of participants Planning of test and audits Audit instructions
Monitoring and evaluation plan for Hortin-GAP test	Learning points for the test and future	PPO	Monitoring and evaluation plan
Kick-off meeting with all parties involved	Informing farmers on objectives, planning and operational issues	IVEGRI and PPO	Workshop on execution of the test
Implementation of Hortin-GAP test	Farmers testing the Hortin-GAP and auditing results	IVEGRI with participants	Registration forms farmers Audit reports
Backstopping test depending on the problem and findings during the test	Monitoring of test to ensure results	PPO	Facilitating the test
Pesticide residue testing	Insight whether farmers comply with MRLs in Indonesia	A governmental laboratory	Results residue analysis per crop per farmer
Evaluation (individual and group)	Learning from the test (all parties involved)	PPO, IVEGRI and participants	Experiences and recommendations for improvement

5.1.2 Participants

Fourteen farmers participated in the test. They are mentioned in Table 27. During the kick-off meeting and the evaluation workshop traders/packers (Bimandiri and Pandu Tani), supermarkets (Carrefour and Hero) and the Centre

of Standardisation and Accreditation (CSA) of the Indonesian government were participating as well. The kick-off meeting was held in May 2005. The test was executed from June till September 2005, one month after the kick-off meeting. A number of farmers had already planted their crops and some had not. Record keeping was to start just before planting or should be done retrosprectively. The forms are based on the Hortin-GAP checklist (Appendix 1). Six forms were distributed to the participating farmers, i.e.: List of Purchase, Inventory List of Pesticide, Inventory List of Fertiliser, List of Sale, List of Field Activities and Field registration list (Appendix 2). The List of Field Activities could be integrated into the Field Registration List depending on the preference of the farmer.
To facilitate the farmers, all lists were combined into one registration book with enough lines to record all activities.

Table 27. Names and address of farmers participating in the Hortin GAP Field Test.

No.	Farmer's name	Address	Field Guide
1.	Usman	Jl. Tangkuban Perahu RT 03/RW 05, Ciburial, Lembang	Denny Hidayat + Sdr. Nono
2.	Engkos Kosasih	Kp. Ciburial RT 03/RW 05, Lembang	Denny Hidayat + Sdr. Nono
3.	Lili Charly	Kp. Ciburial RT 03/RW 05, Lembang	Denny Hidayat
4.	Bunyanun Marsus	Kp. Norotog Wetan RT 05/RW 02, Desa Margamulya, Pangalengan	Denny Hidayat + Nono
5.	Asep Deden	Kp. Pasir Langu RT 02/RW 03 Kec. Cisarua	Denny Hidayat + Nono
6.	Solehudin	Kp. Ciburial RT 03/RW 05, Lembang	Denny Hidayat + Nono
7.	Ajat Sudrajat	Kp. Ciburial RT 03/RW 01, Desa	
8.	Deden Sudrajat	Kp. Suka Mulus RT04/12, Kelurahan Cigugur Girang, Kec Parompong	Denny Hidayat + Nono
9.	Utep Rahmat	Jl. Badak Singa No. 8, Dago Taman Sari (40132), Ibu Lina 70800473	Denny Hidayat + Nono
10.	Edik Yuhanda	Jl. Maribaya Timur No. 363, Cibodas Lembang Tel/Fax 022-2700599	Edik Yuhanda
11.	Dadang Rukmana	Jl. Maribaya Timur No. 363. Cibodas Lembang, HP. 081321089109	Edik Yuhanda
	Didin Sukarya	Jl. Maribaya Timur No. 363. Cibodas Lembang, HP. 081320260509	Edik Yuhanda
13.	Ali Musonif	Jl. Maribaya Timur No. 363. Cibodas Lembang Tel/Fax 022-2700599	Edik Yuhanda
14.	Asep Wawan Gunawan	Jl. Maribaya Timur No. 363. Cibodas Lembang Tel/Fax 022-2700599	Edik Yuhanda

5.1.3 Audits

A monitoring and evaluation plan was drawn up for controlling the process and to make use of the inputs of the stakeholders for improvement of the GAP and to learn as much as possible for future implementation. Part of the monitoring at farm level was done by audits. This chapter describes the results of the audits. Monitoring and evaluation will be discussed in detail in Chapter 7.

Researchers of IVEGRI were responsible for the audits. To prepare for this task, a short audit training was given by PPO and a planning was made for the audits (Appendix 3). Three audits were planned per farmer: in July, August and September 2005. Spread over these three audits, auditors assessed the compliance of farmers with items of the Hortin-GAP checklist (Prime 3): traceability; planning, soil and site management; varieties and rootstock; fertiliser; irrigation; crop protection; harvest; processing; and transport. Results were written down in an audit report (Appendix 3). An additional benefit of the visits of the researchers to the farmers was that they could give some assistance and check the progress of the farmers on registration activities.

5.2 Kick-off meeting (workshop)

The kick-off meeting was held on May 12, 2005 at IVEGRI, Lembang and was attended by representatives of actors involved in the vegetable supply chain (including 14 participating farmers), five IVEGRI researchers, two staff members from CSA and a researcher from PPO of the Netherlands.
The kick-off meeting had a few objectives. First objective was to inform the farmers about the checklist, registration forms, audits and good pesticide practices. Second, the test was explained in relation to developments of the SI SAKTI system (Sistem Sertifikasi Pertanian Indonesia = Certification System of Agriculture in Indonesia). The third objective was to illustrate the relationship of the GAP with future market access and demands of buyers.
The kick-off meeting had the following programme.

Time	Subject	Presenter
8.00 – 9.00	Reception and registration	
9.00 – 9.05	Welcome	Dr. Azis A. Asandhi
9.05 – 10.00	IPM-training	Tonny Mukasan, MSc
10.00 – 10.30	Coffee break	
10.30 – 11.30	Explanation of the prime system (SI SAKTI)	Miss Sri Sulasmi, MSc
11.30 – 12.00	Explanation of Hortin-GAP	Miss Novia, MSc
12.00 – 13.00	Lunch	
13.00 – 15.00	Explanation of test and forms	Dr. Azis A. Asandhi
15.00 – 15.30	Demands of buyers and there view on the protocol	Denny Hidayat of Bimandiri and Edik Rohanda
16.00 – 16.15	Evaluation and closing	Dr. Asiz A. Asandhi

All invited participants were present during the meeting. During the short training on integrated pesticide management (IPM) participants were instructed about the basic principles of the IPM technique. IPM is an important element of Hortin-GAP to control the use of pesticides. Excessive use of pesticide will have a negative impact on farmers, consumers, as well as the environment. The negative impact due to excessive use of pesticides, e.g., consists of pests becoming resistant to pesticides, environmental pollution, killing of beneficial insects and non-target organism, and high pesticide residues that may endanger consumers. There are, therefore, enough reasons to make use of IPM techniques, which are based on four principles: cultivation of healthy crops, making use of natural enemies, routine observations, and training of farmers on IPM techniques.
The Indonesian government is developing a certification system for agriculture in Indonesia (SI SAKTI). Miss Sulasmi of CSA informed and explained status of the SI SAKTI System to the farmers (see 4.1.3). Her colleague miss Novia informed the farmers on the requirements of Hortin-GAP.
After explanation of the Hortin-GAP test and documents by Dr. Azis A. Asandhi all participants could give their opinion on the SI SAKTI system and Hortin-GAP. Buyers and farmers agreed that action must be undertaken to improve food safety and product quality. Joining this test should be a first step. A few remarks were made by the participants.
The first remark was that a certification scheme controlled (and audited) by the government may lead to bureaucracy and the risk of participants being able to buy official documents, without actually meeting the requirements, which would then mean that certification becomes useless, especially from a marketing point of view.
The second remark made by farmers was that they would like a more active participation of supermarkets in Hortin-GAP. Supermarkets are the main buyers and if they acknowledge the importance of certification for food safety and product quality, farmers can (possibly) get a better price for their products.

5.3 Test at farm level

5.3.1 Results of record keeping

The Hortin-GAP test was carried out by 14 farmers from several groups or villages such as Cibodas, Ciburial, Cibogo, Parompong, Cimenyan and Pangalengan and farmer groups of Pandu and Bimandiri.
The audit planning as drawn up in May 2005 was carried out according to plan. An example of audit reports is shown in Appendix 3. The first audit took more time then originally anticipated. The additional time was used for explanation of the documents to farmers, especially record keeping documents. The farmers were very interested in Hortin-GAP and related subjects. During the test they made additional visits to the office of IVEGRI with questions and to learn more about bio-pesticides (project of IVEGRI).
Unfortunately planting time was not uniform. Some farmers had to plant before May and some others after May. However, documentation was recorded from June. Those who had planted before May documented those elements in the forms they could remember.
Record keeping was one of the main elements of the test, since the farmers did not have much experience in record keeping and administrative procedures. In general all farmers were able to complete all documents (Table 28).
The 14 participating farmers counted two exceptions. One farmer from Pangalengan used his own book, which was different from the registration forms supplied by the project team. His records did not show how much pesticide or fertiliser was used and when pesticide or fertiliser was used.
And one farmer from Cibogo had to be helped to complete the forms, either by his grandson or a researcher from IVEGRI during monitoring. The other twelve farmers recorded all field activities and completed all documents as instructed by Hortin project team. One major item was not complete, the pesticide admission number. Significant observation was that most of the pesticide admission numbers were not recorded because farmers did not have access to the list of legal pesticides and the admission number is not stated on the packaging of the pesticide.
Another bottleneck was the certificates of seeds used. Farmers used imported seeds, for which certificates are often not available.

Table 28. Results of record keeping per registration form of farmers participating in Hortin-GAP.

No.	Farmer name	Forms completed					
		List of purchase	List of sale	Inventory of pesticides	Inventory of fertilisers	Field activity	Registration form
1.	Usman	V	V	V	V	V	V
2.	Engkos Kosasih	V	V	V	V	V	V
3.	Lily Charly	V	V	X	X	V	V
4.	Bunyamun Marsus	X	X	X	X	X	X
5.	Asep Deden	V	V	V	V	V	V
6.	Solehudin	V	V	V	V	V	V
7.	Ajat Sudrajad	V	V	V	V	V	V
8.	Deden Sudrajad	V	V	V	V	V	V
9.	Utep Rahmat	V	V	V	V	V	V
10.	Edik Yuhanda	V	V	V	V	V	V
11.	Dadang Rukmana	V	V	V	V	V	V
12.	Didin Sukarya	V	V	V	V	V	V
13.	AliMusonif	V	V	V	V	V	V
14.	Asep W. Gunawan	V	V	V	V	V	V

Note: 1) V – Forms completed.
2) X – Forms not completed.

5.3.2 Hortin-GAP checklist

The test also showed some bottlenecks in the certification for Hortin-GAP. Appendix 5 shows per farmer an overview of findings written down in the audit reports. A number of bottlenecks are described in more detail.

Land use
None of the farmers had a risk analysis of the land. Most of the time a risk analysis is not needed, because the land or field has been in agricultural use for a longer period of time. But many farmers rent their land, in which case the history of the site is often not known to the farmer. To carry out a risk assessment is too expensive for the farmer. Most farmers do not have rotation plans or maps (in writing) of their farm. This means that no records are kept on land-use related matters. Farmers implemented crop rotation systems by using crops that are not from the same plant family. Farmers also plant more than one crop in the same field (intercropping). These rotation plans or intercropping systems were not recorded.

Seed/variety
The seeds that farmers used were mostly imported seeds bought from the store. There were no labels (or certificates) for these imported seeds, while in the control point, seeds used should be labelled (certified) by the government and the variety used should be released by the government. Nevertheless, the farmers are convinced the seeds they used were of good quality. This confidence is based on their experience, such as Danise for cabbage or Marta for tomato.

Fertiliser
Some farmers make use of organic manure, like rabbit urine, during crop growth. The use of organic manure during growing is not allowed according Hortin-GAP in view of the risk for food safety by contamination by micro-organisms.

Irrigation
Water used by the farmers is never analysed. Costs are too high and the possibilities for farmers to have a risk analysis are limited. The water used for irrigation by farmers is therefore of unknown quality. It is suspected that open water holds a number of contaminations, which causes problems during crop growth. Within a sister project, Hortin-Protveg, the quality of the irrigation water used proved critical to crop growth. During this Hortin-Protveg project sweet peppers were grown in two types of greenhouses in Lembang Indonesia. The water used by the Protveg project was causing plant loss and a number of diseases in the greenhouses. The water was surface water which is also used by the farmers in this Hortin-GAP project. This leads to the assumption that surface water is not automatically of good quality.

Crop protection
The most important bottleneck in crop protection is the admission number of pesticides. The Indonesian government does have an admission system for pesticides, but the admission number of the pesticide is not mentioned on the label of the crop protection packaging. Farmers can learn the legal status of the pesticide by buying a book at the Ministry of Agriculture in Jakarta. The book holds the records and admission number of all legally allowed pesticides. During the test just one farmer had a recent book. This book is annually updated.
Another pesticide-related issue is the labelling of pesticides. The labels, if present, often do not show sufficient information on active substance, dosage, admission number and safety interval. For farmers, official information is difficult to find. This causes a risk for food safety. Farmers can buy unregistered or untested pesticides, without knowing this. A number of pesticides on the market come from India and China. These foreign products have no label or no label in the Indonesian language. Most of these pesticide products are not registered. The problem is increased by the fact that two government agencies are making policies on pesticides.
Farmers also make use of bio-pesticides, which are made and prepared by a farmers' group from several plants such as garlic, turmeric, 'keluwak' and 'kacang babi'. There is limited or no insight in the effects of bio-pesticides on food safety and product quality. Farmers assume, based on their experience, that this bio-pesticide has no negative impact.
Another point requiring attention is the cleaning of spraying equipment. There is no instruction or policy from government or pesticides companies on cleaning of spraying equipment in an environmentally friendly way. It is not clear how to clean spraying equipment or what to do with waste water used for equipment cleaning.

Harvesting and post-harvest handling or processing

The procedures for post-harvest handling to maintain product quality is not written down by any of the farmers. The farmers orally instructed the workers. Procedures for cleaning equipment and facilities were also lacking.
Procedures for cleanliness of equipment and facilities are not written down, but the farmers have schedules to maintain the cleanliness of equipment and facilities which are understood by the workers.
Indonesian farmers were not used to the requirement to have washing and toilet facilities near the field; this resulted in comments on how to organise these requirements.

5.3.3 Pesticide residue analysis

IVEGRI took samples of the produce from the farmers to a governmental laboratory. The crops were tested for pesticide residue levels in relation to the official Indonesian Maximum Residue Levels (MRL). MRL is maximum residue content (active ingredient) on the agricultural product that can still be tolerated. MRL is a formal constant as a result of consensus, especially in the interest of health, agriculture and trade.
Most farmers performed well, except a few. Table 29 shows the results of the residue testing as related to MRL values. Residue analyses of farmers' products showed that residue of the mancozeb fungicide on lettuce (0.037%) and the insecticide deltamethrin (0.31674 ppm) were higher than the MRL
A possible explanation for the MRL exceedance can be found in intercropping, which is common practice in Indonesia. This means that a secondary crop was sprayed just before harvesting the first crop.
Residue testing showed that crops with levels above the MRL contained residues of pesticides used on other crops. One farmer exceeded the MRL because he sprayed intercropped plants (tomato) and at the same time unintentionally sprayed the immediately harvested crop (lettuce).

Table 29. Pesticides residues on vegetable crops grown by farmers participating in Hortin-GAP.

No.	Farmer name	Location	Commodity	Pesticide residue	MRL*
1.	Usman	Ciburial	Celery	Imidacloprid: not detected	No MRL
2.	Engkos Kosasih	Ciburial	Lettuce	Deltamethrin: 4.23 mg/kg	0.5 mg/kg
3.	Lily Charly	Ciburial	Cauliflower	Aldrin: 0.00106 mg/kg	0.05 mg/kg
				Cypermethrin: not detected	1 mg/kg
				Mancozeb: 0.0067 %	Revoked
4.	Bunyamun Marsus	Pangalengan	Potato 1)	-	-
5.	Asep Deden	Cisarua	-	-	-
6.	Solehudin	Ciburial	Hot chilli	Mancozeb: 0,0327%	Revoked
				Deltamethrin: not detected	0.2 mg/kg
7.	Ajat Sudrajad	Ciburial	Curly lettuce	Deltamehtrin: 0.31674 mg/kg	0.5 mg/kg
				Mancozeb: 0.0378%	
					Revoked
8.	Deden Sudrajad	Cigugur girang	Bunching onion	Carbofuran: not detected	No MRL
9.	Utep Rahmat	Cimenyan (DAS)	Broccoli	Mancozeb: 0.0079%	Revoked
				Cypermethrin: 0.14165 mg/kg	1 mg/kg
10.	Edik Yuhanda	Cibodas	Cabbage	Cypermethrin: not detected	1 mg/kg
11.	Dadang Rukmana	Cibodas	Tomato	Clorpyrifos: not detected	0.5 mg/kg
12.	Didin Sukarya	Cibodas	Potato	Imidacloprid: 0.00025 mg/kg	0.5 mg/kg
13.	AliMusonif	Cibodas	Hot chilli	Imidacloprid: not detected	1 mg/kg
14.	Asep W. Gunawan	Cibodas	Cauliflower	Imidacloprid: 0,00051 mg/kg	0,5 mg/kg

Note: 1) Sample not sent.
**- Based on FAO MRL information.*

Besides the high pesticides residues above MRL, unintentional spraying of crops may have other negative effects:
- Targeted pests become resistant;
- Resurgence of pests;
- Accidentally killed natural enemies;
- Environmental pollution.

Based on the experience of the Hortin-GAP test, IPM refreshment is still needed while emphasising the knowledge of microbes, health sanitation, environment conservation, reducing pesticide residue by making use of bio-pesticides and implementing strategies to increase biodiversity (making use of beneficial arthropods).

5.4 Closing meeting of Hortin-GAP test

5.4.1 Programme of the meeting

An evaluation meeting with farmers, traders and supermarkets was organised on 24 November 2005 in Lembang. The evaluation with the farmers consisted of four parts.
The first part was the refresher course on food safety, product quality and GAP standards by PPO. The refresher course was to renew the knowledge of the participating parties and to discuss new developments in the vegetable chain. The second part was the presentation of the results of the residue analyses by Ms. Lilis Dari of the laboratory. These results are described in the previous paragraph. The third part was a presentation by IVEGRI of the test results of the registration and the checklist. The farmers could learn from each others results: what they did well and what not, what were bottlenecks and benefits of using the Hortin-GAP checklist and forms.
The fourth part was the group discussion with farmers on bottlenecks, recommendations and the evaluation of the whole test. The participating farmers, traders and supermarkets were split up into two groups. Discussions were lead by researchers of IVEGRI and observed by researchers of PPO. The key questions were:
- What was your general impression about working with the GAP?
- What where difficulties in working with registration forms and checklists?
- What perspective do you see (market, farm)?
- What must be organised on your farm, in the chain, or by the government to make the GAP successful?

5.4.2 Results of discussions with participants

All farmers were enthusiastic and proud to have participated. They got positive reactions about their participation by colleagues and traders. Record keeping was new but caused no major problems. A number of remarks were made to simplify registration or the supporting forms. In general, there was no problem with completing the forms. Difficulties to write down active ingredient, safety interval, admission number of pesticides due to the problematic labels on pesticides or insufficient information on pesticides are major problems.
The request was made to simplify the form on some points, for example the column for fertiliser use (dosage and area covered). Forms for all supporting factors (fertilisers, pesticides, seed, labour cost) should be separated. Another request was to supply a little diary or journal book for quick registration in the field besides the official forms to enable formal registration at a later time. The form and some terminology should be simplified. Sometimes the recordings depended on the farmers' perception.
It is too expensive to analyse irrigation water. The farmers requested whether it would be acceptable to just mention the water source. The awareness factor also influences completion of the form.

Farmers expected benefits of working according to the GAP. A number of participating farmers experience benefits from the Hortin-GAP test (e.g. higher price). The farmers request more publicity about participation in Hortin-GAP, e.g. a sign in the field (billboard, sign). This can improve the image of the farmers among all actors in the vegetable supply chain and so improve their position in this chain. It is agreed that farmers should be involved in the standardisation of quality. Registration stimulates farmers' insight into all inputs used in the farming operation and

thus creates a better view on profits and financial losses. Better perception of inputs could reduce expenditure, especially expenditure on production cost.

The two discussion groups had some suggestions for the government and private companies, more GAP socialisation in the supply chain at a national level. Hortin-GAP, which is part of the 'SI SAKTI'-system, should be enrolled nationally. Government must speed it up the process of enrolling. Presently not all local governments are ready to audit farmers.
Quarantine (import control board) should analyse the residues on imported products. Risk analysis for farmers' land, water and residue analysis of products should be subsidised. Dangerous pesticides must be prohibited.
The government could bridge the distance between producers and consumers through meetings among them. There should be a follow up action from the government after a GAP test. There should be more integrated action among departments on GAP-related matters. It is hoped that continuous 'direct' cooperation among actors, such as: suppliers and farmers, supermarkets and farmers, catering business and farmers, investor and farmers is stimulated.

5.4.3 Conclusions

The farmers were enthusiastic about the test which they all completed. In general they did not have any problems in completing the forms. Record keeping, which was thought to be the biggest obstacle, proved to be not such a big problem. Half of all participants did very well at their administrative processes. The other half of the participants were not keen on administrative duties, but did manage to keep records of almost all their activities.
The test results of Hortin-GAP show that farmers are quite able to reach 'Prime 3' certification requirements. 'Prime 3' is the basic level (Good Pesticide Practice) of the 'SI SAKTI'-system.
A few improvements of the checklist and forms are necessary but this is not only a matter of changing the forms.
A very important bottleneck for a good registration and production relates to the poor communication on and regulation of pesticides and fertilisers. Farmers don't have access to the right information.
Because farmers see possibilities to increase market access with Hortin-GAP, they hope the government (CSA and local government) will start soon with the official certification under the SI SAKTI system.

6. Monitoring and evaluation

Marcel van der Voort & Herman Schoorlemmer, 2006

Development of the protocol by two research institutes from different countries in close cooperation with growers and stakeholders from government and the supply chain can be seen as a process. During this process new ideas came up as result of the participation of different stakeholders, all with their own motives and knowledge. To control this process and to make use of the inputs of these stakeholders special attention has been paid to monitoring and evaluation of the process. The next two paragraphs describe the approach and results according a monitoring and evaluation plan.

6.1 Monitoring & Evaluation plan for HORTIN-GAP

In 2004 a GAP-protocol was developed based on the hazard analysis, interviews in the Indonesian supply chain and the existing EUREP-GAP protocol. A draft of the GAP was discussed with growers and supply chain partners during a workshop in Lembang (2004, October). The aim of the project activities in 2005 was to test this protocol in practice. In this test a group of farmers, two packers, two research institutes and the Indonesian government participated. To make this test useful for evaluation and to get as much as possible information for improvement of the protocol requires prior knowledge on what to evaluate and how to evaluate.

Questions that need to be answered in the test:

- Is the protocol suitable for implementation in practice by the relevant stakeholders? Are the protocol and its forms useful and are there suggestions for improvement.
- Are the protocol and related documents suitable to improve and guarantee food safety and product quality in the Indonesian vegetable supply chain?
- What is the behaviour and attitude of growers and traders towards the protocol?
- What are the benefits or disadvantages of the protocol for the participants in the test?
- Does the protocol give a positive stimulus to food safety and product quality in the Indonesian vegetable supply chain?
- Which issues can obstruct implementation of the protocol?
- Did the method and approach of designing, development and testing of the protocol prove to be suitable for the purpose?

The approach to answer these questions has been elaborated in a Monitoring & Evaluation plan (M&E plan). The plan, described in Table 30, was worked out before the start of the test. This M&E plan lists the evaluation questions and details these into sub-questions or indicators. The target group is the group to evaluate the particular question. Participants stand for the growers and the project team consists of members of IVEGRI (auditors), PPO, and the Indonesian government (CSA).
The kick-off meeting (May 2005) in Lembang and the evaluation meeting (November 2005) with all participants and project team members were important moments for the evaluation. Participants representing traders and supermarkets were present during these meetings and they were involved in the plenary and group discussions. The day after these meetings, the project team came together, evaluated the meeting and discussed the other relevant questions for the project team arising from Table 30.
Between these two meetings farm audits were carried out by project team members of IVEGRI. The Hortin-GAP checklist and audit reports gave insight in the performance of the growers.

Table 30. Evaluation questions.

Question	Sub-question	Target group	Why important?	When?	How?
1. How did the preparation of the test and recruitment of participants go?	• Was the checklist ready in time? • Were the right participants invited and in time? • Was it difficult to find motivated farmers?	Project team	The preparation and recruitment may affect the outcome of test and kick-off meeting	After the kick-off meeting (May 2005)	Discussion by project team
2. How did the kick-off meeting go?	• Were all invited participants present? • Was all necessary information available? • Did farmers understand the information and documents given to them? • Did they react positively to the kick-off meeting?	Project team and participants	A good kick-off meeting for the participants in the test will have great influence on the outcome of the test. If participants do not understand the information or don't have a good motivation, this may hamper or delay the test.	After the kick-off meeting (May 2005)	• Evaluation form completed by the participants • Group discussion by project team after kick off meeting
3. Did all farmers start and continue to work with the protocol?	• Did they start working with the protocol? • Did they keep working with the protocol till the end of the test?	Participants	At this point translation of the newly obtained knowledge into daily work may cause problems.	3 on-farm audits (May-September 2005)	• Audit reports • Hortin-GAP checklist
4. What were the difficulties in working with the protocol?	• What were the problems participants encountered? • - Did the problems have a great effect on the attitude of the participants or the result?	Participants	Discrepancies between the daily routine (work) and the draft protocol must be addressed to reach a good final protocol.	Evaluation meeting (November 2005)	• Discussion with the farmers during the evaluation meeting November 2005
5. Was the test successful?	• How many participants completed the test? • How many participants received a Prime 2 or 3 certificate?	Project team	The outcome of the test can indicate how well the draft protocol fits into the Indonesian vegetable supply chain.	Evaluation meeting (November 2005)	• Group evaluation of test by project team
6. What were the benefits for the participants?	• What is the reaction of participants to the test, will he/she participate again? • Do the participants now have a different view on food safety and product quality? • Did the participants change processes within their company due to this test? • Did the participant receive a Prime 2 or 3 certificate?	Participants	The participants can fail the audit and not receive a certificate. But if they still have a positive approach to the protocol and food safety, and product quality in general, there is a good change they will continue improvements of these items.	Evaluation meeting (November 2005)	• Discussion with the farmers during the evaluation meeting November 2005 • Group evaluation of test by project team (November 2005)

Question	Sub-question	Target group	Why important?	When?	How?
7. What did the project team learn about the method?	• What are the expectations of the project team members? • Does the end result match the expectations? • Did the test go as planned? • Where there arguments on the contents?	Project team	The project team is responsible for the execution of the test and meetings. Difficulties between team members or the lack of involvement of one of the team members can influence the outcome.	Evaluation meeting (November 2005)	Group evaluation of test by project team
8. Was the protocol complete?	• Does the protocol cover all aspects of food safety and product quality at farm level? • Does the protocol cover all aspects of food safety and product quality in processing and distribution?	Project team	Auditors or project team can conclude that essential items are missing in order to guarantee food safety. In that case these items need to be added.	Evaluation meeting (November 2005)	Group evaluation of test by project team
9. What is the conclusion of the test of the protocol?	• Is the protocol suitable for large-scale implementation? • Are any changes required for large-scale implementation of the protocol? • Is the protocol verifiable by auditors of CSA? • Were there items that should be observed in the development of the protocol? • Does the protocol suit the needs of CSA?	Project team	End result of the project should be a protocol that can be used on a large scale. The test should give insight into this matter. Co-operation with CSA should bring large-scale application of the protocol within reach.	Evaluation meeting (November 2005)	Group evaluation of test by project team
10. What can we do with the Hortin-GAP checklist in the future?	• Will the protocol be implemented in the Indonesian vegetable supply chain? • What institutional aspects must be solved? • What can we recommend to the government and the private sector?	Project team	What is the future of the Hortin-GAP checklist as seen by each project team member?	Evaluation meeting (November 2005)	Discussion with the farmers during the evaluation meeting and group evaluation by project team

6.2 Evaluation results

The results for all questions in the M&E-plan are described (Table 30).

1. **How did the preparation of the test, recruitment of participants and kick-off meeting go?**
   The preparations for the kick-off meeting went smoothly. This means that there were no problems in the preparations. Two groups of growers were invited and also willing to participate in the test. The groups of growers were supplying one of the two traders/packers. The first trader who agreed to participate was Bimandiri. They already agreed to participate during the visit of their processing site in October 2004. The second packer who agreed to participate in the Hortin-GAP test was Pandu Tani Group. This brought along a group of 20 growers and 2 packers. Also representatives of supermarkets Hero and Carefour were invited. Food safety is a topical issue in Indonesia with media attention. This increased the willingness of farmers to participate.

2. **How did the kick-off meeting go?**
   The kick-off meeting started with a short IPM training because this is an important part of Hortin-GAP. This was followed by two presentations about the general principles behind the system for certifying food safety and the ambitions of the Indonesian government about the SI SAKTI certification system. This was a warming up for the explanation of Hortin-GAP, the test and the forms, together with some practical exercises. The representatives of the trade companies were asked to give a critical reflection on the test and the future perspectives. After a discussion the day was closed with an evaluation moment.
   All participants were present during the kick-off meeting. The Hortin-GAP checklist and the registration form were checked and translated during the project team meeting before the kick-off meeting,. During this meeting it was also decided to draw-up an instruction for use of the forms. All participants received a copy of every registration form, of the Hortin-GAP checklist, and of the instruction on using the forms.
   The reactions to the kick-off meeting were diverse. This was mainly caused by the nature of the presentations. Two presentations about IPM and about the certification system (SI SAKTI) were quite theoretical in nature. The presentations gave the farmers a good background of the underlying policy and methodology but the theoretical nature of the topic caused very little enthusiasm with the farmers. The other presentations on the Hortin-GAP checklist and the registration forms answered better to the daily activities of the farmers.
   In all, it was concluded by the project team that the kick-off meeting went very well and that the farmers were interested in getting started with the checklist and forms.

3. **Did all farmers start and continue to work with the Hortin-GAP checklist?**
   The participants saw it as a privilege to co-operate in the Hortin-GAP test because there is much media attention for food safety. The farmers were enthusiastic about the test and eager to get certified by the local government. The participating farmers expected that the certification system (SI SAKTI) could be realised in the near future, especially in West Java. When the SI SAKTI system is operational, the farmers can be among the first group of farmers who will be certified.
   All participants completed the test and over 80% of them filled in all registration forms completely. At the start a hurdle had to be taken. The forms had too few lines to write down all activities. IVEGRI project members tackled the problem by making a GAP-book. This is a notebook in which the titles of the forms were incorporated in the top of the notebook. This GAP-book was appreciated by the participants.

4. **What were the difficulties in working with the Hortin-GAP checklist?**
   The farmers were not used to registration of their production activities. In fact it was a new experience, but it caused few problems. During the first audit, almost all auditors gave the farmers additional information on Hortin-GAP and especially on the forms. The other two audits were used to audit the Hortin-GAP checklist and to see how the farmers were doing with the forms.
   The field registration list took too much time. It was not clear enough how to use it. Some problems were related to pesticide regulations and their implementation. There were many problems with registration numbers and safety intervals. The registration number is not always stated on the label. Safety intervals are not mentioned on the label of the pesticides. Farmers could therefore not completely fill out the forms. These are

basic elements for an effective control of food safety. In this case it is not a matter of changing the registration form but of improving pesticides regulations and implementations.
During the project team evaluation it was already concluded that exceedance of the MRL was probably caused by the intercropping practiced by a lot of farmers. This means that a second crop was sprayed just before harvesting the first crop. Hortin-GAP does not adequately cover this aspect and needs improvement.
Registration of fertiliser applications caused some problems. It was difficult to estimate dosage, ingredients and area. Farmers order a truckload and not kilogrammes or cubic meters.
Other items that need attention: difficulty (high costs) of risk analysis for water and soil, mapping of fields, and investments needed in sanitation (toilets).

5. **Was the test successful?**
All participating farmers completed the test. The percentage of collected forms is 82 %, while 57 % of the required information was provided; 43 % of the farmers had suggestions for improvement of the Hortin-GAP checklist and forms or for improvements by the government. In fact two types of farmers participated in the test. The first type is those farmers who are very neat in the field, in their record keeping and who have sufficient IPM knowledge. The second type of farmers is good in crop cultivation but not in record keeping. The motivation and strategy of the second type of farmers should be strengthened by improving their capability and implementation of record keeping.
Farmers were intended to get a Prime 2 or Prime 3 certificate if they completed the test in compliance with the requirements. These are certificates of the SI SAKTI system, for which a part of the audits should be done by local auditors of the government. During the test period it became clear that the organisation of the local government was not ready yet to meet the needs of this certification system. This resulted in none of the participants receiving an official certificate.

6. **What were the benefits to the participants?**
After the test farmers were still satisfied to have taken part in this test. According to IVEGRI project members, the farmers were honoured to join the Hortin-GAP test. Farmers suggested making participation visible by a project billboard in their fields. Other farmers asked IVEGRI whether they could also participate in the test. One of the traders mentioned that he received a better price from some customers by showing the registrations. This was an additional motivation for farmers to participate and to do well in this test.
The test did not change farmers' perception of food safety and product quality but it gave practical ideas about implementation of their control. The test gave farmers a better idea of the shoulds and demands of Hortin-GAP (SI SAKTI) certification.
The Hortin-GAP checklist was designed to fit into the daily routine of the farmers. Farmers didn't mention any change in their daily routine. During the evaluation meeting, farmers emphasised the advantage of the registration forms for a better awareness and control of production costs.

7. **What did the project team learn about the method?**
Before the kick-off meeting the project team expected some farmers to quit and many of them to have problems with the forms. But the farmers were enthusiastic and all of them completed the test. The end result therefore exceeded the expectations of the project team. Broadly, the test proceeded as planned. The missing audits by the local government were taken over by IVEGRI.
The project team was satisfied about the approach of testing a GAP in practice. Interaction with farmers, traders and supermarkets gave useful elements for improvement of food safety and product quality for all stakeholders in the project. At the same time the project received positive reactions of other growers and traders and therefore stimulated good cooperation between research and private sector in Indonesia.

8. **Was the Hortin-GAP checklist complete?**
The Hortin-GAP checklist covers all aspects of food safety and product quality at farm level and in processing and distribution. The test revealed no gaps in the checklist.
Some suggestions were made to improve the practical application of the forms. Some of them are mentioned above. One suggestion was to use a small diary for on-field registration and to copy this in an official GAP-book at home.

9. **What is the conclusion of the test of the protocol?**
   The test showed the need for only a few small changes in the Hortin-GAP checklists and forms. In fact they are suitable for large-scale implementation. The Hortin-GAP checklist and forms are translated by CSA (part of the Indonesian Ministry of Agriculture) to the SI SAKTI system. The use of the protocol by auditors of the government has not been realised in this test.
   A complete checklist is not enough to ensure a safe product. A problematic issue for the market value of this GAP in Indonesia is the inadequate regulation, access to information, and labelling of pesticides. The residue test showed that farmers use pesticides for crops without any idea of official admission and international MRL standards.

10. **What can we do with the Hortin-GAP Checklist in the future?**
    The test was successful. The test results of Hortin-GAP show that farmers are quite eager to meet the certification requirements. Hortin-GAP seems to be a useful certification scheme to meet the government's 'SI SAKTI' system. Record keeping, which was thought to be the biggest obstacle, proved to be not such a big problem. Use of this test on a larger scale needs improvement of several elements. Discussions between participants and project team led to several recommendations towards authorities and supply chain organisations.
    Farmers hope that the government will soon start with the official certification of SI SAKTI in which Hortin-GAP will be integrated. Participants express the fear that the system will lead to governmental bureaucracy.
    There is a need to improve regulations and communication on pesticides registration and labelling in relation to international standards.
    The government can improve the possibilities for analysis of soil, irrigation water and residues. These analyses are currently not available and/or affordable for farmers.
    Stimulate knowledge and awareness about food safety in the market and in the supply chain.
    Traders and producer organisations have to think about incentives for farmers to start with GAP (higher price, sharing experiences).
    Implementation of Good Agricultural Practices must go hand in hand with improvement of product quality to get access to markets with higher price levels, like supermarkets. Lack of quality of Indonesian vegetables compared to imported products is a main factor for imported products being quite popular and being sold for a higher price.

7. Conclusions and recommendations

Several conclusions can be derived from the results of the preceding chapters. These conclusions are followed by recommendations to the government, to the private sector, and to research.

7.1 Conclusions

An indication of the perception of stakeholders in the supply chain of vegetables in West Java about the importance of food safety can be given on the basis of a limited survey among 2 growers, 2 packers, 1 assembler, 1 wholesaler and 2 retailers

For most actors in the vegetable supply chain, food safety is not really a major issue. In fact they do not receive complaints from their clients about food safety. The complaints they are getting are about the outer quality and about price. There are some very basic preventive actions for controlling food safety of products, like integrated pest management, washing and sorting the product. The basic knowledge and awareness regarding the importance of food safety may already be present (especially for supermarkets). However, as yet supermarkets have no food safety guarantee system in everyday practice/operation, since there are still no incentives (e.g. price premium) and pressures (consumer demands) to do so.

Most of the respondents expect food safety to become more important over the next 5 years.

The following statements can be derived from the answers of the majority of the respondents;

- food safety is too complicated;
- they can see the benefits of a food safety system;
- it costs too much to have a proper food safety system in place;
- food safety is not really a major priority;
- there should be more food safety checks by the authorities.

Based on a Hazard analysis with a HACCP team and during a workshop with a group of Indonesian vegetable farmers some conclusions could be derived about the production of vegetables. Structural bottlenecks in the control of food safety during the production of vegetables are:

- A lack of hygienic awareness and procedures: a lack of knowledge on basic hygienic rules causes poor hygienic measures throughout the supply chain. The limited awareness and procedures on hygiene show up especially in processing and handling of fresh produce.
- Pesticides use and regulations: within Indonesian vegetable growing the calendar system is still common use; this causes excessive use of pesticides. The common practice of intercropping and different planting times on one field causes difficulties as regards the official waiting time (pre-harvest interval). This means that residues are found on crops while spraying was meant for a different crop.
  An important element is that farmers have limited knowledge of rules and regulations on admission of pesticides. Access to official information is a problem. This results in purchase of illegal pesticides or wrong use of allowed pesticides.
- No or limited access to testing (laboratory) facilities: a number of assumptions cannot be confirmed or invalidated. Poor water quality is one of these assumptions. In general, testing for MRLs, water and soil quality is not possible or very costly. These testing facilities are not or hardly available to farmers.
- Poor product handling procedures: fresh products are often not transported or packed as required in view of the characteristics of the product.

During this project and in close cooperation with Indonesian farmers and trade companies a Good Agricultural Practice has been developed. This Hortin-GAP has a close relationship with international standards like HACCP and Eurep-GAP and fits into the ambitions of the Indonesian government about a certification system for Indonesian Agricultural Products (SI SAKTI system).

A test of the protocol by 14 farmers during a cropping season showed that the GAP with checklist and derived registration forms is useful and applicable for average Indonesian farmers. The test results of Hortin-GAP show that

farmers are able to meet the 'Prime 3' certification requirements of the SI SAKTI-system; 'Prime 3' is the basic level (Good Pesticide Practice).
Record keeping, which was thought to be the biggest obstacle, proved to be not such a big problem. The test resulted in some practical recommendations for improvement of the forms. A few improvements of the checklist and forms are necessary.
A completed checklist is not enough to ensure a safe product. Very problematic issues for a trustworthy and controllable GAP in Indonesia are the insufficient regulations, access to information and labelling of pesticides. The residue tests showed that farmers make use of pesticides for crops without any idea of official admission and international MRL standards.
There is a growing awareness of food safety issues in Indonesia, as illustrated by the very positive motivation of farmers to participate in the test. Farmers hoped they could be among the first group of farmers to be certified. Incentives from the chain organisations can give this positive attitude a boost. For example, some of the participating growers received higher prices and new buyers for their products by showing results (registrations).

7.2 Recommendations

The Hortin-GAP test was successful and there is a growing interest in food safety and product quality control but there are a number of bottlenecks that require serious attention and a pro-active attitude from all stakeholders. These bottlenecks range from practical problems, like how to organise residue analyses to more fundamental problems like pesticides regulations and the control and total quality concept of the supply chain.
Based on conclusions of this project and on discussions and experiences during its execution, some recommendations can be derived for the government, the private sector, and for research in Indonesia. The recommendations are aimed at a successful introduction of Good Agricultural Practices in Indonesia.

Recommendations for the government

- Start soon with official 'SI SAKTI' certification; the tested Hortin-GAP fits well into the SI SAKTI system. Farmers are able to work with it. The government, which is responsible for implementation, control and maintenance of the 'SI SAKTI' certification system, can enroll the 'SI SAKTI' certification system. Presently, local governments, which are responsible for auditing the system, are not ready to start auditing. Therefore, farmers receive no official certificate for their efforts. The national government should press for the introduction of the certification system. The farmers are eager to get an official certificate. An element to take into account is the fear of bureaucracy felt by farmers and trade companies. This means the government must think about how to assure the independence of the audits and auditors.
- Improve regulations, information and extension about pesticides; a bottleneck regarding pesticide admission and labelling which came up during the test, requires immediate attention of the government. The lack of knowledge (communication) to farmers on the legal status of pesticides, may lead to food safety risks. Farmers must have access to information about admission of pesticides, safety intervals and Maximum Residue Levels. Without such information there is no way food safety can be guaranteed in line with international standards.
- Make testing facilities available and affordable for farmers; The required residue analysis in GAP is very expensive for farmers. To guarantee residue analysis takes place and is done according to required laboratory standards, the local government can make residue analysis a part of regular inspection (audit). Another option is to give farmers funds to pay (or subsidise) for the residue analysis or subsidize laboratory facilities that are performing such analyses.
- Test quality of water; during the test the quality of irrigation water and the presence of micro-organism such as E. coli, Candida and Salmonella are not analysed yet. In the future microbiological and water quality analysis should be conducted for food safety purposes; such analyses contribute to avoiding food safety risks, which is important for public health.
- Test imported products; another request made by the farmers to the government was to apply the same GAP standards and pesticide residue testing for imported products. This request seems a more than legitimate request to the government to uphold the same standards for all vegetable products.

- Improve awareness of all stakeholders in the chain; a condition for successful implementation of a GAP is the awareness of farmers and chain organisations that many handlings and activities can influence the safety of food. This means improvement of knowledge of risks and control methods by communication, education and inspection.

Recommendations for the private sector

- Supermarkets need to think about incentives for farmers; Participating farmers in the Hortin-GAP test were enthusiastic. A number of farmers in the test, who had the same buyer, received a higher price for their products. To stimulate production according the GAP there must be some kind of incentive, like price or market access. A suggestion for the private sector is to combine the GAP with a brand which can be marketed (Indonesian Best, which is suggested by the government).
- Start with markets with added value; in the short term it is not unrealistic to expect that a GAP will only have certain market value at some more exclusive markets in Indonesia like supermarkets, international hotels, export markets. For these markets, controlled production according a GAP is often not a bonus but a condition to supply.
- Development of GAP must go hand in hand with improvement of chain performance; Visits to and discussions with Indonesian supermarkets showed a lack of quality of Indonesian vegetables compared to foreign (imported) products. This is a main factor why imported products are more popular among clients of supermarkets and are sold for a higher price. Problems with the quality of the local product are for example: great variety in size, bad presentation (including packaging), too high percentage of products with bad external quality. If Indonesian growers want to gain access to these markets with a higher price level, development of a good agricultural practice must go hand in hand with improvement of product quality; this requires a chain approach. Participating farmers expressed the hope that improvement of cooperation among supply chain actors, such as agricultural suppliers, supermarkets, caterers and investors will give a more positive stimulus to Indonesian vegetable production and marketing.

Recommendations for research

- Interaction with the private sector; Develop integrated concepts with the private sector. The analysis in Chapter 2 of this report showed that the private sector is not unwilling to improve food safety, but fears complicated systems with high costs. It is important to develop control measures for food safety in close relationship with the private sector to secure practical applicability. The approach of this project with a field test is a good example.
- Insight in risks and prevention; A number of assumptions concerning food safety in Indonesia can not be confirmed or invalidated. Poor water quality is one of these assumptions. Research can be done on risk assessment and on cost-effective and practical control measures for farmers and other stakeholders in the supply chain.
- Integrated pest management; Experience of the Hortin-GAP test shows that refreshing of IPM knowledge is still needed, with emphasis on the knowledge of microbes, health sanitation, environment conservation, reducing pesticides residue by making use of bio-pesticides and implementing strategies to increase biodiversity (making use of beneficial arthropods). IPM technology such as control threshold, sensible use of pesticide, spraying technique, labour safety and equipment preparation are understood by the farmers. One thing the farmers neglecting is to work safely during pesticide spraying. Farmer networks are an excellent way to improve the performance of farmers and increase knowledge transfer from researcher to farmers
- Developments of concepts to improve chain performance; Control of food safety is part of total chain management. Research can be done on concepts for performance improvement, e.g., by researching the Indonesian vegetable supply chain and elaborating, testing and implementing integrated solutions focussing on product quality, IPM, harvest planning, sourcing, logistics and capacity building.

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- European Commission – EU-wide Pesticide residue monitoring reports
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- FAO pesticide management unit
  http://www.fao.org/waicent/FaoInfo/Agricult/AGP/AGPP/Pesticid/Default.htm
- Centraal college Toelating Bestrijdingsmiddelen (CTB) – Relevant links (in Dutch and English)
  http://www.ctb.agro.nl/portal/page?_pageid=33,33017&_dad=portal&_schema=PORTAL
- US Foreign Agriculture Service – International MRL database
  http://www.mrldatabase.com/query.cfm
- BSi Management Systems
  http://asia.bsi-global.com

Appendix 1. Hortin-GAP checklist

Item	Control Point	Prime	Complies	Remarks	Comments
1. Traceability and record keeping					
1.1	Records should be kept of what is sold to who and how much	1-3	yes/no		
1.2	Records must be kept of land use, pesticide use, fertiliser use and irrigation for all crops and sites	1-3	yes/no		
1.3	Records should be kept for a minimum of two years	1-3	yes/no		
1.4	Record should be kept for the purchase of planting material, pesticide, fertiliser and other materials	2-3	yes/no		
1.5	*Every year the farmer must carry out a self-inspection. In line with the findings, corrective actions must be made*	1-3	yes/no		
1.6	*Complaints should be recorded and corrective measures must be formulated*	1-3	yes/no		
2. Planning, soil and site management					
2.1	A risk assessment should be carried out if the site has not been in agricultural use before.	1	yes/no		
2.2	A map or identification system should be drawn up for each field (site)	1-3	yes/no		
2.3	Crop rotations should be made for annual crops	1-3	yes/no		
2.4	Are cultivation techniques used that reduce the chance of soil erosion?	1-2	yes/no		
3. Varieties and rootstock					
3.1	The farmer should be aware that the right variety or good seed quality has a direct relationship with product yield and quality	1-2	yes/no		
3.2	The chosen varieties should have resistance or tolerance against common pests and diseases	1-3	yes/no		
3.3	Own nursery stock should be subjected to the same GAP principles	1-2	yes/no		
3.4	Purchase of seeds or plants should be recorded, variety, number, quality	1-2	yes/no		
3.5	Certified plants or seeds should be preferred	1-2	yes/no		
4. Fertiliser					
4.1	Application of fertiliser must be recorded. Type, date and quantity	1-2	yes/no		
4.2	Fertiliser storage should be separately from the crops, pesticides	1-3	yes/no		

Item	Control Point	Prime	Complies	Remarks	Comments
4.3	Fertiliser storage should be in a suitable area e.g. dry, clean and covered	1	yes/no		
4.4	Human sewage sludge is not used on the farm	1-3	yes/no		
4.5	Organic fertilisers are not used during growth of the crop	1-2	yes/no		
5. Irrigation					
5.1	No untreated sewage water is used for irrigation	1	yes/no		
5.2	Every year a risk assessment must be made on the quality of the water sources	1	yes/no		
6. Crop protection					
6.1	Is the pesticide applied appropriate for the purpose as recommended on the label of the pesticide	1-3	yes/no		
6.2	Only officially registered pesticides can be used	1-3	yes/no		
6.3	A list of officially registered pesticides must be kept in the records	1-3	yes/no		
6.4	The farmer and/or the advisor must work on their competence and knowledge of pesticides to determine the use of pesticides	1-3	yes/no		
6.5	Records must be kept of all pesticide use	1-3	yes/no		
6.6	The operator of pesticide application must work on his/hers competence and knowledge of pesticides	1-3	yes/no		
6.7	The application of pesticide should be accurately be prepared and recorded, following the label of the pesticide	1-3	yes/no		
6.8	The pesticide use must recorded in relation to the pre-harvest interval	1-3	yes/no		
6.9	The pre-harvest interval must be observed before start of harvest	1-3	yes/no		
6.10	The application equipment must function properly and be in good condition	1-3	yes/no		
6.11	Before application the equipment must be clean	1-3	yes/no		
6.12	The surplus of pesticide should be applied over an untreated part of the crop, within the limits. Or should be applied over fallow land	1-3	yes/no		
6.13	The application of surplus pesticide must be recorded	1-3	yes/no		
6.14	The pesticide should be stored in a suitable place, which is located away from the products	1-3	yes/no		

Item	Control Point	Prime	Complies	Remarks	Comments
6.15	The pesticide storage should be dry, clean and covered. No pesticide should come in contact with water in case of leakage	1	yes/no		
6.16	A leaking pan is recommended for the storage facility	1	yes/no		
6.17	Empty cans, containers or boxes should be disposed of by returning them to the supplier or to the official waste disposal	1	yes/no		
6.18	*The waste of the crop must be handled (drowned or burned) appropriate to the GAP, because of the risk of diseases*	1-3	yes/no		
6.19	*The control of the pest was done with consideration to the appropriate attack threshold (The guide)*	1-2	yes/no		
7. Harvest					
7.1	Hygiene and maintenance procedures should be drawn up for all tools and machines involved in the harvest	1	yes/no		
7.2	Hygiene procedures should be drawn up for all personnel involved in the harvest	1	yes/no		
7.3	Personnel should have access to washing and toilet facilities	1	yes/no		
7.4	Containers or packaging material should be clean and used for vegetables only	1-2	yes/no		
7.5	All personnel, involved in the harvest, must receive instructions on the time of harvest and of handling procedures and product quality	1-2	yes/no		
8. Processing					
8.1	A risk assessment should be made for the processing of produce	1	yes/no		
8.2	A hygiene procedure should be made for all personnel involved in the processing of produce	1	yes/no		
8.3	Personnel should have access to washing and toilet facilities	1-2	yes/no		
8.4	All personnel must receive instructions on the hygiene procedures before they start working	1-2	yes/no		
8.5	Water used for processing vegetables must be of drinking water quality	1-2	yes/no		
8.6	All use of pesticides or chemicals after harvest must be recorded	1-3	yes/no		
8.7	All pesticides or chemicals used after harvesting must be suitable for this purpose	1-3	yes/no		
8.8	Facilities for produce handling (buildings and equipment) should be kept clean	1-2	yes/no		

Item	Control Point	Prime	Complies	Remarks	Comments
8.9	Facilities should allow or have sufficient drainage	1-2	yes/no		
8.10	A cleaning plan should be drawn up for all processing facilities	1-2	yes/no		
8.11	Rejected produce and waste materials should be stored in designated areas, and be disposed of frequently	1-2	yes/no		
8.12	Lamps and thermometers in processing and storage facilities should be covered to prevent broken glass in produce	1	yes/no		
8.13	A procedure must be drawn up in case of glass, chemicals, pesticides or any other non produce substance coming into contact with the product	1	yes/no		
8.14	No animals are allowed in the processing or storage facilities	1-2	yes/no		
8.15	Hygiene and maintenance procedures should be drawn up for all tools and machinery involved in the processing	2	yes/no		
8.16	*The packaging of the product must be clean and washed in accordance with the contents*	1-2	yes/no		
9. Transport					
9.1	Transport of produce should be recorded. Which transporters, product, amount, destination	1-2	yes/no		
9.2	Trucks or vans must be clean before loading produce	1-2	yes/no		
9.3	The product should be in crates to prevent damaging or if in net bags not piled too high, with regard to product quality	1-2	yes/no		

Prime 1 - HACCP/EUREP-GAP requirements
Prime 2 - Compliant with Good Agricultural Practices (GAP) and Good record keeping of GAP
Prime 3 - Compliant with Good Pesticide Practices (GPP) and good record keeping for proper usage of pesticides

Appendix 2. Examples of registration form for the Hortin-GAP system

Inventory List Fertiliser

Date	In / out	Name/type fertiliser	Quantity
15-2	in	12-10-18 fertiliser	150 kg
20-2	in	0-0-28 fertiliser	200 kg
16-5	out	12-10-18 fertiliser	50 kg

Inventory List Pesticides

Date	In / out	Admission number (see package)	Name	Quantity
15-2	in	6483	Roundup	15 ltr
20-2	in	12236	Pirimicarb	10 ltr
16-5	out	6483	Roundup	5 ltr

Field registration form		
Name : Address : Place : Tel.nr. : E-mail :	Cert.Inst. : Cert.nr. : Crop : Variety : Own field nr. : Total size. : ha	Applier: 1. 2. 3.
Data on planting material: size: ___/___ quantity: kg/ha or number of seeds/ha		

Supply of organic manure and/or compost etc.	If content known then fill in						Method of applying/equipment
Date:	Type of manure	Ton/ha	kg-N/ton	kg-P_2O_5/ton	kg-K_2O/ton	Applier	1.
							2.
							3.
							4.
Supply fertiliser	If content known then fill in						5.
Date:	Type of fertiliser	Kg / ha	%- N	%- P	%- K	Applier	6.
							7.
							7.
							9.
							10.

Use of pesticide								
Date:	Admission number (see packaging)	Name pesticide / active substances	Dosage per ha	Treated surface (ha)	Reason of application	First possible harvest date	Applier	Method

Use of pesticide		continuation						
Date:	Admission number	Name pesticide / active substances	Dosage per ha	Treated surface. (ha)	Reason of application	First possible harvest date	Applier	Method

Irrigation					
Date:	Water source	Water quality	Quantity (ltr./ha)	Duration of irrigation	Remarks

Harvest date*:	Harvested surface (ha)	Yield * (ton / ha)	Own plot description or remarks

Chemical treatment during sorting/grading/storage: (with too few lines continue on the reverse side)						
			Dosage			
Date:	Admission number	Name pesticide / active substances	per ton	total	Applier	Method /equipment

Purchase list 2004

Date	Product	Type	Vendor	Quality	Quantity	Price
12-04	White cabbage plants	Eton	Jongeneel	Certified	50.000 pieces	(0.03) EUR 1500.-
5-02	Fertiliser	NPK 12-10-18	AgrarUnie	Unknown	250 kg	(0.50) EUR 125.-
6-02	Organic manure	Chicken manure	Spijkeren	Unknown	500 kg	(0.50) EUR 250.-
12-02	Pesticide	Deltamethrin(25)	FytoPro	Unknown	10 ltr	(37.43) EUR 374.30
24-02	Seed Potatoes	Agria	PotatoCo	SE	2700 kg	(0.25) EUR 675.-
	Pesticide	Pirimicarb (50%)				

Sales list 2004

Date	Product	Quality	Quantity	Price	Buyer	Comments	Transporter	Destination
01-01	Tomatoes	Class A	500 kg	EUR 1.- p/kg	Walhi	Sold with help of IVEGRI	Jan Moeijes	Carrefour
20-01	White cabbage	xx	250 kg	EUR 0.12 p/kg	Jansen	Sold with help of PPO	Piet Mozes	Packer A.

Appendix 3. Audit documents

Audit report Hortin-GAP

Write down all findings and impressions on how well, or not, the farmer is doing with the implementation and use of the Hortin-GAP checklist and documents

Date:	
Company:	
Auditor:	
General impression:	
Comments per item:	
Item	Remark
1	
2	
3	

4	
5	
6	
7	
8	
9	
Other remarks:	

Audit plan matrix Hortin-GAP

Item	Name	Audit	1	2	3
1	Traceability and record keeping		X	X	X
2	Planning, soil and site management		X		
3	Varieties and rootstock		X		
4	Fertiliser		X	X	X
5	Irrigation		X	X	X
6	Crop protection		X	X	X
7	Harvest			X	
8	Processing				X
9	Transport				X
	Non-comformities		X	X	X

Appendix 4. Cross-reference matrixes

Cross-reference matrix for Hazard Analysis Table and Hortin-GAP

Hazard analysis table

Process		Potential risk	Seriousness	Frequency	Risk category	GAP-element
General						
Product						
	1	Insects in crop	Low	Average	2 (Q)	7.5
	2	Rotten crop	Low	Low	1 (Q)	7.5
Building						
	3	Contamination with poisoned or unwanted materials in the storage (C, P)	Average	Low	2 (C,P)	4.2 + 4.3 + 7.4 + 6.14
	4	Glass in produce by broken lights (P)	High	Low	3 (P)	8.12
	5	Broken thermometer (C,P)	High	Low	3 (C,P)	8.12
	6	Contamination by condensation on ceiling (M)	Average	Low	2 (M)	8.8
Employees						
	7	Bad hygiene of personnel. hair, food remains, dirty clothing (M,P)	Average	Low	2 (M,P)	7.2 + 7.3 + 8.2 + 8.3 + 8.4
	8	Transfer of contagious diseases by personnel (M)	High	Average	4 (C,P)	7.2 + 7.3 + 8.2 + 8.3 + 8.4 + 8.14
	9	Infection or contamination by wound on hands	High	Low	3 (CP)	7.2 + 7.3 + 8.2 + 8.3 + 8.4 + 8.14
Machinery						
	10	Contamination by bad hygiene of machinery	Average	Low	2 (C,P)	7.1 + 8.15
	11	Contamination by damage crop through bad maintenance (M, Q)	Average	Low	2 (M,Q)	7.1 + 8.15
	12	Leakage of grease/oil on crop (C)	High	Low	3 (C)	7.1 + 8.15
	13	Leakage of the cooling system (C)	High	Low	3 (C,P)	7.1 + 8.15

Process		Potential risk	Seriousness	Frequency	Risk category	GAP-element
Pesticide						
	14	Pesticide from storage come in contact with crops (C)	Average	Low	2 (C, Q)	6.14 + 6.15 + 6.16 + 6.17
	15	Fertiliser or manure come in contact with crop (C)	Average	Low	2 (C, Q)	4.3
	16	Manure come in contact with crop (M)	Average	Low	2 (M)	
	17	Using calendar system of pesticide application (C)	High	High (Every two days)	4 (C, Q)	6.1 + 6.4 + 6.5 + 6.6 + 6.7 + 6.8 + 6.9
Process						
Growth plan						
	18	Rent of poisoned land (C)	High	Low	3 (C)	2.1
	19	Growing crop on decontaminated land, risk of residue of pesticide (C)	Low	Low	1 (C, Q)	2.1
Cultivation						
	20	Leakage of field sprayer (C)	Average	Low	2 (C, Q)	6.10
	21	Improper nozzle (P)	Average	Low	2 (C, Q)	6.10
	22	Organic manure on plants (M)	High	Low	3 (M)	4.5
	23	Bad irrigation water quality (C, M)	High	High	4 (C, M)	5.1 + 5.2
	24	Use of wrong pesticides	High	Average	4 (C)	6.1 + 6.4 + 6.6 + 6.7
Harvest						
	25	Time of harvest (pesticide)	High	Average	4 (C)	6.8 + 6.9
	26	Contamination by rough handling	Low	Low	1 (Q, P)	7.5
Processing						
	27	Contamination by diseases	Average	Low	2 (M,Q)	8.2 + 8.3 + 8.4
	28	Contamination by organism	Average	Average	3 (M, Q)	8.1 + 8.5 + 8.8
	29	Dirty packaging material (C,M,P,Q)	High	Low	3 (C,P,Q)	7.4
	30	Contamination by damaged packaging material	Average	Low	2 (P,Q)	7.4
Transportation						
	31	Contamination during transportation	High	Low	3 (Q,P)	9.2
	32	Overload	Average	Low	2 (Q,P)	9.3

Cross reference matrix for Hortin-GAP and Eurep-GAP (version 2004)

Item	Control Point	Prime	Eurep-GAP
1. Traceability and record keeping			
1.1	Records should be kept of what is sold to who and how much	1-3	1.1
1.2	Records must be kept of land use, pesticide use, fertiliser use and irrigation for all crops and sites	1-3	8.8.15
1.3	Records should be kept for a minimum of two years	1-3	2.1
1.4	Record should be kept for the purchase of planting material, pesticide, fertiliser and other materials.	1-3	8.8.15
1.5	*The audit or the evaluation was carried out periodically, discussed the available problem(s) and improvement(s) that must be carried out*	1-3	2.3
1.6	*The complaints are handled and corrective measures were formulated*	1-3	14.1.2
2. Planning, soil and site management			
2.1	A risk assessment should be carried out if the site has not been in agricultural use before.	1	4.1.1
2.2	A map or identification system should be drawn up for each field (site)	1-3	4.2.1
2.3	Crop rotations should be made for annual crops	1-3	4.2.3
2.4	Are cultivation techniques used that reduce the chance of soil erosion?	1-2	5.3.1
3. Varieties and rootstock			
3.1	The farmer should be aware that the right variety or good seed quality has a direct relationship with product yield and quality	1-2	3.1.1
3.2	The chosen varieties should have resistance or tolerance against common pests and diseases	1-3	3.3.1
3.3	Own nursery stock should be subjected to the same GAP principles	1-2	3.5.4
3.4	Purchase of seeds or plants should be recorded, variety, number, quality	1-2	1.1
3.5	Certified plants or seeds should be preferred	1-2	3.5.3
4. Fertiliser			
4.1	Application of fertiliser must be recorded. Type, date and quantity	1-3	6.2.1/2/3/4/5/6
4.2	Fertiliser storage should be separately from the crops, pesticides.	1-3	6.4.7
4.3	Fertiliser storage should be in a suitable area e.g. dry, clean and covered	1	6.4.8
4.4	Human sewage sludge is not used on the farm	1-3	6.5.1
4.5	Organic fertilisers are not used during growth of the crop	1-2	

Item	Control Point	Prime	Eurep-GAP
5. Irrigation			
5.1	No untreated sewage water is used for irrigation	1	7.3.1
5.2	Every year a risk assessment must be made on the quality of the water sources	1	7.3.2
6. Crop protection			
6.1	Is the pesticide applied appropriate for the purpose as recommended on the label of the pesticide	1-3	8.2.1
6.2	Only officially registered pesticides can be used	1-3	8.2.2
6.3	A list of officially registered pesticides must be kept in the records	1-3	8.2.3
6.4	The farmer and/or the advisor must work on their competence an knowledge of pesticides to determine the use of pesticides	1-3	8.2.6/7
6.5	Records must be kept of all pesticide use	1-3	8.3.1/2/3/4
6.6	The operator of pesticide application must work on his/hers competence and knowledge of pesticides	1-3	8.3.5
6.7	The application of pesticides should be accurately be prepared and recorded, following the label of the pesticide	1-3	8.3.6 / 8.5.4
6.8	Pesticides use must recorded in relation to the pre-harvest interval	1-3	8.3.10
6.9	The pre-harvest interval must be observed before start of harvest	1-3	8.4.1
6.10	The application equipment must function properly and be in good condition	1-3	8.5.1
6.11	Before application the equipment must be clean	1-3	
6.12	The surplus of pesticide should be applied over an untreated part of the crop, within the limits. Or should be applied over fallow land.	1-3	8.6.2
6.13	The application of surplus pesticide must be recorded	1-3	8.6.3
6.14	The pesticide should be stored in a suitable place, which is located away from the products.	1-3	8.8.8
6.15	The pesticide storage should be dry, clean and covered. No pesticide should come into contact with water in case of leakage.	1	8.8.2/3
6.16	A leaking pan is recommended for the storage facility	1	8.8.10
6.17	Empty cans, containers or boxes should be disposed of by returning them to the supplier or to the official waste disposal	1	8.9.1/2/3/4
6.18	*The waste of the crop must be handled (drowned or burned) appropriate to the GAP, because of the risk of diseases.*	1-3	
6.19	*The control of the pest was done with consideration to the appropriate attack threshold (The guide)*	1-2	

Item	Control Point	Prime	Eurep-GAP
7. Harvest			
7.1	Hygiene and maintenance procedures should be drawn up for all tools and machines involved in harvesting	1	9.1.3
7.2	Hygiene procedures should be drawn up for all personnel involved in harvesting	1	9.1.2
7.3	Personnel should have access to washing and toilet facilities	1	9.1.6/7
7.4	Containers or packaging material should be clean and used for vegetables only	1-2	9.2.1
7.5	All personnel, involved in the harvest, must receive instructions on the time of harvest and of handling procedures and product quality	1-2	
8. Processing			
8.1	A risk assessment should be made for the processing of produce	1	10.1.1
8.2	A hygiene procedure should be made for all personnel involved in the processing of produce	1	10.1.4/5
8.3	Personnel should have access to washing and toilet facilities	1-2	10.1.3
8.4	All personnel must receive instructions on the hygiene procedures before they start working	1-2	10.1.4/5
8.5	Water used for processing vegetables must be of drinking water quality	1-2	10.2.1
8.6	All use of pesticides or chemicals after harvest must be recorded	1-3	10.3.7
8.7	All pesticides or chemicals used after harvesting must be suitable for this purpose	1-3	10.3.1
8.8	Facilities for produce handling (buildings and equipment) should be kept clean	1-2	10.4.2
8.9	Facilities should allow or have sufficient drainage	1-2	10.4.1
8.10	A cleaning plan should be drawn up for all processing facilities	1-2	10.4.2
8.11	Rejected produce and waste materials should be stored in designated areas, and be disposed off frequently	1-2	10.4.3
8.12	Lamps and thermometers in processing and storage facilities should be covered to prevent broken glass in produce	1	10.4.6
8.13	A procedure must be drawn up in case of glass, chemicals, pesticides or any other non produce substance coming into contact with the product	1	10.4.7

Item	Control Point	Prime	Eurep-GAP
8.14	No animals are allowed in the processing or storage facilities	1-2	10.4.8
8.15	Hygiene and maintenance procedures should be drawn up for all tools and machinery involved in the processing	1	10.4.2
8.16	The packaging of the product must be clean and washed in accordance with the contents	1-2	
9. Transport			
9.1	Transport of produce should be recorded. Which transporters, product, amount, destination	1-2	
9.2	Trucks or vans must be clean before loading produce	1-2	
9.3	The product should be in crates to prevent damaging or if in net bags not piled too high, with regard to product quality	1-2	

Prime 1 - HACCP/EUREP-GAP requirements
Prime 2 - Compliant with Good Agricultural Practices (GAP) and Good record keeping of GAP
Prime 3 - Compliant with Good Pesticide Practices (GPP) and good record keeping for proper usage of pesticides

Appendix 5. Highlights from the audit reports on participating farmers in Lembang

	1	2	3	4	5	6	7	8	9
Parti-cipant	Tracing	Land use	Seed/variety	Fertiliser	Irrigation	Crop protection	Harvest/ handling	Processing/ hygiene	Sales/ transport
1	Clear	No risk analysis	Good quality; No resistance information - uncertified	Well recorded; Good & dry storage	No risk analysis; Irrigation with drinking water	Well recorded; Some cases started with bio-pesticides; Residue, no report	Clean instruments; No field toilets	No risk analysis; Good oral instruction	Recorded; No information on transportation
2	Properly recorded	No risk analysis; Land use >5 years	Good; Variety according to experience	Good recording; Storage separated; Organic fertiliser applied	No risk analysis; Source of drinking water quality	Good recording; reg.no.; Stored away from crop, product, harvest; Used containers buried	Good instruments; No toilet in the field	Good oral instruction for handling/ packaging	Sales are good; Transport unknown
3	No clear information	No risk analysis	Quality potatoes var. according to experiences	Unclear recording	No risk analysis	No information available	Good harvest; No toilet in the field	Oral instruction for handling	No clear information
4	Properly recorded; notes since January 2005	No risk analysis; No map; No clear land history	Seed germination about 90%; No information on seed resistance	Fertiliser quality good; Storage untidy & moist	Source: G. Putri, No risk analysis; Water clear (visually)	Pesticide input and output are recorded; Use pesticides with reg.no.; mancozeb and deltamethrin higher than MRL	Good techniques for harvest; No toilets in the field	Good oral instruction for packaging	Good sales
5	Incomplete documentation; Difficulties in written activities	No risk analysis; No map; No land history	Seed germination 90%; Quality by experiences	Fertilisers are good; Storage untidy	Source: not far away; Visually the water looks clean	Good understanding IPM; Recording problem; Mancozeb above MRL	Clean instruments for harvest; No toilets in the field	Good oral instruction for packaging	Good sales

	1	2	3	4	5	6	7	8	9
Parti-cipant	Tracing	Land use	Seed/variety	Fertiliser	Irrigation	Crop protection	Harvest/ handling	Processing/ hygiene	Sales/ transport
6	Proper recording	No risk analysis; No map; No land history	Good stocks for planting material; Selection materials	Fertilisers are good; Storage untidy	Water source far away; No problem during dry season	Pesticides are recorded well; input and output written down; Dosage a little high	Good harvest practice; No toilet in the field	Oral instruction for packaging	Sales are recorded
7	Clearly recorded	No risk analysis; No map; Rotation good	Yield influenced by seed quality	Good records; Storage clean and dry	Natural source for irrigation; No risk analysis for water quality	Uses according label; Registered pesticides only; Use of bio pesticides	Good handling; No pesticides on post harvest; No toilets in the field	Clean tools and building; for packaging no procedure for lamp protection	Good packaging for sales; clean transportation
8	Unclear recording; Partly documented	No risk analysis; No map; Rotation according to experience	Seed effects the yield	Fertiliser use documented; Storage combined with pesticides; Organic fertiliser use prior to planting	Natural water source; No risk analysis water quality	Pesticides use according to label; Only registered pesticides are used	Harvest automatically; No special instruction for harvest; No toilet in the field	No special building for packaging; All packaging was executed in the field and directly shipped	No record of sales; Transportation material is clean; Packaging in vehicle is good
9	Incomplete records	No risk analysis; No map	Seed quality effects yield	Fertiliser use documented; One storage of fertiliser and pesticide; Dry and clean storage	Natural water source; No risk analysis of water quality	Pesticides use according to label; Only registered pesticides are used	No toilets in the field	No building for packaging; All packaging executed in the field and directly shipped	No records on sales and transportation

	1	2	3	4	5	6	7	8	9
Parti-cipant	Tracing	Land use	Seed/variety	Fertiliser	Irrigation	Crop protection	Harvest/ handling	Processing/ hygiene	Sales/ transport
10	Proper tracing; Well recorded	No risk analysis; No map	Seed quality affects yield	One storage of fertiliser and pesticide; Dry and clean storage	Natural water resource; No risk analysis on water quality	Pesticide use according to label; Registered pesticides used only; No purchase information	No toilet in the field	No building for packaging; All packaging executed in the field and directly shipped	Sales directly to trader; No information on transportation
11	Clear documentation	No risk analysis; No map	Seed quality affects yield	Use and storage according to GAP	Natural water resource; No risk analysis on water quality	Pesticides use according to label; Registered pesticides used only; Imidacloprid above MRL	Clean tools; No toilet in the field	No instructions on handling; but good practice	Good sales; Transport provided by trader
12	Documentation on laptop	No risk analysis; No map; Planting on 30-60° land position	Tuber seed quality affected yield; records require improvement	Good records fertiliser use; Storage separate from pesticides	Natural water source; No risk analysis on water quality	Pesticides use according to label; Imidacloprid above MRL	Handling in order, but not written down; No toilets in the field	Packaging and handling good, but not written down	Packaging and transportation looks tidy
13	Incomplete information					Mancozeb above MRL			
14	Incomplete information					Deltamethrin above MRL			