Food System Transformation in Indonesia: Factors Influencing Demand and Supply for Alternative Pest Management Farming Systems

by

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Contents

List of Tables

List of Figures

Abbreviations

ACIAR	Australian Centre for International Agricultural Research
AIC	Akaike Information Criteria
ANOVA	Analysis of Variance
APM	Alternative Pest Management
BIC	Bayesian Information Criteria
BMPs	Best Management Practices
BSE	Bovine Spongiform Encephalopathy
BW	Best Worst
BWS	Best Worst Scaling
COOL	Country of Origin Labelling
FFS	Farmer Field School
GAP	Good Agriculture Practices
GDP	Growth Domestic Products
GM	Genetic Modified
GMO	Genetic Modified Organism
HAACP	Hazard Analytical by Critical Control Point
HGV	Hydroponically Grown Vegetables
HPAI	Highly Pathogenic Avian Influenza
HS	Household Size
HSD	Honest Significance Difference
ICASEPS	Indonesian Center for Agricultural Socio Economic and Policy Studies
IFPRI	International Food Policy Research Institute
IMR	Inverse Mill's Ratio
IPM	Integrated Pest Management
IPM-FFS	Integrated Pest Management – Farmer Field School

LC	Latent Class
LR	Log-likelihood Ratio
NOP	National Organic Program
NRM	Natural Resource Management
OLS	Ordinary Least Squares
PATANAS	Panel Tani Nasional (National Farmers Panel Survey)
PSM	Propensity Score Matching
RT	Rukun Tetangga
RW	Rukun Warga
SA	Sustainable Agriculture
SAP	Sustainable Agriculture Practices
SD	Standard Deviation
SPF	Stochastic Production Frontier
TE	Technical Efficiency
TPC	Third Party Certification
UK	United Kingdom
US	United States
USDA	United States Department of Agriculture
WTP	Willingness To Pay

Abstract

In Indonesia, demand is growing for food with additional food safety and quality assurances, termed credence attributes. Indonesian food retailers are selling fresh fruits and vegetables labelled as organic and pesticide-free. Some of these claims are underpinned by retailer-mandated food standards, which include specific farming systems that can be verified and certified. If these private sector standards are set too high, smallholders may be excluded from food markets. Additionally, if claims are not certified by a reputable third-party then information asymmetry is an issue.

Little is known about the types of food certifications and claims most valued by Indonesian consumers. Chapter 2 addressed the gap in the literature on demand for credence attributes in Indonesia through analysis of data collected as part of a food consumption study of 1180 urban Indonesian households. In the study, consumers indicated their willingness-to-pay (WTP) for three certified food products. Consumers were on average, willing to pay 17 to 19 per cent more for certified organic horticultural products (chillies and mangoes). WTP data was analysed using a Cragg double-hurdle model. The empirical results suggest the target market for certified organic food products in Indonesia is higher educated females who live in higher incomes households and frequently shop in modern food retail outlets (supermarkets).

Higher food quality and safety requirements are likely to be a challenge for smallholder farmers in Indonesia. Thus, Chapters 3 to 5 provide insights on what can be done to create an “enabling environment” for smallholders. The analysis of survey data from 687 shallot-producing households (Chapter 3) found that conventional farmers are less educated, have fewer production and household

assets, have limited access to modern technology such as computers and the Internet, are more risk averse, and are less likely to join a farmers group. The prevailing attitude towards farmers groups lowers the probability that conventional farmers are exposed to new technologies. Shallot farmers adopting Alternative Pest Management (APM) practices made significant changes to production activities, in particular they used less chemical inputs.

The results of a Best-Worst Scaling analysis (Chapter 4) suggest that the most important attributes for the average Indonesian shallot farmer when considering a new crop or non-conventional farming system are related to relative economic advantage. A Latent Class Analysis identified three segments of producers with unique preferences for technology attributes. Clusters were characterised post-hoc using farmer and farm household characteristics, adoption behaviour, access to credit, participation in farmer groups and sources of production information. Unfortunately the analysis did not lead to a clear story on why preferences for technology attributes differed.

Finally, in Chapter 5, Stochastic Production Frontier (SPF) analysis found that conventional methods of producing shallots resulted in higher productivity compared to APM methods, with significant differences in the productivity of land, chemical pesticides, insect traps and labour. However, the yield loss associated with APM shallot farming systems was only than 1.5 per cent lower. Ultimately, the findings of the study suggest that training programs for smallholders on how to implement APM farming practices will result in improved yields for adopters.

Declaration

I, Wahida, certify that this work contains no material which has been accepted for the award of any other degree or diploma in my name, in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. In addition, I certify that no part of this work will, in the future, be used in a submission in my name, for any other degree or diploma in any university or other tertiary institution without the prior approval of the University of Adelaide and where applicable, any partner institution responsible for the joint-award of this degree.

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North Terrace Campus, 15 July 2015

Wahida

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1 Chapter One: Introduction

1.1 Background and Motivation

As in other Southeastern Asian countries, Indonesia food systems are undergoing significant transformation. Indonesian consumers' diets have been changing as a result of rising disposable household incomes, urbanisation, increasing numbers of women in labour force and globalisation (Reardon et al. 2014; Umberger et al. 2015; World Bank 2007 and 2013). Indonesians are now consuming more diverse diets than they did a decade ago, including new varieties of fruits and vegetables, more and different types of protein, and increasingly processed and convenience foods (Reardon and Timmer 2014). Additionally, as a result of increasing disposable incomes, media attention and several food safety scares, anecdotal evidence suggests that demand for food with additional food safety and quality assurances, termed credence attributes, is growing in Indonesia.

Several studies in the South-East Asian region report evidence of demand for fresh food products with credence attributes, particularly attributes that are perceived to address concerns about pesticide residues and other food safety concerns. These studies highlight the significant interest among urban consumers to pay higher prices for products labelled as pesticide free in Thailand (Posri, Shankar and Chadbunchachai 2006), organic in Malaysia (Ahmad and Juhdi 2010), and safe produce in Vietnam (Mergenthaler, Weinberger and Qaim 2009).

The dramatic changes occurring in food retailing and food consumption are interrelated; and these changes are perhaps, most notable as they impact the other sectors of the food system, particularly agricultural producers (Pingali 2007; Reardon et al. 2003; Reardon and Timmer 2014). Changes in consumption patterns towards higher value agricultural and food products are associated with a need for more organized retail sectors, which leads to opportunities for foreign direct investment in food retailing by “modern” multi-national food retailers (supermarkets).

In Indonesia, significant modern retail market growth intensified beginning in 1998 after the country began to recover from the monetary crisis, and as a result of the Indonesian government signing an agreement with the International Monetary Fund which allowed foreign direct investment in food wholesaling and retailing (World Bank, 2007). In the ten years from 1999 to 2009, Dyck, Woolverton and Rangkuti (2012) estimated that the number of supermarkets grew by 67 per cent and the number of hypermarkets increased by a factor of seven. Over this time period, household share of food expenditures at supermarkets and hypermarkets on just packaged and processed food grew from about 20 per cent to 30 per cent (Dyck, Wolverton and Rangkuti 2012). On average, supermarket sales are estimated to be growing at an average rate of 15 per cent per year in Indonesia (Dyck, Woolverton and Rangkuti 2012; Suryadarma et al. 2010).

Penetration of supermarkets has been shown to lead to changes in marketing structures that involve farmers, traders, wholesalers, retailers and distribution centres. For example, wholesalers become more specialized and procurement of food from farm-to-table tends to become more formalised as summarised by McCullough, Pingali and Stamoulis (2008). For example, in response to the emerging demand in Indonesia for fresh food products with higher safety and quality attributes, both modern-food retail markets and wet markets are now selling fresh fruits and vegetables labelled with credence attributes such as organic and pesticide free. Some of the claims are underpinned by a specific farming system and standards that can be verified and certified. Farmers who sell produce to these retailers must be able to prove that they have followed the protocols related to the claims. There are other claims that are likely to not be based on standards; rather they are “self-claimed”.

As Reardon et al. (2009) suggested, the role of the private sector in governance of food systems, particularly, modern-food retailers are becoming increasingly important. Retailers often develop private standards when there is little public governance of food systems. Independent third-parties may be used to verify that producer, processors and others involved in supplying retailer with products adhere to the standards. However, there are concerns about the conditions and role of the private versus the public sector in the governance and setting of strict standards for credence attributes in food. There are concerns that if the standards are set too high, smallholder farmers may be excluded from food systems (McCullough, Pingali and Stamoulis 2008; Maruyama and Trung (2007).

Although, third-party certification systems for verifying these production methods for fresh fruits and vegetables are increasingly being imposed on food supply chains by modern retailers, little is currently known about what type of food certifications and claims are most valued by Indonesian consumers. Furthermore there is no known research that sheds light on what entity Indonesian consumers would most trust to verify claims. This information is needed to develop domestic food policy for production and process-related food claims.

Thus this thesis aims to address this gap in literature on demand for credence attributes related to food safety and food quality in Indonesia by presenting empirical research that will increase the level of understanding regarding Indonesian consumers’ concerns about food safety and food quality issues and their willingness-to-pay for food products guarantying higher quality or providing additional safety assurances and how this relates to the rapid development of modern food retail markets.

Considering the production or supply side of food system transformation, Pingali (2007) explained that higher food quality and safety requirements are likely to be a challenge for smallholder farmers in Indonesia. The new market demand conditions may force smallholders to transform their production systems to maintain a market for their products. Smallholder farmers may have to make an adoption decision regarding whether they will change their farming systems from conventional methods, which often involve the use of a substantial amount of chemical inputs to using no chemicals or fewer chemical inputs.

Pingali (2007) suggested that it is important to create an enabling environment for smallholder transformation through initiatives that will introduce smallholders to new technologies. Part of creating this enabling environment is an understanding of what incentives motivate producers to adopt new production technologies or farming systems which can help increase food quality and safety (Shepherd and Schalke1995). This PhD research provides insights on what can be done to create an “enabling environment” and whether smallholder producers in Indonesia require different incentives for adoption of alternative farming systems. There are concerns that the yield produced from alternative farming systems such as “organic” or “pesticide-free” is lower than conventional farming systems (Sipiläinen and Oude Lansink 2005). If these systems are less efficient, then it is not surprising that farmers are reluctant to adopt them. This is a particular concern for shallot farmers in Indonesia, as shallots are known to be one of the crops sprayed most heavily with pesticides (Shephard et al. 2009).

1.2 Research Questions

In order to understand the impact of the transition in food systems in Indonesia outlined above, this thesis addresses the following research questions:

1) What are the determinants that help explain demand for certified organic high-value agricultural products?
2) Are there any differences in characteristics between adopters and conventional farmers in terms of socio-demographic, production and marketing decision in shallot industry?
3) What factors determine shallot farmers' preferences towards technology attributes in relation to the adoption of non-conventional farming practices?
4) Are Alternative Pest Management farming systems adopted by shallot farmers in Indonesia less efficient than conventional farming systems?

Thus, this thesis aims to contribute to the scholarly literature by expanding the understanding of the impact of the transition both the demand and supply side of the market, especially in the context of high-value agricultural commodities in Indonesia. The analysis that is presented in this thesis was developed based on empirical studies that focussed on both consumers and producers. Certified organic and pesticide-free high value agricultural commodities were selected as the focus of analysis in the consumer study, while the producer study focussed analysis on non-conventional technology adoption by smallholder shallot growers.

This thesis illustrates and analyses both demand and supply aspects of the market for specific types high value agricultural products: organic and low pesticide or pesticide-free. To be able to produce these types of products, most conventional farmers would need to change their farming systems and adopt an alternative farming system which require the use of less chemicals such as pesticides and herbicides. Products from these farming systems are similar to those that are sometimes marketed, through labels and/or certified with credence attributes such as “organic” or “pesticide-free”.

Two major studies form the basis of this project. Study 1, presented in Chapter 2, discusses demand for food safety and quality certifications from the perspectives of urban Indonesian consumers. The analysis in Study 1 analyses data from a survey of 1180 urban Indonesian households. On the other hand, Study 2, analyses data from a survey of 687 smallholder farming households which specialise in producing shallots. Study 2 is presented in Chapters 3 to 5 and explores issues related to adoption of non-conventional farming systems, which incorporate some type of alternative pest-management (APM) method or system.

1.3 The Structure of Thesis

The following paragraphs summarise the main outline and aims of the remaining chapters of this thesis.

Chapter 2 explores the determinant factors that drive urban Indonesian consumers’ demand for certified organic products. The chapter provides an overview of the relevant literature on consumer willingness-to-pay for credence attributes in food, particularly those attributes which signal organic or low-to-no pesticide farming systems. In this chapter the factors which influence consumers’ participation in the certified organic food market and the maximum amount consumers are willing to pay for certified organic food products are examined. A double-hurdle or Cragg model is used to overcome zero consumption observations that tend to appear as a problem when measuring the effects of socio-demographic and attitudinal variables on consumer expenditure decisions. Moreover, this chapter also provides information regarding urban consumers' perceptions and knowledge of organic and pesticide-free farming systems as well as their preferences for governance of such systems.

Chapter 3 shifts the focus from the consumer to the producer. This chapter provides a detailed overview of the methods used to obtain the sample of shallot farmers. It also sets the stage for Chapters 4 and 5 by summarising and highlighting differences in characteristics of smallholder shallots farmers who are determined to be adopters of alternative pest management farming systems compared to conventional shallot farmers. These characteristics include: socio demographic (farmer and farm household), land use and production, marketing information, marketing practices and perceptions towards modern marketing channels.

Chapter 4 provides insight on shallot farmers' preferences for technology attributes, specifically crop and non-conventional farming system attributes. A short summary of the seminal and most relevant technology adoption literature is provided. The Best-Worst scaling (BWS) experiment and methods used to elicit farmers' preferences for attributes are explained. The Latent Class cluster analysis and post-hoc characterisation used to analyse the data from the BWS are discussed. Finally, data from the BWS experiment is analysed to empirically determine: 1) the aggregate or average importance shallot farmers placed on 11 attributes; 2) whether or not shallot farmers are heterogeneous in their preferences for technology attributes and 3) if preferences are heterogeneous then are their farmer and farm household variables which are useful in characterising different clusters or segments of farmers.

Chapter 5 measures and quantifies the yield loss that is associated with farmers' decisions to adopt the alternative pest management technology. Propensity score matching is used to overcome the self-selection bias that appeared during sampling selection and data collection. After the matching process, the empirical analysis in this chapter estimates the productivity and technical inefficiency from both adopters and matched-conventional shallot farmers using a Stochastic Production Frontier approach. The results from this estimation are used to quantify the yield loss that was caused as a result of the technology adoption process.

The final chapter of the thesis, **Chapter 6**, presents the main findings and implications of this research project as a whole. The chapter provides a short summary of the main findings of Chapters 2 through 5. Implications of the findings are discussed and recommendations are offered for policy makers and future research on these topics.

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2 Chapter Two: Exploring Indonesian Consumers’ Demand for Certified Organic Agricultural Products

2.1 Introduction

Since the late 1980s, global demand for food products has been characterised by increasing requirements for safety and quality assurances. This has been triggered by several factors, including a variety of food scares, with two of the key crises being the outbreaks of bovine spongiform encephalopathy (BSE)[1] or 'mad cow disease' in 1987, and more recently by highly pathogenic avian influenza, known as HPAI[2] or 'bird flu'. Other factors include criticism by consumers of various aspects of the production processes of food at both farm and processing levels, such as the use of genetically modified organisms (GMOs), pesticides, antibiotics and growth promoting hormones, as well as concerns over the impacts of these processes on human and animal welfare and on the environment. In order to address these consumer concerns, a number of quality assurance and certification schemes as well as food standards and food labelling programmes have been introduced by public, private and non-government organisations in many countries.

Many studies have explored the factors motivating consumer demand for those food safety and quality attributes that are affected by production and processing steps. This is because these types of attributes, termed *credence* attributes, are unique in that consumers cannot determine whether the attribute is present when they purchase or consume a product. As a result, labels, standards,

[1] BSE is a fatal disease affecting cows causing degeneration of the spinal cord and brain. The disease can be passed to humans causing a new variant, Creutzfeldt-Jakob Disease (vCJD). BSE was identified in the UK in the late 1980s and CJD in humans in 1996. The BSE outbreak across the UK in the late 1980s and early 1990s resulted in a large-scale cull of cattle and serious beef trade restrictions. BSE has affected other countries to a lesser degree. Controls have been introduced in many countries to stop the spread of BSE.

[2] Bird flu or avian influenza is the strain of the H5N1 virus that makes the transition from birds to humans. It has killed millions of poultry across Asia, Europe and Africa. The fear is that it will eventually cause an epidemic in humans. There was an outbreak focused in Asia in the late 2000s and into the early 2010s and it remains a threat.

certification and traceability systems may be required to credibly verify and signal the existence of the attribute.

As early as 1973, Darby and Karni (1973) found that credence attributes tended to be incorporated into the branding and labelling of a product, yet since there was no way to enforce the verification of such tools, in some cases this could result in fraud, that is, in consumers paying more for attributes which were in fact not present or were at least misrepresented. These authors illustrated this condition by identifying the factors determining the provision of automobile repair services. In doing this, they found that branding and client relationship appear to be appropriate tools to monitor credence attributes. Here, the client relationship itself determined an implicit understanding that customers would return for future automobile services as long as they did not detect any fraud or low quality of services.

More recently, Loureiro and Umberger (2007) used data from a US household survey in a consumer choice experiment about buying beef. In the survey they found that food safety inspection was selected as the most important attribute, followed by the country of origin, then traceability or tenderness factors. In agri-food systems, Hatanaka, Bain and Busch (2005) found that third party certification (TPC) was emerging as an influential mechanism for monitoring and enforcing standards for both food safety and quality.

TPC is able to assist suppliers to remain in their existing markets, as well as to help some producers enter the niche market for non-conventional products and to build trust between actors by providing independent assurances about a commodity and its production process. Furthermore, consumers may believe labels and claims by retailers relating to the production and process-related credence attributes in food, including whether they are organic, pesticide-free or environmentally friendly, thereby implying higher levels of food safety or quality. In actuality, however, these claims may not always be entirely valid. The degree of safety or quality depends on a variety of factors, including the specific system used to produce the food as well as the traceability and certification program (or lack thereof) used to verify the claim.

As a result of all these issues, there has been a substantial amount of debate in the literature regarding whether public or private governance is required to verify credence attributes in global food systems. Ultimately the level of governance required depends on a country's food policy paradigm, whether or not a market failure exists and the relative costs and benefits of implementing public versus private standards and related certification and labelling systems. Further, evaluation of standards and certification systems requires an understanding of a variety of factors to determine the actual value consumers place on these attributes: first, why consumers value the attributes and what they perceive the attributes to mean; how value and determinants of value differ across the segments of the market, and; who consumers trust to verify the attributes.

These issues are of immediate concern in Indonesia, as in many South-East Asian countries, where food systems are being transformed as a result of modern food retail development and the penetration of multinational retailers, as well as rising disposable incomes and food safety concerns. However, although the marketing of organic and pesticide-free food products is growing in Indonesia, there is currently very little government oversight of these programs and many of the products are marketed with attributes which are 'self-claimed', that is, the producers/suppliers state that the products have certain attributes, but these claims are not backed up by TPC. Many are calling for increased government and/or independent third-party involvement in the food system to ensure that organic and other credence-related food claims are legitimate.

In order to assess the need for this kind of intervention, it is important to understand consumers' values and their current understanding of these attributes with respect to food. To address this issue, this study investigated consumers', perceptions and demand for food products marketed as 'certified organic' using data from an urban consumer survey conducted from November 2010 to January 2011 in Indonesia. The focus was on the 'organic' attribute because it is one of the most commonly marketed credence attributes seen in food markets in Indonesia.

Potential demand for certified organic food products was quantified using respondents' stated willingness-to-pay (WTP) for certified organic fruits (mangoes) and vegetables (chillies), and chicken. The study explored the demand for three different types of food products because the motivation for buying organic food may vary depending on consumers' perceptions of the quality and safety risks associated with each product, and some of these will be specific to each product. Looking at three different products gives a more balanced view of the patterns of impacts on consumer preferences for quality and safety attributes, more accurately than focusing on just one product type only.

In emerging economies in South-East Asia, including Indonesia, Malaysia, Thailand and Vietnam, it has become more and more common for food products to be marketed with credence attributes such as 'safe', 'clean', 'pesticide-free' and 'organic'. In particular, in Malaysia, Thailand and Vietnam, this growth has been related to the penetration of supermarkets (Mergenthaler, Weinberger and

Qaim 2009; Tandon, Woolverton and Landes 2011), as well as to environmental concerns (Ahmad and Juhdi 2010) and in some cases to governments attempting to address consumer concerns resulting from reports of high amounts of pesticide and chemical residue found in fresh produce (Posri, Shankar and Chadbunchachai 2006).

Anecdotal evidence suggests that similar concerns exist in Indonesia in terms of credence attributes for higher assurances on food safety and quality. However, no known research has explored consumer demand or WTP for these attributes in Indonesia. This is surprising, considering that Indonesia is facing conditions that are typical of many of the fast-growing emerging Asian economies (Asian Development Bank 2012) regarding population, income growth, resulting impacts on consumer demand, and so on. For example, Indonesia has experienced a substantial increase in the size of its middle class. In 2003 the middle class was only 37.7 per cent of the population, while by 2010 the percentage had increased to 56 per cent or 134 million people (The World Bank 2012). Thus, as other emerging Asian economies, Indonesia is experiencing developments which are leading to increased demand for food products with quality and safety assurances, especially globalisation, urbanisation, rising living standards, and, very significantly, a massive penetration of modern food retail markets (Mergenthaler, Weinberger and Qaim 2009; Pingali 2007).

The objective of this study, then, was to investigate Indonesian urban consumers' understandings, perceptions and demand for food products with credence attributes, specifically for certified organic agricultural products. A Cragg (double-hurdle) model (discussed in detail below) was used to estimate consumers' WTP for certified products and to provide a better understanding of the drivers of demand for certified organic chicken, chilli and mango products among Indonesian consumers. This understanding was achieved by estimating the effects of the socio-demographic and attitudinal variables of urban consumers in relation to these agricultural products, which, in Indonesia, are considered to be high-value commodities. The double-hurdle model estimates two hurdles: consumer willingness to purchase certified organic products and the maximum premium that those consumers would be willing to pay for them.

This study adds to the literature in that it is the only known study to address the value that Indonesian consumers place on certified organic products and determinants of value including attitudinal variables (for example, variables created from factor analysis of consumer responses to nutrition and food safety beliefs and concerns). Furthermore, it explored consumers' WTP for three different food products to determine if premiums differ across food products, which may present various levels of food safety risk. Finally the study aimed to provide policy guidance by assessing consumers' awareness of food standards and labelling, by increasing knowledge of the meaning of the term 'certified organic' and informing the debate about the preferred entity to oversee organic certification and standards.

Understanding the characteristics of consumers who are willing to pay a premium for this specific credence attribute can guide policymakers and firms in the food industry to target the audience of their campaigns and to work towards the general acceptance and understanding of labelling and certification for certified organic products. This process is very important in this context since many Indonesian consumers may not be able to distinguish between self-claimed brands and verifiable certification for the organic products that they consume.

Meanwhile, for producers, the information contained in this study may help them to meet the accelerating demand by adopting new farming systems and post-harvest handling and marketing strategies, in order to keep their share in the organic market.

2.2 Literature Review

2.2.1 Consumers' Understanding, Perceptions and Willingness to Pay for Organic Food Products

Many studies have explored consumer motivation in purchasing organic products. Hughner et al. (2007) conducted a comprehensive literature review and used nine 'themes' to summarise consumers' motives for purchasing organic food products. These themes include concerns or beliefs related to a variety of issues: 1) health or nutrition; 2) taste; 3) environment; 4) food safety; 5) animal welfare; 6) state of the local economy; 7) wholesomeness; 8) nostalgia; and 9) 'fashionableness' and curiosity.

Moser, Raffaeli and Thilmany-McFadden (2011) investigated relevant attributes that influence consumer buying behaviour for organic and low impact environmental production systems (such as Integrated Pest Management) for fresh fruit and vegetable products. They summarised the level of importance (ranging from strongly determinant to not investigated) of various attributes across 40 different studies. These studies were conducted in three different regions, namely the United States (US), Europe (plus some countries of the Middle East), and the Eastern Asia/Pacific Rim including China and Thailand. The authors emphasised that, from the consumer perspective, the key important attributes differed across regions. For example, US consumers generally preferred pesticide-free rather than organic products, while for the European consumers' health and experience features were the strongest attributes. In the East Asia/Pacific Rim region, there was a paucity of work done looking at certification, food origin and brand relating to food product attributes. Significantly, developing countries with broader food security issues seemed to be more concerned about the issue of food security (such as guarantees of sufficient quantity and access to food) as well as dietary needs, rather than about credence attributes.

There are a number of positive motives which have been associated with the purchase of organic products, such as harmony with the universe, a sustainable future, or simply as a broad range of ecology concerns Grunert and Juhl (1995) such as the following: often related to an alternative lifestyle such as environmentalism or vegetarianism (Cicia and Giudice 2002); environmental concern and animal rights issues (Honkanen, Verplanken and Olsen 2006), and; self-responsibility for health (that is, well-being, healthiness and a long life) (Magnusson et al. 2003; Makatouni 2002). Furthermore, Hughner et al. (2007) extended their literature review by also listing the obstacles to consumers purchasing certified organic products. Those barriers are high price premiums, lack of availability (in relation to continuity of supply in the long run), consumer scepticism about certification boards and organic labels, insufficient marketing (such as ineffective retailing, including the paucity and ineffectiveness of organic food promotion), satisfaction with current food sources, and cosmetic defects such as blemishes or the imperfect appearance of the products.

The massive expansion of the modern food retail market in developing countries has increased the importance of food safety and quality standards for fresh food products from the production side (on-farm) to the display shelf in the supermarket. In response to the growing market demand for this higher quality and safety, various products with credence attributes (labelled or non-labelled) have been introduced in developing countries. These products are known as credence goods. However, in many cases information about these products is asymmetric (Giannakas 2002) and studies have emphasised different aspects of the impacts of retail systems. Caswell and Mojduszka (1996) declared that the existence of quality signals is a key indicator to determine whether the market for higher quality products is working efficiently. In modern food retailers the guarantee of food safety and quality are often signalled to consumers through food labelling or a standardisation system. Reardon et al. (2009) found that the role of the modern retail market in developing a private standard as a guarantee system for credence products is very important in countries with a near absence of standardisation conditions. Private standards are developed in response to the absence of a prevailing role by public standards in monitoring food safety and quality issues. An earlier study by Berdegué et al. (2005) supported these findings by highlighting the role of private standards in relation to credence attributes. For example, leading supermarkets in Central America have imposed private standards for leafy greens and some fruit in order to reduce cost and to be able to compete with wet markets in leading chain procurement systems (Berdegué et al. 2005).

With respect to South-East Asia, a review of the literature shows that this demand for credence attributes in fresh food products has been expanding since the early 2000s from a relatively low base. Although demand is in the early stages of growth, information regarding the call for these specific attributes is very important, in particular to facilitate an appropriate change in the food system which is consumer-driven, and in the marketing system which plays an important role as the transmitter of consumers' expectations to the farmers. Unfortunately, at this moment there have only been a few farmers who have been able to participate in these new demand systems (Timmer 2009).

Several studies in Asian developing countries have reported evidence of these new demands. For example, an intensive pesticide application has played an important role in the success of the agricultural sector in Thailand. Among agricultural products, vegetables have been the commodities which have been most heavily sprayed with pesticides. Here, in response to concerns about farmers' health, pesticide contamination of water and soil, and pesticide residue, a range of projects has been undertaken by the Thai Government, as well as by NGOs, since 1991 (Posri, Shankar and Chadbunchachai 2006). The Department of Agricultural Extension in the Ministry of Agriculture started the initiatives by launching the Hygienic Fresh Fruit and Vegetable Production pilot project. The aim of this project was to support farmers' willingness to eliminate pesticides on fresh fruit and vegetable products. In a similar project to complement the initiatives, the Department of Agriculture set up a parallel project called the Pesticide Free Vegetable project. Thus, at the moment, both institutions provide a national level inspection and certification program that enables participants to use a government-backed logo which is called 'hygienic food'.

Moreover, a similar Thai initiative for different credence attributes had been introduced in 1995 by the establishment of a private certification body for organic agriculture. The King of Thailand supported the movement by setting up a Royal project for organic agriculture (Posri, Shankar and Chadbunchachai 2006). Then, as part of this organic movement, the Thai Government's Ministry of Agriculture introduced the organic food label known as 'Organic Thailand'. At the time of writing, six major safe food labels have been introduced in Thailand,

and the labelling process is certified by the government and an NGO (the International Federation of Organic Agriculture Movement, or IFOAM) (Roitner-Schobesberger et al. 2008). Roitner-Schobesberger et al. (2008) explained that these labels are designed to guarantee that the vegetables are produced according to specified pesticide residue limits set by Government authorities such as the Ministry of Agriculture and the Ministry of Public Health, which follow an international standard on maximum residue limits or IFOAM standards for organic products. Therefore any fresh food products which are labelled by these six certifiers are entitled to the safety attributes from the certifiers. However, violation of the pesticide residue limit principles has still occurred in some cases (Hardeweg and Waibel 2002) and this violation has had large coverage in the mass-media and in open discussion forums (Kramol et al. 2005).

Consequently, in this context in response to the need to understand consumers' knowledge and motives in purchasing organic products, a consumer intercept survey was carried out in five supermarkets and two health food stores in the centre and outskirts of Bangkok. Consumers in each location were stopped at the point of purchase and asked about their general knowledge and purchasing experience of organic vegetables and fruits that used the 'safe food' labels from the six major certifiers in Thailand. Interviews from 848 customers were collected by 12 trained Thai students in late April and early May 2005. As a result, it was found that the most important consumer motive in purchasing organic products was the expected positive health effects from consuming lower quantities of pesticide than had been used on non-certified products. The consumers of organic products in Thailand were found to believe that organic products do not contain pesticides at all, or that they have lower levels of pesticide residues (Roitner-

Schobesberger et al. 2008). A similar study in Malaysia also found that most of the respondents perceived organic food to be relatively healthy, fresh and natural (Ahmad and Juhdi 2010).

2.2.2 Consumers' Willingness to Pay for Food Products with Credence Attributes

In relation to the given definition of credence attributes, it is assumed that consumers only purchase the products if they can find the credence attributes that they perceive to be valuable to them. Grunert (2005) described this situation as that consumers who require reliable assurance of particular quality and safety attributes will only purchase the product if they perceive that these high expectations will be met. These consumers will reflect their ability and willingness to purchase the product as their 'willingness- to- pay' (WTP), or as their perceived value for money (Zeithmal, 1988, cited by Grunert, 2005).

Grunert (2005) introduced three main streams of research on food quality and safety. These are consumer demand for quality and safety, the provision of quality and safety, and consumer perception of quality and safety. In Grunert's (2005) study the first stream was associated with the demand side and it used the concept of WTP for credence attributes in food products. The second stream corresponded with structural changes made in the organisation as a response to the provision of additional safety and quality attributes, and it related to the supply side. The third stream was used to describe how consumers perceived the quality and safety attributes. This last stream played a role as a bridge or connection between the first and the second streams. Thus, as pointed out by Krystallis and Chryssohoidis (2005), in many studies that deal with food quality and safety attributes, the WTP concept can be used as a good estimator or predictor of consumers' demand for organic food products. These authors mentioned that in a number of Greek consumer surveys, the measurement of WTP was indicated by the price premium, which was defined as the excess price paid over and above the ‘fair’ price that is justified by the ‘true’ value of the product.

The concept of WTP for credence attributes in food has been examined in both developed and developing countries. In the context of Greek consumers’ diets, WTP across 16 basic and non-basic organic food products (fresh and processed) was explored by Krystallis and Chryssohoidis (2005) in a survey of supermarket customers. The survey gathered information from Greek respondents about the following issues: 1) shopping behaviour at different food retail outlets; 2) food choice preferences over a number of criteria (e.g. origin, appearance, brand); 3) food purchasing frequency of the 16 food product categories; 4) organic food purchasing frequency of the 16 food products categories, and; 5) WTP to purchase organic food products using a premium price range from 0 per cent, and from 30 to 120 per cent, in increments of 15 per cent. The most frequently purchased products were (in decreasing order): fruit (apples and oranges), vegetables (tomatoes and lettuce), milk, pasta, bread, feta cheese, poultry and legumes (lentils and dried beans). The survey also found that the most frequently purchased products were (in decreasing order): red meats (beef, pork), eggs, fish (sea bream, sea bass), yellow cheese (Gouda, Edam) and olive oil, while the least frequently purchased were cured meats (ham, sausages), biscuits and tinned food (tuna, tomato juice). The survey found that the purchasing frequency of the organic type of all the food products was low. Among the organic products, the basic components of the Greek diet such as fruit, vegetables, poultry, legumes, and olive oil were the most frequently consumed, while processed organic foods, such as biscuits and tinned food were the least consumed.

The majority of consumers were willing to pay a price premium of 30 per cent higher than the standard price for the chosen organic products. This study also found that the highest percentages of WTP (with decreasing percentages of consumers) were found for fruits (45, 60 and 90 per cent), with 30, 45 and 60 per cent more for vegetables. WTP for the organic type was higher for the most frequently purchased food product categories, but this did not apply for all food products in this group. Meanwhile, it was noted that socio-demographic variables such as age, education, income, gender, marital status, number of children and profession were not significant in determining the WTP for organic products. However, this study did not apply any econometric model that could explain more robust results in identifying determinant factors that influenced WTP for purchasing the organic food products.

In many European countries, third-party certification has been known as an instrument to gain consumer trust in the credence attributes of goods (Janssen and Hamm 2012). Organic certification logos have been used as product labelling to help consumers to be sure about the credence attributes of the products that they purchase. In the European Union, products can be labelled and sold as organic food if they meet the standard of the regulated principle of organic production, certification and labelling covered under Regulation (European Commission) No. 834/2007.

Janssen and Hamm (2012) explored WTP among consumers in several countries in the European Union. Choice experiments were used to determine the EU consumers' WTP for two organic products (apples and eggs) and the selection of organic logos that were differentiated as: (1) the EU logo, (2) governmental logos, (3) private logos and (4) prefix organic, without logos. Each country had a different set of logos that were used in choice experiments. Only organic logos that already existed in the market were included in the experiments.

The results of the Janssen and Hamm (2012) study showed that consumers in the Czech Republic and Denmark were willing to pay the highest price for apples and eggs if the product was certified by government. Consumers in Germany indicated the highest WTP for apples certified either by the government or by private organisations. In Switzerland and the UK private logos were perceived to reflect the highest WTP attribute for consumers as, at the time of writing, neither Switzerland nor the UK had a governmental logo. Nevertheless, these authors found that basic awareness of the logos was not sufficient to influence the consumer's decision to buy organic products, rather that this needs to be fuelled by consumer perceptions and attitudes towards the message that is delivered by the logo.

A similar study in the context of US consumers was carried out by Batte et al. (2007) who focussed on the estimation of consumers' WTP for multi-ingredient organic processed food. They measured the WTP for four levels of organic content in organically processed food under the NOP (National Organic Program). The NOP itself is known as a novel labelling standard for food products in the US, launched in 2002. In order to identify the characteristics of shoppers for organic products, the data in this study were first collected from a consumer intercept survey of six stores comprising a traditional US national grocery chain. Then, two years later in 2004, these earlier data were compared with a survey in a speciality grocery outlet.

The results showed that traditional shoppers were willing to pay the highest premium for pesticide-free, 100 per cent organic, and locally-grown ingredients, while speciality shoppers similarly indicated their highest WTP was for 100 per cent organic, pesticide-free and locally grown ingredients, and for them the WTP amount was larger when compared to the traditional cohort. For credence attributes of cereals, demographic variables such as age, income per person in the household, level of education, race and gender indicated less significant impact on willingness to pay a premium for this attribute. However, these variables indicated a significant impact on the amount of premium that consumers were willing to pay. Consumers with children were less likely to pay a premium for pesticide-free cereal, and higher education levels contributed in negative ways to consumer WTP for products made with less than 70 per cent of the ingredients being organic.

Batte et al. (2007) implemented the double-hurdle model to estimate two different tiers relating to the level of WTP. The first hurdle refers to whether consumers were willing to pay a premium for credence attributes for cereal (willingness to pay a premium) while the second hurdle estimates the maximum amount (and therefore the maximum premium) that the consumers were willing to pay. In the results of the estimations, several variables were not significant in the first hurdle, but were found to be significant in the second hurdle. For example, as an independent variable, age was not significant to influence consumers' decision to pay a premium for credence attributes for cereal. However, the estimation from the censored model indicated that older consumers were willing to pay a higher premium for pesticide free, 100 per cent organic, 70–95 per cent organic, and for less than 70 per cent organic products. Other determinants such as income and gender also indicated the same result; both factors were not significant in the first hurdle (the probit function) while in the second hurdle, the estimation from the censored model found that consumers with higher income were more likely to pay a larger premium for 70–100 per cent organic cereal. Female consumers were willing to pay a higher premium for all categories of organic and pesticide free ingredients. The other significant variable was consumers with children and this variable indicated a negative result in the first hurdle (willingness to pay a premium). However, in the second hurdle, consumers with children were willing to pay a larger premium for 70–95 per cent and 95–99 per cent organic ingredients. Again**,** an awareness of the NOP was not significant. As mentioned above, awareness of certification or organic logos was not found to be sufficient to impact upon the amount of premium that consumers were willing to pay.

In Thailand, preferences and WTP for a 'safe vegetables' label on Chinese cabbages by upcountry, semi-urban and rural consumers in the Khon Kaen Municipality area of North-Eastern Thailand were examined by Posri, Shankar and Chadbunchachai (2006). North-Eastern Thailand is known as the most populous and most economically backward province in the country. Using ordered probit regression, these authors explained that consumers who had any of the following attributes were more likely to have a positive WTP: female consumers; above 40 years old; completed higher education; have a medium or high income; shop frequently in supermarkets, and; believe that vegetables with the 'safe vegetables' label have a better taste. In contrast, the variable of extended family had the opposite effect.

In Vietnam, consumers in Hanoi and Ho Chi Minh City were surveyed by Mergenthaler, Weinberger and Qaim (2009) to determine Vietnamese urban consumer valuation of two issues: 1) convenience attributes of potatoes (the four convenience attributes are: washed, peeled, pre-cut, packed and cooled), and; 2) the reduction in agrochemical residues (food safety) in Chinese mustard (locally pak choi), which is known as the most important component in Vietnamese diets. This study is distinct in that the authors examined the impacts of the forms of media regularly accessed by consumers as a variable in determining their WTP. The media channels included in the variables were TV, radio, newspapers and the Internet. Probit and Sobel tests were applied in this study and the results showed that socio-demographic and media variables influenced WTP indirectly. In relation to food safety, Vietnamese consumers on average were willing to pay 60 per cent more for Chinese mustard that was free from agrochemical residues, while only 19 per cent were prepared to pay more for potatoes with any of the convenience attributes. Other determinant factors such as education, income, location and regular use of media channels significantly influenced consumer perceptions and led to indirect positive effects on WTP.

In the Klang Valley of Malaysia, Ahmad and Juhdi (2010) analysed the determinant factors that influenced urban consumers to purchase organic products. Demand for organic products has been influenced by increasing awareness of destroying the environment as an impact of high use of chemical and hazardous substances in the agricultural sector. Consumers indicated their preference for consuming any food that had been produced using environmentally-friendly farming systems.

At the time of the Ahmad and Juhdi (2010) study, the Malaysian market for organic foods was considered to be in the early stages of development. In this mall-intercept survey, consumers were asked to indicate their perceptions towards the attributes of organic fruits and vegetables, and these attributes were healthier, less chemicals used in production, natural, fresher, environmentally-friendly and family influenced. Some consumers were unable to distinguish the differences among these attributes, or misunderstood the definition of each product attribute, and in some cases were unable to remember their previous purchases and the credence attributes that were attached to the organic products that they had consumed. Here, the results from multiple linear regressions showed that there was a variation in consumers' intentions to purchase organic products which was explained by attitudinal attributes in relation to organic products, such as consumer perception and belief in friendliness to the environment, as well as in safer and healthier products.

Thus, as a result of world-wide studies, it is clear that consumer demand for quality and safety assurances on food products is growing. There have been a number of food scares in developed countries, while in developing countries the issue of high pesticide residue content in fresh produce is increasingly evident. These growing demands are clearly indicated by consumers' WTP for premium products labelled as organic (whether self-claimed or certified). However, as a result of there being limited research to date, little is known about the context of South-East Asia in general, and Indonesia in particular. Consequently, this study is responding to the increasing need to understand the impacts of credence attributes and consumer WTP for labelled organic and pesticide-free products in these locations.

2.3 Methodology

2.3.1 Model Specification for Willingness-to-Pay (WTP)

This study attempts to understand Indonesian consumer demand for certified organic food products by exploring factors which may influence both stated preferences for certified organic products and willingness to pay a premium for certified organic products.

Adding further to the concept of willingness-to-pay, Mabiso (2005) explained that WTP for quality or safety is the distinction between a consumer's decision to purchase premium products and the actual premium prices that consumers are willing to pay. In this study the concept of WTP is based on utility maximisation theory. The WTP measurement is determined by consumer socio-demographic characteristics, and knowledge, attitudes and perceptions of quality, safety and health issues. WTP is used as a proxy for Indonesian's demand for food safety. In this study, food safety refers to safety assurances such as those labelled organic, certified organic or pesticide-free.

Demand for food safety is determined by consumers' willingness to pay for additional safety attributes, while on the producer side, supply of food safety is defined as the cost for producing food with additional safety assurances. It has thus been shown that the market for food safety will be in equilibrium when consumers' WTP for safety assurances is equal to or exceeds the price at which producers are willing to sell. Thus, it is important to gain an understanding of the potential willingness to pay for safety assurances.

Wilcock et al. (2004) conducted a thorough review regarding consumer attitudes, knowledge and behaviour in relation to food safety issues. One of the main points explored in the review is consumer knowledge. The authors found that knowledge is associated with current consumer practices in consumption.

Consumers who have sufficient knowledge of food safety may indicate positive preferences for food products with additional safety attributes. This type of consumer could be targeted as a consumer who is more likely to purchase food products with additional safety attributes.

The concept of WTP for various safety-related attributes has been discussed in many studies. In the context of developed countries such as the United States, Loureiro and Umberger (2007) used a representative sample from a mail survey sent to households in the continental US to a series of information points regarding respondents' purchasing behaviour and attitudes towards consumption of beef products, beef qualities that were considered as most desirable by consumers and food safety attitudes. In the US, WTP for food-safety related attributes has been measured in relation to COOL.

In the US WTP is also measured for food labelling standards such as the NOP (Batte et al. 2007). In the context of developing countries in South-East Asia, similar attributes have become important in marketing, for example methods of production such as safe vegetables in Vietnam and Thailand (Mergenthaler, Weinberger and Qaim 2009; Posri, Shankar and Chadbunchachai 2006), and organic produce in Malaysia (Ahmad and Juhdi 2011). In the present study the aim of using WTP is to demonstrate a better understanding of the premium market for certified organic products in Indonesia.

In this data set, there were respondents who indicated that they would either not be interested or willing to purchase certified organic products, and/or they would not be willing to pay a premium for certified organic products. This is the case in many cross sectional consumption data sets. These observations of zero consumption can be problematic when analysing data and trying to examine the effects of socio-demographic and attitudinal variables on consumer expenditure decisions. Still, it is important to be able to understand factors that help explain both the decision of whether respondents would be willing to purchase a certified organic product, and if so, the premium they would be willing to pay for a certified organic product. These factors may be different, for example the set of variables that help explain purchase decision may be different than those that influence a consumer’s willingness to pay a premium. As such, the econometric methods used to estimate these two decisions should be considered carefully.

In Taiwan, Huang, Kan and Tan-Fu (1999) used a filter-questioned design to solicit consumers’ willingness to pay for food safety assurances for hydroponically grown vegetables (HGV). A filter question was implemented in this study asking whether or not the respondent was concerned about several food safety issues that were raised in the survey. The next question, a degree-of-concern question, was only asked to those respondents who indicated a positive response to the first one. Huang, Kan and Tan-Fu (1999) applied the double hurdle model, which used a probit model in the first hurdle, and an ordered probit in the second hurdle.

In another study, which explored Irish households’ expenditure on prepared meals, Newman, Henchion and Matthews (2001) applied a generalised double-hurdle model to address zero expenditures in consumption. Zhang et al. (2008) also used this model using 2003 Nielsen Home Scan data to estimate consumers’ demand for fresh organic produce in the United States.

In these studies, the dependent variables had observations coded as zero, representing zero consumption. As explained by Newman, Henchion and

Matthews (2001), measures of zero consumption can be caused by several conditions:

(i) respondent-households not purchasing products due to economic reasons, for example price or income;

(ii) respondent-households not participating in the market for non-economic reasons, for example vegetarian preferences or for religious reasons;

(iii) the survey period being too short for the household's purchasing cycle for the good.

In order to address issues resulting from zero consumption, the double-hurdle or Cragg model was selected. This model has been used by many previous WTP studies to overcome issues resulting from observations of zero in consumption data. The double-hurdle model was proposed by Cragg in 1971 and it is also known as the nested tobit model.

One of the oldest approaches used to deal with data that consists of many zeros is the standard tobit model since these typical data will have censored dependent variables (Wodjao 2007). The standard tobit model was originally formulated by Tobin (1958), and it incorporates all observations including dependent variables that are censored at zero, without considering the sources of the zeros. However, the tobit model is very restrictive in that it assumes that zeros only result from economic reasons (income or price). Although the tobit model has been used widely to deal with these limited dependent variables (that is, variables which may contain zero observations), it also has limitations in that it assumes that all zero observations represent standard corner solutions. However, this assumption may be wrong in cases where the zero observations are caused by non-participation decisions (Wang, Jensen and Yen 1996).

Heckman (1979) proposed a new approach to deal with the zero observations that may appear from non-participation decisions. This model (referred to as the Heckit) applies a two-step estimation procedure in which a full sample probit estimation is followed by a censored estimation carried out on the selected subsample. The second estimation only applies for any respondents who have indicated positive responses to dependent variables in the first estimation or probit model. Different from the tobit model, the Heckit model assumes that zero observations mainly arise from respondents' deliberate choices to not enter the market or consume the product of interest (Wodjao 2007).

More recently, the double-hurdle model has been generalised to overcome the restrictions in the tobit model by incorporating the possibilities of the sources of zeros caused either by non-participation (which leads to a double-hurdle model) or to infrequency of purchases (Newman, Henchion and Matthews 2001). Wang, Jensen and Yen (1996) explained that the Cragg model assumes that each consumer makes two different choices when they would like to maximise their utility. These are whether to consume (a participation decision), and how much to consume (a consumption decision). These authors concluded that the double-hurdle implies that positive consumption can be observed if a consumer passes two hurdles as a potential user of the product or actually uses the product. These assumptions are strongly relevant to the observations of the present study, which aims to examine consumer WTP for certified organic products and to move towards consumption of high-value agricultural products. In this study the assumptions can help to explain the variations among household consumers because, besides dealing with potential and actual users, this sample also covers non-user respondents, who tend not to consume certified organic agricultural products.

In this respect, this study is similar to that conducted by Batte et al. (2007) in which the size of the maximum premium that consumers are willing to pay for certified organic products is explained by two conditions. First, the household decides whether they would like to purchase the certified organic product if the price is right. Second, by taking into account search, information and transaction costs, this study is able to show the factors which help explain the maximum premium they would be willing to pay to purchase certified organic agricultural products.

2.3.2 The Double-Hurdle Model

In this study, a probit model was used to analyse the determinant variables that influence consumers' decisions to purchase certified organic products as the first hurdle of the double-hurdle Cragg model. In the second hurdle, truncated regression was used to estimate the determinant variables that influence consumers' decisions to a premium for certified organic products. Here, the decision to purchase a product with certain credence attributes is estimated using explanatory variables such as income, or socio-demographic and attitudinal variables. Previous analyses have most often used the same set of explanatory variables in both of the two stage analyses of the Cragg model. For example, a study of US consumers by Batte et al. (2007) used socio-demographic variables (e.g. age, education, presence of children in the household, race, gender,), income, a dummy for survey location (e.g. speciality store) and respondents' awareness of the NOP as explanatory variables in both stages of the Cragg model.

Huang, Kan and Tan-Fu (1999) also used a double-hurdle model in analysing consumers' willingness to pay for HGV in Taiwan, using variables such as age, presence of children under 12 (dummy), education, history of chronic diseases (dummy), income, price, and experience with eating outside home (a dummy variable which, if indicated, equals to 1 if the household has experienced eating outside at least 3 times a week). These variables were used in the probit model as the first stage. In the second hurdle, similar socio-demographic variables, history of chronic diseases (dummy) and income, were used as explanatory variables in the ordered probit model.

The double-hurdle model integrates the probit model to determine the probability of y>0 and the truncated normal model for positive values of y (Burke 2009). Furthermore, Burke (2009), who explained the implementation of this model in the Stata program, offered the alternative equation:

$$f(w, y|x_1 x_2) = \{1 - \emptyset(x_1\gamma)\}^{1(w=0)} \\ [\emptyset\ (x_1\gamma(2\pi)^{-\frac{1}{2}\sigma^{-1}} / \emptyset(x_2\beta/\sigma)]^{1(w=1)} \quad (1)$$

where w is a binary indicator equal to one if y is positive and zero otherwise. Burke (2009) pointed out that in the double-hurdle model, the probability of y>0 and the value of y given y>0, are explained through different processes (the vectors γ and β, respectively). There are two different conditions that might occur. First, if there are no restrictions on the elements of x_1 *and* x_2, each decision can be determined by different explanatory variables. Second, if $x_1 = x_2$ and $\gamma = \beta/\sigma$, the explanatory variables become identical in the two models. In Burke's (2009) study, the author used one set of explanatory variables for both equations ($x_1 = x_2$). These variables represent the relevant socio-demographic, attitudinal, and factor score variables that were available in the data and might be related either to participation or to consumption decisions.

2.3.3 Consumer Survey Data

For the data collection process of the present study, 35 trained enumerators were hired and supervised by a collaborative research team from the International Food Policy Research Institute (IFPRI), the Indonesian Center for Agricultural Socio-Economic and Policy Studies (ICASEPS), and the University of Adelaide. From November 2010 to January 2011, the project team carried out a survey of urban consumers in Indonesia. A sample of 1,180 households was drawn from a three-stage random sampling method in three cities on the island of Java. Java is known for its massive population growth and high density of population (1,062 people per km^2 in 2010), as well as for major development of the modern retailing sector in Indonesia including hypermarkets, supermarkets and minimarkets. The difference between these types of modern retailing outlets here is based on the number of cash registers. A hypermarket was defined as a very large modern store with ten or more cash registers, for example Carrefour, Giant, Lotte Mart, and Hypermart. Hypermarkets provide a large variety of fresh produce such as vegetables, fruits, meats, fish, and poultry products. Meanwhile a supermarket in Indonesia was defined as a medium or large modern store with between three and nine cash registers. Examples of supermarkets include: Hero, Matahari, Yogya and Asia. At the time of the study, supermarkets only provided a small selection of fruits and vegetables. A minimarket was identified as a small modern store with 1-2 cash registers; some examples of minimarkets are Alfa and Indomart. Fresh produce was also rarely found in minimarkets.

Three cities were chosen to represent Indonesian consumers living in three types of urban areas. Starting from a list of the 20 cities in Indonesia with a population of at least 500,000 people, this study selected the three cities of Surabaya, Bogor and Surakarta. Surabaya is representative of a large metropolitan city. It is located in East Java Province and has a population of 2.8 million. Bogor in West Java represents a medium city with a population of more than 949,000, and Surakarta represents a small city, located in Central Java, with 506,000 inhabitants.

In the next stage, a sample selection process developed a hierarchy by using the Indonesian Government Administration Areas illustrated in Table 2.1.

Table 2.1. The hierarchy of Indonesian government administrative living areas

Government hierarchy level	Number of population
Municipal (city)	More than 500,000
Kecamatan (council)	26,000 – 200,000
Kelurahan (suburb)	2,000 – 48,000
RW [Rukun Warga]	200 – 2,400
RT [Rukun Tetangga]	20 - 150

Each city is composed of Kecamatans (sub-districts with councils) made up of Kelurahans (suburbs). The sample selection process began by selecting Kelurahans using a stratified random sample in each city. The Kelurahans were stratified by proximity to modern retail hypermarkets and supermarkets. Maps were used to identify the location of these types of stores, and for convenience they are referred to simply as supermarkets. As a large metropolitan city, Surabaya contains many supermarkets so two strata were defined based on whether or not they had a supermarket inside their borders. As the middle-sized city, Bogor has only a few supermarkets, so the two strata are defined here by whether or not there was a supermarket within 5 kilometres. In Surakarta, because the map showed supermarkets and Kelurahan offices but not Kelurahan borders, the stratification here was between Kelurahans whose offices were within 5-10 kilometres of a supermarket and those whose offices were not.

In Bogor and Surakarta, local expertise was used to support the stratification process (this was not the case with the data for Surabaya), in particular when the study team identified the size of the supermarket as shown on the map. As a result, a list of Kelurahans was produced, with additional information about whether or not these Kelurahans had a supermarket nearby. A systematic random sample was drawn by oversampling Kelurahans that were near a supermarket. This process produced a list of selected Kelurahans in each city. The survey team continued the sampling process by visiting each selected Kelurahan office and interviewing the staff in order to rank the Rukun Warga (or RWs, that is, the associations of household groups) by income. Similar procedures were implemented through the RWs and through the Rukun Tetangga (RTs) or household groups themselves. In each selected RT, we listed all the households and selected the respondents randomly, and oversampled the high-income households to increase the probability of the respondents shopping at modern food retail stores. The total number of selected Kelurahans, RTs and households in each city is shown in Table 2.2.

Table 2.2. Number of selected Kelurahans, RTs and households in each stratum in three cities

City	Number of Kelurahans close to supermarkets	Number of Kelurahans not close to supermarkets	Number of selected RTs per Kelurahan	Number of selected household per RT	Number of household samples in each city
Surabaya	15	5	2	15	600
Bogor	10	10	2	7	280
Surakarta	8	7	1- 4	12	300

Data was collected from 1,180 households as follows: 600 households in Surabaya, 280 households in Bogor, and 300 households in Surakarta. The surveyed households were located in 105 RTs across 95 RWs, 54 Kelurahans, and 31 Kecamatans in three cities.

The implementation of sample selection in this study followed a stratified hierarchical multistage sampling design. By adopting this pattern, Pfeffermann (1996) found that each stage of selection involved the selection of clusters that are nested within clusters selected at the previous stage. Earlier studies have identified some advantages of multistage sampling designs such as reducing the survey cost, and making it easier to facilitate field work as well increasing the quality of the data and improving the precision of the estimates through the pre and post stratification and various adjustment procedures (Lee, Forthofer and Lorimor 1986). Moreover, such designs are common and have been implemented in many social economic surveys in Indonesia.

In this study, the sampling design consists of several stages of selection as mentioned above, in particular, innovating a hierarchy of Indonesian Government Administrative Areas in selecting the sample, moving from the city through suburbs (Kelurahans), associations of household groups or neighbourhoods (RW) to the neighbourhoods (RT), and then finally selecting the household. Pfeffermann (1996) mentioned that in general, clusters selected at different stages are homogenous groups such as neighbourhoods, medical institutions, or households. Thus, in some cases there are possibilities that observations that are collected within the same cluster are ordinarily correlated. Although this may not occur at every stage, unequal selection probabilities may appear during the sample selection process. In this study, unequal distribution may appear for certain reasons such as the oversampling of high income households and in some cases the study team experienced high refusal especially from this income group. Thus, this condition may result in the sample observations not being able to represent population distribution; and as a result, sampling weights were used to overcome the obstacles during the sampling process and data collection.

Generally sampling weights are used to compensate for under- or over-representing certain households in a sample. Sampling weights are known as expansion factors and these are calculated as the inverse of the probability of selection. In principle sampling weights also represent unit response probabilities as long as the researchers are able to provide this information.

In this study, sampling weights were used to compensate for over-representing of certain observations (high income households) and to better reflect urban consumers' demand for certified organic products in the three study locations (Surabaya, Bogor and Surakarta). The method for calculating the sampling weights was to divide the total number of sampling units by the number of sampling units selected for each hierarchical stage. Household weights were calculated in order to extrapolate from the sample to the population level. Because a two-stage selection procedure was used to obtain the sample, the weights were calculated by multiplying two terms:

$$W_e = (V_d/v_d) * (H_e/h_e) \qquad (2)$$

where:

W_e is the weight for a household in an enumerator area e
V_d is the total number of enumeration areas in city d
v_d is the number of enumeration areas in each selected city d
H_e is the total number of households in enumeration area e
h_e is the number of households selected from enumeration area e

The respondent in the consumer survey in this study was the person who was responsible for purchasing most of the foods that were consumed in their household. The survey elicited information regarding household characteristics including information on: demographics and household assets, consumer attitudes regarding food safety and quality, concerns about nutrition and health, and for specific food product categories, consumer awareness, and previous experience with organic products as well as perceptions, understanding and preferences for organic food products. We also asked respondents to identify the agency (for example, government, industry or independent third-party) that they would trust to verify the production methods used to produce their food.

2.3.4 Principal Component Factor Analysis

As mentioned above, the questionnaire included a section used to assess consumers' attitudes related to various aspects of food safety and quality, and nutrition and health concerns. Consumers were asked to indicate their level of agreement with 27 questions, using a Likert-type scale, with end-points where 1 = strongly disagree and 5 = strongly agree.

Principal component factor analysis was used to reduce the number of attitudinal variables to a more manageable number for econometric analysis. This method uses the eigenvalues of the correlation matrix of a specific dataset to simplify the variation among variables. As Bond, Thilmany and Keeling Bond (2008) explained, in factor analysis, each factor is associated with an eigenvalue that can be determined as a linear weighted combination of included variables. A compound variable creates a single factor and it will be named based on the information obtained from each variable in the compound. An individual consumer tends to reflect their behavioural attitudes in variable compounds.

Thus, using a principal component factors method in Stata 12, orthogonal varimax (Kaiser off) was used as a rotation method and eigenvalues greater than one were selected as a cut-off point for extracting the number. The result from the principal component factors resulted in six factors using 22 out of the 27 attitudinal questions. Cronbach's alpha reliability tests determined the selection of the factors (the value of each compound variable should be greater than 0.60). Only four factors, which had appropriate Cronbach's alpha values, were used as explanatory or independent variables in the model.

- *Factor 1 (Cronbach's alpha: 0.868)* is explained by 44.7 per cent of the total covariance. The first factor tends to be dominated by concerns about contamination from chemical products. This compound variable reflects consumers' attitudes towards the use of pesticides, additives, preservatives and artificial colour, as well as heavy metal and toxic chemical contents in food and bacterial contamination. As such, this factor is interpreted as consumers' attitude towards or concerns about food contaminants (*Contaminant*) with a factors loading range from 0.834 to 0.729.
- *Factor 2 (Cronbach's alpha: 0.771)* is explained by 34.0 per cent of the total covariance. The second factor comprises consumers' attitudes towards the use of food labels. It illustrates the benefits consumers perceived might occur as a result of the regular use of food labels as a basis of nutrition information for selecting the food. For example, whether consumers believe that nutrition information on food labels is useful, whether consumers feel confident in using food labels, whether reading food labels makes it easier to choose foods, and if consumers try new food products because of the information on food labels. As such, this

factor was called *Usefoodlabels*, with a factors loading range from 0.803 to 0.551.

- *Factor 3 (Cronbach's alpha: 0.8475)* is explained by 47.2 per cent of the total covariance. This third factor emphasises consumers' attitudes towards high amounts of fat, cholesterol, salt and sugar in food. As such, this factor is referred to as *Nutrition*, with a factors loading range from 0.877 to 0.834.
- *Factor 4 (Cronbach's alpha: 0.6830)* is explained by 11.9 per cent of the total covariance. Finally, this fourth factor represents consumers' attitudes related to the importance of healthy living, doing exercise regularly and avoiding smoking. As such, we named the fourth factor as *Health*, with a factors loading range from 0.601 to 0.506.

2.3.5 Willingness to Purchase and to Pay a Premium for "Certified Organic" Food

In the questionnaire, the measurement about WTP for certified organic products was developed through a set of questions. First, respondents were asked the following questions *"Does your household ever purchase [product X]?"*. The products included in the study were chilli, mango and chicken. If they answered "*yes*" then they were asked, *"What is the normal price (rupiah/kg) you pay for this product?"* This allowed us to establish a "base price" as the price paid for each of the products was likely to differ from household to household depending on where they purchased these products (e.g. traditional versus modern market) and the quality of products they were purchasing.

Next respondents, who completed the previous set of questions, were asked the following: *"If you have a choice between buying conventional [product*

X] and [product X] that is labelled "Certified Organic", which one would you buy?" Respondents selected either "*No, I would NEVER buy the "Certified Organic" product"* (coded as 0) or "Yes, *I would buy the "Certified Organic" product if the price was right*" (coded as 1). For every 'yes' answer, respondents were then asked *"What is the maximum amount extra that you would be willing to pay for [product X] that is labelled as "Certified organic"?* Premiums for the three certified organic products (truncated at zero), were then calculated based on responses to these questions.

2.3.6 Empirical Model

Consumers' responses in relation to the amount of premium they were prepared to pay for organic foods were represented by observations with value censoring at zero. Hence, a positive premium or extra price for a certified organic product is observed only if the consumer would purchase the product. As a result, the determinant of the regression model for WTP for certified organic food products is truncated at zero.

For the data analysis both a tobit model and a double-hurdle model were tested in the initial stages of analysis. For the final analysis the double-hurdle model was selected based on test results. Specifically, a log-likelihood ratio (Janssen and Hamm 2012) test was used to test the performance of the models considered. The results showed that across three different commodities, namely chicken, chilli e and mango, the LR test of the double-hurdle model against the tobit model was strongly rejected. From these results it was confirmed that zero consumption for certified organic products was a deliberate choice made by the household (Wodjao, 2008). Based on the LR test and also the features of consumption for certified organic products in our study, it was confirmed that across the three different commodities, the double-hurdle model is more appropriate to be used in this analysis.

In this study, the first of the two hurdles relates to whether or not the consumers would be interested in purchasing certified organic food products, including certified organic chicken, chilli and mango. Equation (3) was used to estimate the first hurdle and includes the variables that were expected to help explain the probability that each of the 1,180 respondents would participate in the organic market (PURCHASE) and purchase each of the three "certified organic" products. A probit regression was used to estimate the first hurdle.

PURCHASE = f (*Female, Education, Age, Income, Child5, Preglact, HHsize, Smfrexp, Surabaya, Bogor, Contaminant, Usefoodlabels, Nutrition, Health*) (3)

The dependent variable, PURCHASE, equalled one if consumers indicated that "yes" they would buy the certified organic product if the price was right and equalled zero otherwise. Socio-demographic and attitudinal variables were included as explanatory variables to examine whether they were useful in explaining the consumers' decision to purchase certified organic products. A description of each variable is presented in Table 2.3.

The coefficients on *Education* and *Income* are expected to be positive. *Education* is a continuous variable and represents the years of schooling completed. In Indonesia, consumers with higher education are more likely to be exposed to information regarding food scare issues, food and nutrition, healthy living habits and other food safety issues. Meanwhile, since the organic or certified organic foods are known to be relatively expensive products compared to non-organic alternatives, the level of income is expected to influence the buying capacity of the respondents. Earlier studies showed the significance of these variables in explaining the participation behaviour of US consumers in purchasing organic milk products (Alviola and Capps 2010) and fresh organic produce (Zhang et al. 2008).

A respondent who had children under five years old (*Child5*) and who was pregnant or in a lactating period (*Preglact*) was also expected to be more likely to purchase organic. Consumers were found to recognise that having young children, being pregnant or in a lactating period were amongst the most important periods in human life. Households in this situation were assumed to be more prudent in selecting the food for their family. However, previous studies confirmed mixed results in this regard (Umberger, Boxall and Lacy 2009; Zhang et al. 2008).

A larger household size (*HHSize*) was taken to be a constraint for the household to purchase certified organic products. It strongly relates to the disposable income per capita that could be allocated for consuming these products. Zhang et al. (2008) and Alviola and Capps (2010) found a negative and statistically significant relationship between household size and consumers' decisions to purchase the certified organic products.

Respondents from Surabaya and Bogor were expected to be more exposed to modern food retail outlets because the number of modern food retailers per capita was higher. Thus, the coefficients on these two dummy variables were expected to be positive. In the participation equation we also included share of food expenditure at modern food retail outlets (*Smfrexp*). In Indonesia, at the time this study was conducted, there were few speciality stores selling organic food products, so the majority of organic products were marketed through modern food retail outlets. The organic food movement in Indonesia was infant at the time of the study; and thus, *Smfrexp* was used to investigate whether the share of food expenditure in modern food retail outlets has any relation to the likelihood of purchasing certified organic products.

This study used principal component factor analysis to create attitudinal variables to capture consumers' attitudes about different types of contaminants (*Contaminant*) as well as concerns about nutrition (*Nutrition*) and health (*Health*) and use of food labels (*Usefoodlabels*). The factor analysis is explained further in the following section. The coefficients of *Usefoodlabels*, *Nutrition* and *Health* were expected to be positive, since consumers with these specific attitudes were expected to be more likely to purchase certified organic products or to have positive attitudes towards purchasing them.

The coefficient for the *Contaminant* variable was expected to be positive for both hurdles. In other words, consumers who are concerned about food being contaminated with chemical inputs, which are used during production and may impact food safety (e.g. pesticides, herbicides, heavy metals), are expected to be more likely to purchase and to be willing to pay more for certified organic products. In Indonesia, organic products are considered to be luxury products and are relatively expensive. Moreover, consumer knowledge and concerns about food safety issues are just beginning.

Organic products may actually be considered to be higher risk, particularly by knowledgeable consumers. For example, Magkos, Arvaniti and Zampelas (2006) conducted a comprehensive literature review regarding food safety issues on organic products, and they found that organic products may contain contaminants originating from untreated manure often used in organic farming systems. Thus, organic farmers who use untreated manure as organic fertilizer may produce a higher risk of bacterial contamination especially on organic vegetables. Furthermore, a microbial analysis of 476 organic and 129 conventional fresh fruit and vegetable samples produced by 32 organic and 8 conventional farms in Minnesota, USA conducted by Mukherjee et al. (2004) found that 1.6 per cent of conventional and 9.7 per cent of organic samples were positively seen to contain E. coli. Among fresh produce, organic lettuce had the largest prevalence of E. coli compared with other products. These authors confirmed that all the organic farms used aged or composted animal manure as organic fertilizer. Moreover, the microbial analysis results also indicated that organic samples that used manure or compost which was less than 12 months old had a prevalence of E-coli 19 times higher than other organic farms which used older materials. In focus groups conducted with Indonesian consumers during the survey design phase, participants expressed concerns about organic food because of what they had heard through the media regarding the use of manure as a fertilizer.

The first equation (Equation 3) included all 1,180 respondents. The second hurdle of the double-hurdle model was a truncated regression procedure to explain factors that influenced consumers' decisions to pay a premium for the certified products. Consumers who indicated they would choose to purchase a certified organic product (PURCHASE = 1) were included in the estimation of Equation (4).

$$WTP_{organic} = f\,(\mathit{Female, Education, Age, Income, Child5, Preglact, HHsize, Smfrexp, Surabaya, Bogor, Contaminant, Usefoodlabels, Nutrition, Health, Price, Organicexperience}) \qquad (4)$$

The observations for the truncated regression were different across commodities: 740 households for chicken, 753 households for chilli, and 726 households for mango. Respondents included in the second stage may have not been willing to pay a premium, or in other words, the data for the second equation were truncated at zero.

In the truncated regression, female respondents were expected to be more highly concerned about food safety issues and thus more likely to pay a premium; therefore the coefficient on *Female* was expected to be positive. Many studies have found a positive relationship between females and WTP, however the levels of significance have varied widely between studies. Female consumers in Northern Italy were more likely to pay more for organic fresh fruits and vegetables (FFV) which were considered pesticide-free products. Boccaletti and Nardella (2000) argued that female consumers were more family oriented, therefore they were highly concerned about food safety issues, in particular pesticide residues on fresh fruits and vegetables. Moreover, McCluskey et al. (2005) surveyed Japanese consumers and also found that female consumers were willing to pay a higher premium for bovine spongiform encephalopathy tested or BSE-tested beef.

Consumers with a higher level of education and income were also expected to be more likely to pay a premium price, although earlier studies concluded a mixed effect for these two variables. Some found that consumers with a qualification from a tertiary institution or a higher level of education were less likely to pay a premium (Alviola and Capps 2010; Boccaletti and Nardella 2000; Huang, Kan and Tan-Fu 1999). However, Zhang et al. (2008) found a positive and significant relationship between education and WTP for fresh organic products. Similar mixed effects were also seen in previous WTP studies in relation to other socio-demographic variables such as age, the presence of children, household size, race, and living areas. By contrast, in many studies the coefficient of income showed a consistent positive relationship with WTP so for these consumers income determines the affordability of organic products.

Previous studies also included shopping behaviour as a variable. In many cases shopping frequency at different outlets was used to determine the differences in consumer behaviour in purchasing organic and conventional products. For example, in developed countries, studies used shopping frequency at farmers markets or speciality stores as explanatory variables (Carpio and Isengildina-Massa 2009; Govindasamy and Italia 1998; Govindasamy, Italia and Adelaja 2001; Posri, Shankar and Chadbunchachai 2006; Yue and Tong 2009). Share of food expenditure in modern food retail outlets *(Smfrexp)* was expected to be positive and significant as consumers who shop more at modern retail outlets may be more willing to pay higher prices for products they believe are higher quality.

Surabaya and *Bogor* are dummy variables, being the locations of the studies representing metropolitan and urban areas. Previous literature used ‘urban’ as a variable in the model and found a positive relationship between willingness to pay for food safety and urban households in Minnesota (Yue and Tong 2009), thus the coefficients of these two variables were expected to be positive.

Boccaletti and Nardella (2000), Govindasamy and Italia (1998) and Tsakiridou et al. (2011) also included attitudinal variables representing consumers’ concerns regarding health risks associated with pesticide use in fruits and vegetables and consumers’ use and awareness of food labels and certifications. In general, similar attitudinal variables in previous studies were positive and significant in influencing the WTP for commodities with credence attributes. Thus, similar to the first hurdle, consumers who regularly use the food labels and are concerned about nutrition and health were expected to be willing to pay more for certified organics, while consumers identified as most concerned about contaminants and about price levels were expected to have negative coefficients.

2.4 Results and Discussion

2.4.1 Summary of Variables

The definitions and summary statistics for each of the dependent and independent variables included in the models are shown in Table 2.3. Summary statistics without sampling weights and with sampling weights are both provided.

Nearly 90 per cent of the respondents were female and middle-aged (44.8 years old). The respondents' average period of education was 10.3 years, which in Indonesia is equivalent to a high school education level. The mean income per household was calculated as between 2–5 million rupiah per month. Nearly 34 per cent of the households had children below five years old and the average household size was 4.4 people. The average household's share of food expenditure in modern retail outlets was around 16.4 per cent. Fifty per cent of the respondents lived in Surabaya, while 23.7 per cent lived in Bogor.

Price was clearly the most important factor for consumers, on average when selecting food; with approximately 70 per cent of the consumers confirmed this. With respect to the dependent variables used in the double hurdle model, over 60 per cent of respondents indicated they were willing to purchase organic products if the price was affordable: 61.0 per cent for chicken, 63.3 per cent for chilli and 60.5 per cent for mango. Further, the data from the survey revealed that the average maximum extra price that the consumers were willing to pay was around 16.1 per cent, 18.3 per cent and 22.1 per cent respectively for chicken, chilli and mango.

Table 2.3. Summary statistics of variables used in the analysis

Variable	Description	Without sampling weights				With sampling weights						
		Mean	SD	Freq.	Per cent	Mean	SD	Freq.	Per cent	Min	Max	N
Female	Gender of the respondent (1=female, 0=male)	0.894	0.308			0.888	0.316			0	1	1180
Age	Age of the respondent	44.831	12.863			43.019	12.404			15	83	1180
Education	No of schooling (in years) of the respondent	10.345	4.545			9.347	4.518			0	22	1180
Income	The approximate household income in monthly basis	5.764	1.296			5.530	1.198			0	8	1180
	0= less than 50,000 IDR per month											
	1= 50,000 to 100,000 IDR per month			2	0.17			0	0.02			
	2= 100,000 to 200,000 IDR per month			4	0.34			6	0.49			
	3= 200,000 to 500,000 IDR per month			3	0.25			4	0.86			
	4= 500,000 to 1,000,000 IDR per month			43	3.64			46	4.77			
	5= 1,000,000 to 2,000,000 IDR per month			113	9.58			148	17.28			
	6= 2,000,000 to 5,000,000 IDR per month			297	25.17			345	46.51			
	7= 5,000,000 to 10,000,000 IDR per month			417	35.34			418	81.91			
	8= More than 10,000,000 IDR per month			170	14.41			156	95.15			
Child5	1 if child 0-5 years old in the household, 0=otherwise	0.341	0.474			0.369	0.483			0	1	1180
Preglact	1 if any households with members who were either pregnant or lactating , 0=otherwise	0.119	0.324			0.144	0.352			0	1	1180
HH Size	Size of the household (Zhang et al.)	4.414	1.759			4.467	1.674			1	12	1180
Smfrexp	Share of food expenditure in modern retail outlets	16.385	16.886			13.393	14.972			0	83.71	1180
Surabaya	1 if respondent lives in Surabaya, 0= in Bogor or Surakarta	0.509	0.501			0.614	0.487			0	1	1180
Bogor	1 if respondent lives in Bogor, 0= in Surakarta or Surabaya	0.237	0.426			0.214	0.410			0	1	1180
Contaminant	Factor scores representing household perceptions on contaminants concerned of pesticide use, additives, bacteria and heavy metal and toxic materials in food	1.10E-09	1.000			-0.092	0.960			-4.023	2.199	1180
Use food labels	Factor scores representing household perceptions on use food labels such as useful, feel confident in consumption, easier to choose and try a new food	6.36E-09	1.000			-0.083	1.055			-4.947	2.376	1180

Table 2.3. Continued. Summary statistics of variables used in the analysis

Variable	Description	Without sampling weights				With sampling weights				Minimum	Maximum	N
		Mean	SD	Freq.	Per cent	Mean	SD	Freq.	Per cent			
Nutrition	Factor scores representing household perceptions on nutrition concerned of fat or cholesterol, salt and sugar on food	7.29E-09	1.000			-0.065	0.955			-4.385	2.239	1180
Health	Factor scores representing household perceptions on health concern of healthy product, diet and nutrition attitude, regular exercise, avoid smoking and safety concerned	3.39E-10	1.000			-0.078	1.017			-4.731	2.955	1180
Price	1 if 'price' as the most important factors in purchasing food in general, 0=otherwise	0.698	0.459			0.758	0.428			0	1	1180
Organic experience	1 if respondent ever purchased food products that are sold as organic, 0= otherwise	0.331	0.471			0.217	0.412			0	1	1180
Chicken choice (participation)	1 if respondent willing to purchase 'certified organic chicken' if the price is right, 0=otherwise	0.649	0.477			0.610	0.488			0	1	1180
Chilli choice (participation)	1 if respondent willing to purchase 'certified organic chilli' if the price is right, 0=otherwise	0.668	0.471			0.633	0.482			0	1	1180
Mango choice (participation)	1 if respondent willing to purchase 'certified organic mango' if the price is right, 0=otherwise	0.634	0.482			0.605	0.489			0	1	1180
Chicken extra price	Maximum extra price that consumers' willing to pay for 'certified organic chicken' (in percentage)	17.310	18.138			16.143	15.821			0	100	812
Chilli extra price	Maximum extra price that consumers' willing to pay for 'certified organic chilli' (in percentage)	18.799	18.929			18.317	18.307			0	100	820
Mango extra price	Maximum extra price that consumers' willing to pay for 'certified organic mango' (in percentage)	21.085	21.168			22.119	21.777			0	100	773

2.4.2 Consumers' Perceptions, Experiences and Knowledge of Certified Organic Foods

In addition to understanding WTP, it is important to understand Indonesian consumers' perceptions, experiences and knowledge of certified organic foods. In the questionnaire, we asked consumers to indicate whether they had ever heard of or been aware of organic products, and if so, whether or not they had previously purchased and would prefer to purchase these products in the future. This study also investigated consumers' perceptions and knowledge by asking what they believed or agreed with in relation to several attributes of organic products which would work towards a list of possible characteristics of certified organic foods. Consumers' responses to these questions are summarised in Table 2.4.

More than 51.4 per cent of these consumers indicated that they had previously heard of food products sold as certified organic, but only 21.5 per cent had previously purchased these products. Respondents' actual purchases of organic products were lower than their stated preferences for organic products; this is likely to be due to issues with access, i.e. high prices and availability. At the moment, self-claimed or certified organic chicken, chillies and mangoes are only available at modern food retailers (supermarkets) and these products are considered to be expensive and exclusive. Approximately 50 per cent of consumers would prefer to purchase products that were certified, and consumers indicated that they preferred certification to be overseen by the central government. In order to ascertain consumers' perceptions or knowledge of certified organic products, the results from Table 2.4 showed that the majority of consumers agreed that certified organic products were safer and healthier compared to conventional products. Notably, nearly 93 per cent of consumers agreed with the view that these products contain no pesticides and are more environmentally friendly. In this respect, the results from this survey were similar with previous studies that have been conducted in South-East Asian countries (Ahmad and Juhdi 2010; Roitner-Schobesberger et al. 2008). Furthermore, in the context of organically grown fresh produce attributes in a developed country, there is a strong similarity to other studies: in a US study 52 per cent of the participants considered good for health to be a very important attribute, and 26 per cent thought it to be important. Meanwhile, nearly 83 per cent also thought that these products were safe to eat (Yue and Tong 2009).

Table 2.4. Consumers' perception and knowledge of certified organic products

Variable	%	N
Percentage of consumers who know what it means when a product is labelled or certified as organic	51.5	608
Percentage of consumers who had ever seen or heard of food products sold as organic/certified organic	51.4	606
Percentage of consumers who had ever purchased food and beverages sold as organic/certified organic	21.7	256
Percentage of consumers who would prefer to purchase food and beverages sold as organic/certified organic	50.5	596
Percentage of consumers who agreed that certified organic products are safer to eat	97.9	596
Percentage of consumers who agreed that certified organic products are healthier	95.5	580
Percentage of consumers who agreed that certified organic products contain no pesticides or residues	93.7	570
Percentage of consumers who agreed that certified organic products are more eco-friendly or environmentally friendly	96.4	586
Percentage of consumers who agreed that certified organic products are produced without pesticides	90.9	552
Percentage of consumers who agreed that certified organic products have a better taste	72.7	443
Percentage of consumers who agreed that certified organic production methods are overseen by the government	69.1	420
Percentage of consumers who agreed that certified organic products are produced without GMO	65.6	399
Percentage of consumers who agreed that certification of organic product is important	82.1	500

In this study, the majority of Indonesian consumers (69 per cent) assumed that organic production methods are overseen by the government. This is concerning because at the time of writing, the Indonesian government essentially very limited oversight of the organic program for food with essentially no quality standards or organic standards for any fresh food products. Thus there is no way to verify whether certified organic claims on food currently marketed are actually legitimate. Yet, various food products labelled as organic products can easily be found in hypermarkets, supermarkets and speciality stores. Anecdotal evidence that emerged during the data collection in Bogor, Surabaya and Solo, indicated that the majority of the organic products in Indonesia were self-claimed labelling programs, and, as mentioned, Indonesian consumers appeared to have difficulties in distinguishing which products were actually legitimately organic. Nevertheless, nearly 82 per cent of consumers agreed that certification of organic products was important.

A similar result was found in earlier studies conducted in Bangkok when Roitner-Schobesberger et al. (2008) conducted a customer intercept survey in supermarkets and health food stores. These authors found that consumers preferred to ignore the differences between credence attributes on fresh produce labels, such as hygienic, safe and organic, and the main reason for this ignorance was lack of recognition of the terms by the consumers. The authors confirmed that 52 per cent of their respondents had heard the term organic, although they were not quite sure about the meaning.

Interestingly, at the time of writing, Indonesia had only one logo for certified organic products, the logo known as *Organik Indonesia,* authorised by the Ministry of Agriculture and accredited by seven organic certifiers dominated by domestic and international NGOs. However, in this study, products under this logo were rarely found in the markets.

2.4.3 Estimating WTP for Certified Organic Agricultural Products

In this study, the estimation of the premiums that Indonesian consumers were willing to pay for certified organic chicken, chillies and mangoes were calculated by asking the usual price that consumers paid for each product and the amount they would be willing to pay for a certified organic version of the same product. The premium was recorded by enumerators as a percentage over the conventional value and this percentage was used as the dependent variable in the willingness- to-pay model.

Table 2.3 shows willingness to purchase certified organic products varied across commodities. Almost 65 per cent of the respondents were willing to purchase certified organic chicken, 66.8 per cent for chilli, and 63.4 per cent for mango. It was not surprising that the highest share of consumers were interested in purchasing organic chilli as most households consumed chillies daily as part of various meals.

Table 2.5 provides a summary of the WTP premium for each of the three products. It presents consumers' WTP in deciles and cumulative amounts. For all three commodities, at least 49 per cent of consumers were willing to pay at least 10 per cent more for certified organic products. Not surprisingly, the proportion of consumers who were willing to pay a premium decreased as the premium level increased, as illustrated in Table 2.5.

Table 2.5. Percentage of consumers who were willing to pay various premiums for certified organic food products (deciles and cumulative)

Maximum extra amount WTP in %	Chicken		Chilli		Mango	
	Deciles	Cum.	Deciles	Cum.	Deciles	Cum.
0%	8.9		8.2		6.1	
1 - 10%	46.2	55.1	43.8	52.0	43.1	49.2
11 - 20%	18.8	73.9	17.8	69.7	17.9	67.0
21 - 30%	15.3	89.2	16.3	86.0	15.3	82.3
31 - 40%	1.0	90.1	1.2	87.2	2.1	84.4
41 - 50%	7.3	97.4	10.1	97.3	10.7	95.1
51 - 60%	0.0	97.4	0.1	97.4	0.7	95.8
61 - 70%	0.1	97.5	0.1	97.5	0.5	96.3
71 - 80%	0.4	97.9	0.1	97.7	0.2	96.5
81 - 90%	0.1	98.0	0.2	97.9	0.5	97.0
91 - 100%	2.0	100.0	2.1	100.0	3.0	100.0

The results of maximum likelihood estimation of the three double-hurdle models for both participation and WTP are presented in Table 2.6. Marginal effects for the probit regression (first hurdle) and the truncated regression (second hurdle) are provided for chicken, chilli and mango. The log likelihood statistics over three probit models and the corresponding chi-square statistics indicated that the probit models were significant at α = 0.05 level.

Byrne, Capps and Saha (1996) explained that "the parameters estimated with the probit technique are not directly interpretable with respect to the magnitude of effect, but only interpretable with respect to the direction of effect on the probability" (p.619). As presented in Table 2.6 for the three probit models, many variables were significant in explaining the decision to purchase certified organic chicken, chilli and mango.

The results imply that the education of the respondent was positive and significant for each model, as was expected. An earlier study conducted in Taiwan also found a similar condition in that the probability of WTP for premium

Hydroponically Grown Vegetables increased for respondents who had a higher educational level (Huang, Kan and Tan-Fu 1999). However, the opposite result was found in Thailand where consumers who had completed a tertiary degree or a higher level of education were less likely to purchase ‘safe’ vegetables (Posri, Shankar and Chadbunchachai 2006).

The estimated coefficient of the household income variable was significant from zero and positively associated with consumer likelihood to purchase certified organic products. As the income levels increased from the means (on average around 2–5 million rupiah per month) to more than 5 million rupiah per month, the probability of Indonesian consumers to purchase these products increased by 2.9 per cent for chicken, 3.6 per cent for chilli and 5 per cent for mango. These coefficients were statistically significant at the 1 per cent level for the chilli and mango models, while for the chicken models it was significant at the 5 per cent level. As discussed earlier, the belief by consumers that organic products were relatively expensive was the largest constraint for consumers to select this product in their food choices. This result also confirmed that the possibility to consume these products expands when a consumer’s income rises.

Other socio-demographic variables such as the presence of children below five years of age (*Child5*), households with members who were either pregnant or lactating (*Preglact*), and household size (*HHsize*) were not statistically significant. Although the estimated coefficients were not statistically significant, the signs from the *Female* and *Age* variables did not violate assumptions and supported similar findings discussed previously from earlier studies.

The probit models also demonstrated that consumers with a higher percentage of food expenditure in modern retail outlets were more likely to purchase certified organic products. This result confirmed the current situation in Indonesia, where modern hypermarkets and supermarkets are the main shopping outlets that provide certified organic products. The targeted consumers for marketing these products could be the modern food retail outlet users.

Meanwhile, variables representing more urbanised locations (Surabaya and Bogor) were not significant in the first hurdle. The signs from these two variables were expected to be positive, since we assumed that consumers who lived surrounded by modern retail markets were more likely to purchase certified organic products.

Consumers who were classified as concerned about contaminants (*Contaminant*) and health (*Health*), and were also food label users (*Usefoodlabels*), were more likely to purchase certified organic products. Concern about nutrition (*Nutrition*) was not significant, although it had a positive coefficient.

The second hurdle sheds light on the determinant factors (socio-demographic and attitudinal variables) that influenced consumers' WTP for certified organic products. In Table 2.6 the results of the truncated regression are presented side-by-side with the probit regression. The chi-square statistic indicated that the model is significant (α = 0.01). Meanwhile, the Inverse Mills Ratio (λ) were significant at an α level of .01. These results indicated that sample selection bias would have resulted if the second hurdle equation had been estimated without taking into account the decision on the first hurdle or consumers' decision to purchase certified organic chicken, chilli and mango.

With respect to gender, female consumers were willing to pay extra for certified organic products. This result supports the studies mentioned earlier in that the females appeared to be more informed about organic, and were thus more likely to express a positive WTP (Ahmad and Juhdi 2010; Batte et al. 2007; Boccaletti and Nardella 2000; Yiridoe, Bonti-Ankomah and Martin 2007).

In all WTP models, the estimated coefficients on *Education, Age, Child_5, Preglact,* and *HHSize* were not statistically significant. Consumers with higher levels of household income were willing to pay a statistically higher premium for all three certified organic products. This result confirmed that consumption of certified food products in Indonesia is associated with increasing household incomes.

Table 2.6. Maximum likelihood estimation of double hurdle models: Consumers' purchase and WTP for certified organic products

	Chicken		Chilli		Mango	
Variable	Probit (ME) (z)	Truncated WTP	Probit (ME) (z)	Truncated WTP	Probit (ME) (z)	Truncated WTP
Female	0.054	44.153**	0.072	36.764**	0.045	46.904*
	(0.269)	(2.062)	(1.464)	(2.031)	(0.900)	(1.798)
Education	0.010***	2.442	0.009**	0.846	0.007*	-0.267
	(2.515)	(1.555)	(2.334)	(0.670)	(1.857)	(-0.150)
Age	0.000	0.255	-0.001	0.024	-0.002	-0.239
	(0.383)	(0.618)	(-1.076)	(0.065)	(-1.270)	(-0.462)
Income	0.029**	11.321*	0.036***	9.698*	0.050***	15.258**
	(2.001)	(1.825)	(2.533)	(1.847)	(3.378)	(1.944)
Child_5	0.011	-4.869	-0.003	-0.517	0.014	10.183
	(0.301)	(-0.396)	(-0.077)	(-0.048)	(0.372)	(0.674)
Preglact	-0.023	12.196	-0.042	6.128	-0.064	9.986
	(-0.486)	(0.794)	(-0.872)	(0.452)	(-1.275)	(0.536)
HHSize	0.010	-0.051	0.008	1.052	0.008	-3.277
	(1.067)	(-0.018)	(0.886)	(0.408)	(0.880)	(-0.840)
Smfrexp	0.003***	-0.063	0.002**	-0.033	0.003***	-0.547
	(2.714)	(-0.190)	(2.265)	(-0.110)	(3.092)	(-1.251)
Surabaya	-0.034	26.554*	-0.067*	29.198**	-0.061	38.005**
	(-0.915)	(1.854)	(-1. 816)	(2.242)	(-1.630)	(2.024)
Bogor	-0.046	0.091	-0.075*	11.567	-0.063	38.623**
	(-1.057)	(0.006)	(-1.703)	(0.886)	(-1.401)	(1.948)
Contaminant	0.060***	-9.670*	0.062***	-12.603***	0.053***	-7.302
	(3.982)	(-1.711)	(4.188)	(-2.436)	(3.485)	(-1.076)
Use food	0.068***	0.096	0.055***	1.544	0.066***	8.738
labels	(4.484)	(0.017)	(3.698)	(0.298)	(4.221)	(1.129)
Nutrition	0.020	9.243	0.012	6.634	0.006	8.023
	(1.399)	(1.520)	(0.886)	(1.326)	(0.398)	(1.150)
Health	0.028*	-0.980	0.032**	0.262	0.024*	-1.634
	(1.902)	(-0.203)	(2.258)	(0.061)	(1.618)	(-0.271)
Price		-22.080**		-27.993***		-32.468**
		(-1.971)		(-2.653)		(-2.238)
Organic		38.741***		23. 671**		27.965*
experience		(2.634)		(2.163)		(1.821)
Constant	-0.258**	-245.908***	-0.160*	-181.533***	-0.241**	-222.477***
	(-2.316)	(-2.833)	(-1.474)	(-2.873)	(-2.146)	(-2.038)
Observation	1180	740	1180	753	1180	726
Log likelihood	-691.98		-678.36		-695.10	
Restricted log Likelihood	-764.60		-750.16		-775.08	
Chi-squared	145.24***		143.61***		159.96***	
Hosmer-Lemeshow						
chi-squared	18.70		28.18		16.39	
ρ-value	0.016		0.000		0.037	
λ (sigma – IMR)		46.100***		44.778***		55.814***
Chi-squared		164.12		173.22		161.04
ρ-value		0.000		0.000		0.000

Note: (***), (**),(*), indicates statistical significance at the $\alpha = 0.01$, 0.05, and 0.10 level, respectively; ME= Marginal Effects and z = coefficient/standard error.

Also, as the study team expected in our hypothesis, consumers who lived in a metropolitan city like Surabaya were willing to pay a statistically higher premium for certified organic chicken, chilli and mango. Consumers who lived in Bogor were only willing to pay a statistically higher premium for certified organic mangoes. Since Surabaya is the country's second largest city and has a large number of hypermarkets and supermarkets, the results imply that consumers in this area might more easily to buy organic products from these outlets.

Interestingly, the coefficient on the *Contaminants* variable was negative and significant at the one per cent and five per cent levels respectively, for chilli and chicken. The results of this factor analysis confirmed that the level of WTP for certified organic chilli was significantly and inversely related to consumers' perceptions of the risk of bacterial contaminations from organic farming practices. The urban consumer survey data covers consumers from all income levels, and to date, organic products in Indonesia have been considered to be an expensive or luxury good. Although consumers with concerns about contaminants were more likely to purchase certified organic products, they were reluctant to pay a premium. The Chilli model had slightly better results compared to chicken and mango model. This may be because chillies are considered essential ingredients in Indonesian diet, they also fluctuate dramatically in prices, combined these aspects may limit the ability of consumers to pay more for certified organic chillies. The coefficients on *Usefoodlabels*, *Nutrition*, and *Health* were not significant.

As expected, consumers who considered the price for food in general as a very important factor (*Price*) in their purchasing were less likely to pay more for certified organic chicken, chilli and mango. This result was consistent and similar to the measurement of WTP for low-pesticide fresh produce in Taiwan (Fu, Liu and

Hammit 1999; Yue and Tong 2009). The message from this finding in the model suggests that consumers who are strongly concerned about price are not main target to consider in the marketing strategy for organic produce in Indonesia.

The variable representing previous experience purchasing organic products (*Organicexperienced*) was highly significant and shown to have a strong positive influence on consumers' WTP for certified organic chicken and chillies.

2.5 Conclusion

The aim of this study was to investigate urban Indonesian consumers' understandings, perceptions and demand for food products with credence attributes, specifically a "certified organic" claim. This study represents the first Indonesian consumer research on certified organic food products. The analysis focused on the estimation of consumers' WTP for certified organic chicken, chilli and mango. Three Cragg double-hurdle models were used to examine the factors, which explain: 1) consumers' participation in the market for and consumption of certified organic products. As explained earlier in the methodology section (p.46) and Table 2.5, the average premiums that consumers were willing to pay premiums of about 17.3 per cent for certified organic chicken, 18.8 per cent for certified organic chilli, and 21.1 per cent higher for mango. These findings suggest a strong potential for the growth of certified organic products in Indonesia.

Education and income variables were found to have significant impacts in influencing consumers' decisions to purchase certified organic products. The income variable indicated a positive relationship in both hurdles in the models, with higher income consumers being both more likely to purchase certified organic food products and were willing to pay a higher premium. Additionally, it was shown that consumers who were female, who indicated they had previously purchased organic products, and that lived in a metropolitan city area such as Surabaya were willing to pay significantly higher premiums for certified organic chicken, chilli and mango.

Considering these results, we might conclude that females, with higher education and higher household incomes and those who frequently shop in modern food retail outlets are the consumers who should be targeted when marketing certified organic or organic food products in Indonesia. The majority of female consumers in big cities or metropolitan areas are working women who have very limited time to be involved in domestic work, including preparing the food for their family. Thus, organic producers should market their products in modern retail outlets around the central business districts in the metropolitan area in order to allow female consumers to get access and purchase organic products at their convenience.

Furthermore, consumers who considered price as the most important factor in purchasing food were less likely to pay a premium. This finding may signal that certified organic food products are considered to be relatively expensive and consumers most concerned about food prices are more likely to consume conventional agricultural products and thus are not the appropriate target for marketing of organic products.

The results of this study also highlighted the importance and need for the development of governance, labelling and traceability systems for certified organic products in Indonesia. For example, results from the first hurdle showed that consumers who regularly use food labels were more likely to purchase certified organic products again. Therefore, labelling can lead consumers to purchase higher quality organic products, and if consumers are satisfied with those products they are likely to continue to purchase the products.

Approximately 80 per cent of the consumers agreed that certification and traceability systems are important for them. Traceability and labelling are two issues that should be handled properly in the Indonesian organic markets as near-absence of standardisation has become the biggest obstacle that could limit the growth of these products. To address the current lack of standardisation, the Indonesian government has to start implementing a series of policies in the various organic sectors to facilitate an affordable standardisation scheme for different types or levels of organic farming systems.

Further results from the first hurdle showed that consumers who indicated they were concerned about contaminants were more likely to buy certified organic chicken, chilli and mangoes but less likely to pay a premium for certified organic chicken and chilli. This is not surprising because chillies are a staple food product and used daily in Indonesian cooking and poultry tends to be a relatively expensive food product. Meanwhile, as highlighted earlier in this chapter, demand for food with additional safety and quality attributes is just recently starting to grow in Indonesia. The fact that the organic market is only infantile in Indonesia, may be why some of the results from second hurdle not as expected. The interpretation of contaminant concerned may differ if the sample only considered households that use modern food retailers (supermarkets). This limitation considered as future research that can be expanded and highly important to be explore in Indonesia.

However, as found in developed countries with advance growth in organic products, many consumers thought that organic products were free from pesticides and safer, but at the same time they also realised that the possibility of using untreated manure in organic farming may cause health issues as a result of bacterial contamination. Further researchers could consider the economic feasibility of food traceability systems in Indonesia. Hatanaka, Bain and Busch (2005) suggested that traceability systems should be used as a tool in helping farmers to ensure that any food safety or quality problem, including the use of various inputs, can be traced back to its origin. For example, farmers can divide their farms into individual plots and then have to keep all the documentation that records all the activity on that plot, starting from planting (in this way the farmer has to record exactly what varieties are planted, and when). They would record the application of different inputs use (including the type of chemical inputs, and the applicator), as well as the harvesting and post-harvest activities, if any. Third-party certification schemes, which are emerging at this moment, can play a key role as an institutional mechanism for monitoring and enforcing standards for food safety and quality throughout the whole food system, thus reducing concerns about organic fertiliser.

Ultimately, organic products could be a new niche market for smallholder producers. By providing an affordable standardisation scheme, the government could guarantee that these smallholder producers would not be excluded from the market and would be able to participate. On the consumer side, the Indonesian government should guarantee that consumers will get a benefit from consuming organic products to the extent that they are willing to pay for a premium. These findings suggest that the involvement of the Indonesian government is needed to introduce certified organic logos as a guarantee system and the distribution of self-claimed products should be regulated.

Facing the conditions prevalent in many fast-growing economies, it is very important for Indonesia to explore the demand for credence attributes in relation to agricultural products. As the middle-income population is growing in Indonesia, predicting the potential growth in consumer demand offers vital information for the smallholder producers and the marketers of potential new market opportunities. Furthermore, there is now a pressing need to inform policymakers of the importance of government oversight to verify credence claims and to reduce those free-riders in the organic market who are sustained by marketing self-claimed organic or safety assurance attributes.

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3. Chapter Three: Smallholder Shallot Farmers and Technology Adoption

3.1 Rationale

This chapter addresses the second research question: are there significant differences in characteristics between Alternative Pest Management (APM) adopters and conventional farmers in terms of socio-demographic, production and marketing decisions in shallot industry? Following the general background section, an overview of the Indonesian agriculture and shallot industry is presented. This chapter then explains the survey sample and household survey design and t-test procedures. The t-test is used to examine the differences between the APM adopters and conventional farmers for all key household level variables. The descriptive analysis is presented in four categories: 1) human assets; 2) farm and farm management; 3) sales and marketing, and; 4) adoption and collective action.

The previous chapter demonstrates that Indonesian consumer demand for fresh food products with higher safety and quality attributes is likely to grow in the future. While in early stages, the evolving consumer demand presents opportunities and challenges for smallholders. Asia is characterized by farmers who cultivate small plots of land (Thapa and Gaiha 2011). Smallholders dominate Indonesia's agricultural sector. Using 2007 secondary data from the International Food Policy Research Institute (IFPRI), Thapa and Gaiha (2011) estimated that almost 87 per cent of the world's small farms (farmers who own less than 2 hectares of cropland) were located in the Asia and the Pacific region. The 2013 Indonesian Agricultural Census indicates that there are more than 26 million agricultural households. The average size of irrigated land (*sawah*) is 0.098 hectares.

A key research question facing the international development community over the past decade is what has been the impact of agri-food transformation on smallholders and the rural economy. A large, earlier development literature focussed on smallholder adoption of green revolution technology: the technology package introduced in the early 1970s that lead to major structural changes in social and economic conditions in Indonesia's rural areas. For example, Manning (1988) found that the green revolution resulted in both positive outcomes (overcoming food shortages, increased incomes, more food security) and negative outcomes (displacement of labour and discrimination).

More recently, Indonesia's agricultural sector is undergoing a second major transformation influenced by: 1) rapid urbanization and demographic changes; 2) a sustained period of per capita income growth resulting to diet shits to more protein and related higher-value products; and 3) the transformation in the agri-food value chains and industry, much of it through foreign investment by global supermarket firms (Thapa and Gaiha (2011). Thapa and Gaiha (2011) highlight the challenges and opportunities for smallholder farmers, including the difficulties they facing producing food in a sustainable manner, shifting from staple crops to higher value crops, and adopting new varieties.

In Indonesia, the green revolution technology resulted in much higher use of external inputs, pesticides in particular, leading to soil and water degradation in many irrigated areas. Over–use of pesticides has been the cause of serious food scare issues, and pesticide residues are currently known as a major food safety threat in much of Asia. Using annual agriculture data from 1955 – 2005, Simatupang and Timmer (2008) measured the trends in production, harvested area and yield for rice and found that, the low level of land quality and fertility has influenced the ability of many producers to implement sustainable farming systems on their farms as well their ability to diversify their cropping pattern.

Over time, sustainable farming systems have been introduced to Indonesian farmers. Examples include Integrated Pest Management (IPM) and organic and pesticide free technologies, as well as specific management standards such as Good Agriculture Practices (GAP). IPM was first introduced in Indonesia in 1979 and it became a nation-wide pest management program in 1989. The introduction of IPM was implemented in reaction to the devastating outbreaks of pests, notably the Brown Plant Hopper (BPH) in major rice producing areas in Java in 1976 (Resosudarmo 2012). The green revolution period in Indonesia began with the introduction of pest eradication technology in the early 1970s aimed at boosting national food production, in particular, rice (Simatupang and Timmer 2008). During this period, the over-use of insecticides resulted pest-resistant conditions.

IPM includes chemical pesticide use on an occasional basis, but without sacrificing or destroying the pest's existing natural enemies on the farm. Moreover, in Indonesia, IPM became well-known as an example of a large scale participatory approach to deal with the complex agro-ecological dynamics operating on the farms (Fakih, Rahardjo and Pimbert 2003). These authors (2003) assessed the impact of community IPM in Java in relation to the following issues: 1) policy reform at national and local levels; and 2) social and environmental impacts in a variety of local settings, and organisational changes within the government, the main funding agency (FAO), and other support agencies. Moreover, these authors explored how the large-scale participatory approach was achieved with the implementation of farmer field schools (FFS). FFS aimed to educate farmers and ensure they were able to make maximum use of their farms, replace their dependency on external inputs, and replace those inputs with labour management skills and knowledge.

The program was halted in 1998 due to the financial crisis that hit many Southeast Asian countries including Indonesia.

A nation-wide organic agricultural program known as Go-Organic was introduced in 1987 by Reverend Agatho Elsener (Jahroh 2010). He established community development centre in 1984, located in Cisarua, West Java.
The implementation of organic farming was started in 1987 in the centre's farmland. Since then, the organic farming practices are developed and the community centre shifted into a place for organic training and termed as the Center for Organic Agriculture Development. A national networking was set up to accommodate local or provincial organic movements in 1998. In 2000, the Ministry of Agriculture and academician established the Indonesian organic farming society and it followed by the launching of "Go Organik 2010" program in 2001(Ariesusanty 2011). However, the national movement towards organic farming was not successful; the development of organic technologies did not show a strong growth (Mayrowani 2012). A lack of support from central government, in this case the Ministry of Agriculture, was identified as the source of failure of this program (Jahroh 2010). Both Jahroh (2010) and Mayrowani (2012) explored the development of organic farming in Indonesia but from different perspectives. Jahroh (2010) used organic farming in West Java and North Sumatera as case studies to explain the process of organic development, while, the second author focused on development at the national level. These studies show that local and international non-government organisations are leading the development of the organic movement.

The Indonesian Ministry of Agriculture has also introduced the implementation of the Good Agriculture Practices (GAP) program with the aim of increasing food safety and quality in fresh food products, in particular fruits and vegetables. In 2009, the Ministry of Agriculture launched national legislation detailing GAP standards' operational procedures that were differentiated by location (area of production), commodity, and targeted markets. To date, no empirical studies document the adoption of GAP or related APM practices by farm households.

The following section outlines the survey design used to gather the data to analyse adoption of APM practices for one of Indonesia's most important agricultural products, shallots. The study team included agricultural economists from three research institutions working collaboratively to design a robust, multiple stage sample frame to evaluate how the evolving modernization of Indonesia's food sector impact shallots, chilli and mango producers. This PhD contributed to this larger project by examining APM adoption by shallot producers.

This PhD focuses on adoption of APM farming practices by shallot farmers for several reasons. First, shallots are an essential ingredient in Indonesian cuisine, recognized as a high-value commodity and eaten every day by the majority of Indonesian households. Second, shallots provide a good example to analyse because it is amongst the most pesticide intensive crops (Shepard et al. 2009). In a review of 8 horticulture crops in Asia, Shepard et al. (2009) found that unsafe pesticide application methods was the most common problem. Third, the analysis in Chapter 2 suggests that over time consumers will increasingly demand higher food safety standards in their food. Finally, experience suggests that as incomes continue to rise in Indonesia, government regulations will require farmers to both meet food safety standards and better protect the health of their soil and water.

For this thesis, APM is defined as the implementation of a farming system that is based on safer pest management technology, including IPM and the application of pesticide-free principles. The shallot grower survey identified the steps in the diffusion of APM farming practices, starting from their awareness or how they heard about the practices, to their participation in training and their adoption.

3.2 The Indonesian Agriculture and Shallot Industry: An Overview

Rusnono et al. (2013) indicate that among South-East Asian consumers, Indonesia is the largest consumer of shallots compared to Malaysia, Thailand and the Philippines. Notably, those countries also consume onions. In Indonesia onions are not as popular as shallots. Amongst the various types of cuisine across the Indonesian archipelago, shallots are known as the most essential ingredient in daily cooking. Shallots are important enough to be included in the consumer price index formula. Shallots are an important cash crop for smallholder households. Table 3.1 shows that for the five years to 2012, the productivity of shallots has tended to be relatively stable.

Table 3.1. Harvested area, production and productivity of shallots in Indonesia, 2008 - 2012

Year	Harvested area (ha)	Production (ton)	Productivity (ton/ha)
2008	91,339	853,615	9.35
2009	104,009	965,164	9.28
2010	109,634	1,048,934	9.57
2011	93,667	893,124	9.54
2012	99,315	960,072	9.67
Average	99,593	944,182	9.48
Growth (%/year)	0.63	1.57	0.95

Source : Rusnono et al. 2013

Farmers are able to grow three times a year (two dry seasons and the rainy season). At the national level, nearly 77 per cent of local production of shallots is concentrated in Java and Bali, almost 10.7 per cent produced in West Nusa Tenggara and the remaining production comes from Sumatera, Sulawesi and Kalimantan. Central Java is the main production area (51.4 per cent) while East Java only contributes around 30 per cent and West Java less than 20 per cent (16.4 per cent).

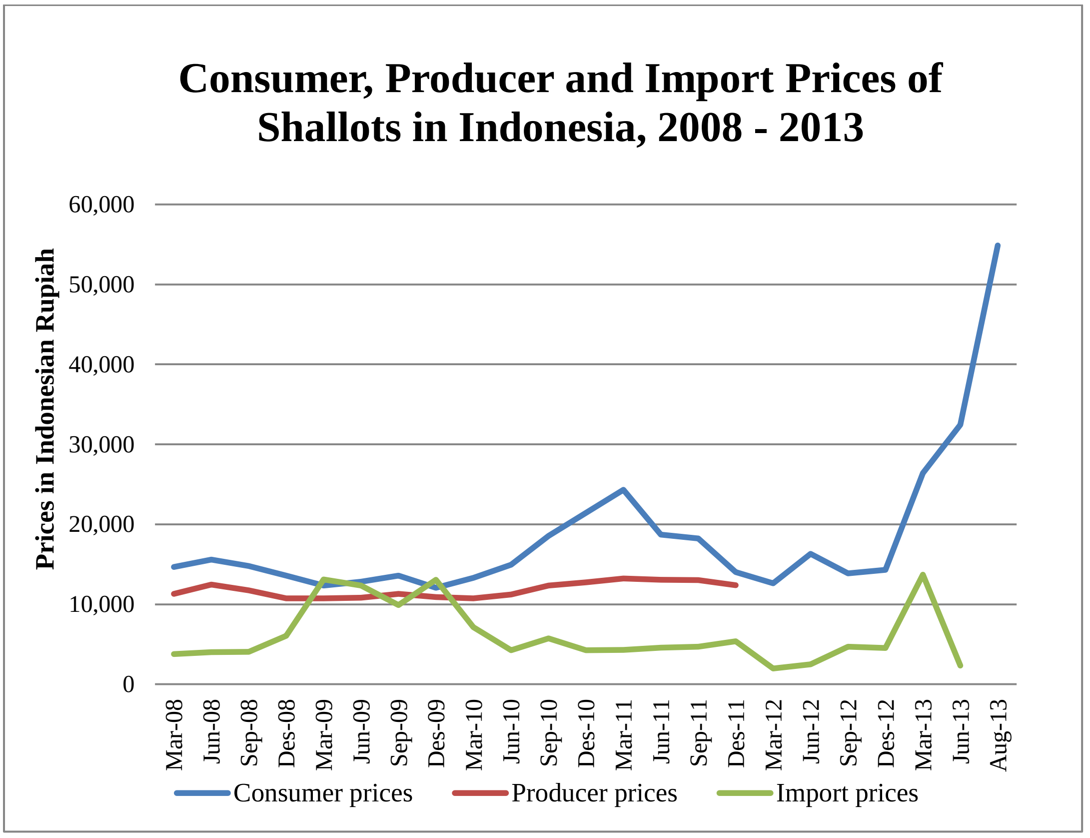

Figure 3.1. Consumer, producer and import prices of shallots (Rusnono et al. 2013)

Like most all agricultural crops, shallots also demonstrate fluctuations in price as presented in Figure 3.1. The consumer price shows a significant growth compared to producer and import prices. The highest prices for shallots normally occur during important Moslem festivals such as Ramadhan, Eid-al- Fitr or during the wet season when shallot production is constrained by climate conditions. Although local production indicates a sufficient amount in production, Indonesia still imports shallots during the wet season as shown in Table 3.2, despite that Indonesian shallots are different from the imported ones in particular in relation to fragrance, taste and colour attributes.

Table 3.2. Value and volume of export and import for shallots, 2011-2013

Year	Export		Import	
	Volume	Value (000 USD)	Volume	Value (000 USD)
2011	19,085	8,812	122,191	54,480
2012	8,042	4,189	117,627	52,766
2013	30	52	70,952	32,001

Source: Rusnono et al.2013

3.3 The Survey Data

As noted by Doss (2006), panel data provide the most suitable and ideal data set to use to study adoption. However, adoption studies using panel data are limited, with most studies using cross-sectional data, which limits the ability to measure the dynamic process of technology adoption at the household or farm level. To address this limitation, this study uses a series of four steps in the household questionnaire to capture the diffusion of innovation by asking about specific stages in the innovation process. The four steps are: 1) awareness; 2) training; 3) adoption and 4) continuing to adopt. The following section explains how the sampling methods were employed in the survey, as well as the questionnaire development process and survey implementation.

3.3.1 The Sampling Selection Process

The household survey took place in Brebes, Central Java from June to July 2011. Brebes is a major shallot producing area. A sample of 687 shallot growers was drawn from two separate sampling selection methods. A stratified random sample was used to identify 531 shallot growers. The second sample of 156 producers was selected from the list of farmers who purchase organic fertilizer supplier (NASA) and a list of non-conventional growers identified by key informants in selected villages.

The study team began the sampling design processes for traditional or conventional farmers by collecting annual chilli and shallot production data over the most recent five year period for which data was available, 2005 – 2009 (see Table A.1). These production data consisted of information about the volume of production for chilli and shallot from the 17 sub-districts which were known to be shallot and chilli producing areas in Brebes. The study team collected these data from the Dinas Pertanian Kabupaten Brebes or the Brebes Agricultural Office. In Indonesia, Agricultural Offices have responsibility for collecting information related to agricultural production and prices, including farm gate, wholesale, and retail prices.

Secondly, from the production data, the study team calculated the average production of chilli and shallots for the 2005 to 2009 period. Thirdly, the team collected the average farm gate prices for chilli and shallots over the first three-quarters of the following year (January – September 2010) at the district market. The average farm gate price was multiplied by the average production of chilli and shallots to obtain the total value of production of chilli and shallots in each sub-district. Fourthly, the sampling process was carried out by calculating the cumulative total over the value of production of chilli and shallots in each sub-district.

The study team selected villages randomly in proportion to the value of chilli and shallots production in each district. At the end of these selection stages, 47 villages were selected randomly from 13 sub-districts.

Table 3.3. List of general and non-conventional populations and samples in Brebes, 2011

Sub-District (Kecamatan)	No. of selected villages		Population of samples		No. of selected samples	
	Tra-ditional	Non-conventional	Tra-ditional	Non-conventional [a)]	Tra-ditional	Non-conventional
Brebes	7	6	826	40	84	38
Bulakamba	5	7	847	44	60	37
Jatibarang	2	4	111	13	24	11
Kersana	1		275		12	
Ketanggungan	2		225		24	
Larangan	10	6	1648	6	120	5
Losari	2	2	153	4	24	4
Paguyangan	2		291		24	
Pamengger		4		6		
Sirampog	8		940		96	
Songgom	2	3	258	37	26	31
Tanjung	3	1	661	1	36	1
Wanasari	11	13	1343	37	132	31
Total			7578	188	662	158

The study team designed the selection process for villages at sub-district level with replacements. A sub-district could thus be selected more than once and each selection corresponded to either one or more villages. It was clear that the selection process of villages followed the proportional value of the production means. This indicates that any sub-district which had a higher production of chilli and shallots was more likely to be selected. During this process, any sub-districts or *kecamatan* which had a value of production greater than the interval might be selected for at least one village.

The team visited each selected village to collect farm household names and locations form the village land-tax office. From this office visit, the team collected hundreds of names, addresses, and other additional information regarding rural landowners. In the final selection stage, the study team used a spread-sheet program to randomly select 12 households to be interviewed from each village based the list compiled at the village land tax office. By applying these stages of the sampling selection process, the team was able to select 561 traditional or conventional shallot growers. Using this list, the trained enumerators then interviewed the selected household or respondent face to face using the 24-page, structured questionnaire. A copy of producer survey instrument is provided in the Appendix.

Part of the sample of the ‘non-conventional' shallot farmers came from a list provided by a local organic fertilizer supplier NASA. The aim of selecting this type of farmer was to explore if the farmer had been exposed to APM practices such as IPM and pesticide free practices. The list provided by NASA included names, addresses and mobile numbers of farmers who had purchased organic fertilizer from the local supplier. The study team visited each farmer on the list and inquired if they cultivated shallots over the last five years. Farmers who answered 'yes' were then included in the sample.

In addition to the NASA list, the research team obtained information from key village leaders, farmer groups and key informants to identify farmers who had received training in non-conventional farming practices or had implemented non-conventional practices on their farms. A random sample of 156 households from 32 villages was drawn from these non-conventional producer lists. In some cases the conventional and non-conventional shallot farmers lived in the same village. Overall, from this selection process, there were 214 farmers determined to be "APM adopter-farmers" (120 farmers from the non-conventional group and 94 from the conventional group) and 473 farmers classified as "conventional" or "general farmers" (36 from the non-conventional group and 437 from the conventional or general farmer group). The following section explains the approach that this study used to define the APM-adopter farmers versus conventional / general farmers.

3.3.2 Defining Adopters of Alternative Pest Management Farming Systems

Lambrecht et al. (2014) used an innovation approach to model the decision making process of farmers when they decided to adopt new technology. In the present study a similar approach is used and responses are used to define the APM-adopters. The following steps covered in the questionnaire are used to determine adopters: 1) awareness about technology; 2) participation in agricultural training such as farmer field school; and 3) adoption of technology. Awareness of the existence of the technology is usually a first prerequisite step for a farmer to apply new methods. While training is typically considered as the second step in the innovation approach, not all farmers in this study who were classified as adopters actually received training (Table 3.4). Ultimately adoption takes place when farmers are able to convince themselves to try out the technology by considering information received either from the attendance in farmer field school or having some experience with trying out the new technology.

Table 3.4. Farmers' awareness, training, adoption and continue to adopt rates of shallots growers in Brebes (Central Java) in percentage, 2011 *(N=687)*

Description	Yes		No	
	Freq. (n)	%	Freq. (n)	%
Awareness	421	61.28	266	38.72
Training	239	34.79	448	65.21
Adoption	214	31.15	473	68.85
Training, conditional on awareness	239	34.79	448	65.21
Adoption, conditional on awareness	214	31.15	473	68.85
Adoption, conditional on awareness and training	168	24.45	519	75.55

This present study defined the APM-adopter as farmers who adopted the technology with or without having participated in training. Table 3.4 indicates receiving no training has not prevented farmers from adopting the technology, with 214 of the shallot farmer respondents indicating they had adopted APM technology.

The descriptive analysis in this present study differentiated the characteristics of shallot growers over the APM- adopters (214 farmers) and non-adopter or conventional (473 farmers).

3.3.3 Questionnaire Development and Data Collection

The household questionnaire design for this PhD included several steps:

1) Designing a questionnaire (English version) to elicit information required to answer the thesis research questions, e.g., socio-demographic characteristics, shallot farming activities and technology adoption.
2) Training enumerators were trained to ensure their understanding of the questionnaire and how to implement it.
3) Collecting the data based on manuals written in English by the researcher.
4) Translating from English to Bahasa Indonesia to finalize the questionnaire and manuals.

During the survey interview process, the enumerators asked all the questions in the questionnaire to all of the respondents, to elicit any information that had relation with technology adoption. This information included the following: 1) household characteristics including housing and assets; 2) agricultural land including everything regarding land sizes, tenancy systems, and crops; 3) shallot production and marketing; 4) input use based on the largest plot and the most recent completed harvest; 5) farmers’ access to production and marketing information; 6) attitudinal questions in relation to risks (soil fertility, applying certification and health issues); 7) adoption of new crops and new farming systems, in this case green technology practices; 8) best-worst scale questions about the adoption of sustainable farming methods, and; 9) income.

3.4 Descriptive Analysis

Analysis of Variance (ANOVA) was used to test the differences between means for the descriptive analysis presented in this section. The T-test was used to compare a pair of means from the two samples across the household-level variables: farmers who have adopted APM practices (adopters) and traditional or conventional farmers. These differences are presented in each table together with the significance levels for each descriptive analysis measured by the t-test. This section is grouped into 4 different categories, namely: 1) human assets; 2) farms and farm management; 3) sales and marketing, and 4) adoption and collective action.

3.4.1 Human Assets

An important article by Feder, Just and Zilberman (1985) documents that the main determining factor influencing farmers' decisions to adopt new technology is human capital. The survey data from the shallot household survey indicate that adopter farmers are more educated than traditional farmers. In Indonesia, the average length of schooling for primary school is 6 years (years 1 to 6). On average both respondents and their spouses from the traditional shallot farmers' group had not completed primary education. In relation to the adoption of sustainable farming systems, Tilman et al. (2002) show that these sustainable farming technologies require intensive knowledge tasks for farmers to learn. In particular, the knowledge required is not always practical, and in some cases the farmer has to visualize an abstract concept as part of the package of new technology.

Almost all adopter farmers were able to speak Bahasa Indonesia, while 90 per cent of traditional farmers speak the national language. This information is important for the extension officers or institutions who deliver any new technology to farm households. The difference in literacy level may also influence the farmers' understanding of the technology package, which includes both theory and practice. In many cases, the farmer is required to read and understanding flyers, brochures or a training module during their exposure to technology adoption procedures. Similarly, Matteson, Altieri and Gagne` (1984) found that scientific concepts that were introduced to farmers were based on unfamiliar principles and ways of thinking, and required literacy skills.. Here, these variables are used to measure the respondent's level of understanding of the technology and the learning process that the farmer had experienced, since these may determine their decision to adopt the technology (Lee 2005; Matteson, Altieri and Gagne` 1984; Pretty and Ward 2001).

Additionally, an earlier study indicated that younger people were more likely to take risks and more willing to be included at an earlier stage of the technology adoption process. Older people, by contrast, felt themselves to be more experienced and therefore less likely to adopt technology that involved higher cultivation costs, since they considered it a risk having an uncertain outcome (Angeli Kirk, Winters and Davis 2010).

Table 3.5. Characteristics of Indonesian shallot growers in Brebes (Central Java) in percentage, 2011

Household characteristic	All samples (n = 687)		Adopter (n=214)		Conventional (n=473)		Diff.
	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev	
Age of respondent (years old)	47.34	11.06	46.57	10.98	47.69	11.09	1.112
Education of respondent (years old)	6.02	4.20	7.87	4.02	5.18	4.01	-2.690***
Age of spouse (years)	41.75	10.39	40.95	10.54	42.12	10.31	1.177
Education of spouse (years)	5.21	3.68	6.44	3.71	4.65	3.53	-1.797***
Household size	4.28	1.64	4.35	1.49	4.25	1.70	-0.103
Number of adults male in the household	1.61	0.81	1.54	0.68	1.65	0.86	0.112
Number of adults female in the household	1.58	0.78	1.58	0.77	1.58	0.78	-0.00483
Percent of households with children 0-5 years old	22.13	41.54	28.04	45.02	19.45	39.62	-0.0859*
Percent of households with school aged-children (6-18 years old)	60.12	49.60	59.35	49.23	1.12	0.00	0.0112
Percent of respondents who are able to read (literacy)	84.43	36.29	94.86	22.13	79.70	40.26	-0.152***
Percent of spouses who are able to read (literacy)	78.60	41.04	88.32	32.20	74.21	43.80	-0.141***
Percent of respondents who speak Bahasa Indonesia	93.01	25.51	99.07	9.64	90.27	29.66	-0.088***
Percent of spouse who speak Bahasa Indonesia	83.70	36.97	91.12	28.51	80.34	39.79	-0.108***

Note: ***,**,* indicate statistical significance at the 1%, 5%, 10% levels, respectively.

3.4.1.1 Profession and Household Income

Table A.3 in the appendices of this chapter shows that, on average, the total household income was 131 million rupiah per year for adopter farmers and 107 million rupiah per year for conventional farmers. Adopter farmers are more specialized in shallot farming compared to conventional farmers, with shallots contributing more than one-third of their total household income. In relation to the total household income from shallots, these differences are highly significant. For the traditional farmers, the contribution to their total household income was less than 25 per cent. Also, the adopter farmers had more income sources, as presented in Table A.4.

Manning (1988) found that the introduction of mechanization during the green revolution technology era in Indonesia affected the distribution of employment opportunities. In this study, farmers with limited access to land used both farm or off-farm working opportunities to meet their basic income needs, as presented in Table A.2.

Another significant contribution to the household income was from trading activities. Although the differences here were not significant, income earned from trading contributed almost 27 per cent for both the adopter and conventional farmers. The data in Table A.4 indicate that more than 50 per cent of the total household income for conventional farmers was generated from trading activities. The data in Table A.2 indicate that the involvement of women (usually spouses) in trading activities was significant.

*3.4.1.2 **Household and Production Assets***

More than 50 per cent of adopter farmers owned a radio at home, more than 20 per cent had a computer, and 37 per cent had access to the internet at home. Farmers could potentially use these assets to increase their exposure to any information related to technology adoption and marketing. The availability of internet and computers may help support and improve their ability in shallot farming. Adopter farmers are asset rich compared to traditional farmers. In the survey, adopters had more access to production facilities such as water pumps (to ensure water availability in the dry season), storage, as well modes of transportation (such as motorbike, *tossa* [motorbike with cart] and cart). Additionally, nearly 15 per cent of adopter farmers owned goats which could be used to produce manure (as a self-source of fertilizer) and to sell during festivals, while only 7 per cent of traditional farmers owned goats. Both agricultural and non-agricultural assets were occasionally required as a guarantee or collateral for gaining access to credit from banks or other financial institutions. Credit access can help cover initial costs incurred by new technologies, like water pumps, to reduce the risk and uncertainty. Thus, as mentioned earlier, the ownership of technology, production and transportation, as well as non-agricultural assets was lower for traditional farmers. These factors potentially limit the ability of these farmers to maximize their income from shallots or other agriculture commodities.

Table 3.6. Household and production assets of shallow growers in Brebes (Central Java) in percentage, 2011

Type of Assets	All samples (n=687)	Adopter (n=214)	Conventional (n=473)	Diff.
Household Assets	Percent			
Radio	40.90	50.93	36.36	-0.146***
Television	93.45	94.39	93.02	-0.014
Computer	9.75	20.09	5.07	-0.150***
Landline	1.75	3.27	1.06	-0.022*
Mobile phone	79.48	85.05	76.96	-0.081*
Internet	25.76	36.45	20.93	-0.155***
Motorbike	77.73	86.92	73.57	-0.133***
Car	3.64	5.14	2.96	-0.022
Truck	0.44	0.47	0.42	0.000
Tossa - Motorbike with cart	2.33	4.21	1.48	-0.027*
Cart	13.83	23.36	9.51	-0.139***
Agricultural Production Assets				
Water pump	59.39	68.22	55.39	-0.128**
Spraying equipment	95.63	96.26	95.35	-0.009
Tractor or hand tractor	2.33	3.27	1.90	-0.014
Storage house	7.42	17.76	2.75	-0.150***
Grain mill	2.91	5.61	1.69	-0.039**
Cattle/buffaloes	0.87	0.00	1.27	0.013
Goats/sheep	9.61	14.95	7.19	-0.078**
Poultry	47.74	54.67	44.61	-0.101*
Average distance from house to (in km):				
a. Road of any type	0.01	0.01	0.01	0.001
b. Asphalt road	0.11	0.10	0.12	0.015
c. Village market	2.31	2.14	2.39	0.249
d. Sub-district market	13.56	11.90	14.32	2.420**

Note: ***, **, * indicate statistical significance at the 1%, 5%, 10% level, respectively.

3.4.2 *Access to Agricultural Land: Type of Land and Tenancy Systems*

In their 1985 study, Feder, Just and Zilberman (1985) reviewed a rich literature of technology adoption studies. Among their findings, farm size was a major determinant influencing farmers' decisions to adopt new technologies. They also found that the relationship between farm size and technology adoption was highly influenced by other factors including fixed adoption costs, risk preferences, human capital, credit constraints, labour requirements and tenure arrangements.

Table 3.7. Agriculture land by irrigation and tenure systems of shallots growers in Brebes (Central Java) in hectares, 2011

Agricultural land	All samples (n = 687)		Adopter (n=214)		Conventional (N=473)		Diff.
	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev	
Land ownership (assets)							
Farmland	0.410	0.974	0.536	1.289	0.354	0.787	-0.182*
Irrigated	0.345	0.661	0.468	0.823	0.289	0.565	-0.179***
Land cultivation size by irrigation system							
Irrigated	0.562	0.843	0.824	1.281	0.443	0.497	-0.381***
Rain fed	0.064	0.242	0.037	0.142	0.077	0.275	0.0401*
Dryland	0.035	0.387	0.051	0.532	0.028	0.299	-0.023
Land cultivation size by tenure system							
Owned and farmed	0.283	0.583	0.370	0.842	0.244	0.411	-0.126**
Owned and rented out	0.019	0.147	0.041	0.215	0.009	0.100	-0.009
Owned and sharecropped out	0.052	0.255	0.059	0.284	0.049	0.241	-0.032**
Rented from owner	0.156	0.397	0.189	0.428	0.140	0.382	-0.049
Sharecropped from owner	0.077	0.162	0.083	0.176	0.074	0.156	-0.009
Borrowed from owner	0.053	0.451	0.132	0.792	0.017	0.087	-0.115**
Land cultivation size by irrigation type in rainy season							
Without irrigation	0.089	0.467	0.117	0.728	0.076	0.278	-0.062*
Gravity	0.101	0.239	0.110	0.244	0.097	0.236	-0.181***
Pumped surface water	0.227	0.486	0.334	0.728	0.178	0.310	-0.011
Pumped ground water	0.127	0.375	0.143	0.350	0.120	0.386	0.005
Land cultivation size by irrigation type in dry season							
Without irrigation	0.035	0.315	0.078	0.546	0.016	0.091	-0.041
Gravity	0.476	0.648	0.600	0.783	0.420	0.568	-0.013
Pumped surface water	0.028	0.176	0.035	0.188	0.025	0.171	-0.157***
Pumped ground water	0.004	0.041	0.001	0.012	0.006	0.049	-0.023

Note: ***, **, * indicate statistical significance at the 1%, 5%, 10% level, respectively.

In terms of land as an asset, adopters owned farm land that was almost 34 per cent larger in size and nearly 38 per cent larger for irrigated land when compared to conventional farmers. Conventional shallot farmers also cultivated smaller sizes of irrigated land. The difference is highly significant at almost 50 per cent smaller sizes. The non-adopter farmer group also had fewer land transactions (purchased and sold) over the last five years (2007 – 2011). Nearly 17 per cent of adopter farmers had purchased land in the previous 5 years, while 6 per cent had sold land. For traditional farmers 11.4 per cent had purchased land and less than 2 per cent had sold their land.

Pingali (1997) demonstrated that farmers with access to larger shares of irrigated land are better able to specialise. He also found that the irrigated lowlands are more market-oriented due to the ability to generate surplus crops and better transport infrastructure. Adopter farmers who were more exposed to frequent land transactions were able to generate more income from shallot farming. Some 98.6 per cent of adopters cultivated their shallots on irrigated land, while the traditional farmers had nearly 10 per cent less, as is presented in Table A.6.

In terms of land tenure, the adopters occupied larger amounts of land compared to the conventional farmers, and this difference is significant. The composition of farmers who owned and farmed the land was comparable between these two groups. Adopter farmers, however, had a larger share who rented, sharecropped, and borrowed land.

During the rainy season, shallot farmers, both adopter and conventional alike, were highly dependent on gravity or irrigation systems from the canals, with more than 90 per cent using gravity systems. Table A.6 shows the number of farmers with differing access to water during the rainy and dry seasons. On average, however, the total land size of farms that were irrigated using gravity systems was smaller when compared to the land area of farms which utilized surface water. Access to water is an important yield determinant during the dry season. As presented in Table A.6, during the dry season, pumped water from surface or ground water is more likely to be selected by shallot farmers. On average, farmers planted larger land sizes in the dry season, as yields and profits are generally higher.

3.4.2.1 ***Cropping Patterns and Planting Times***

Planting times in major irrigated lands in Indonesia are divided into three different seasons, dry season 1, the rainy season and dry season 2. The data in Table A.8 indicate average land size by different commodities in different seasons. In the questionnaire, respondents were asked to indicate their first and secondary crops. As a result, the data in Table A.8 show that both groups of farmers planted shallots almost throughout the year. On average during dry season 1 and dry season 2, shallots are the dominate crop. These data show that adopter farmers had a larger size of land for shallots during dry season 1 and dry season 2, and the differences were highly significant. In Brebes, many farmers applied multiple cropping between shallots and chillies, and after 30 days of planting, many shallot farmers planted chilli between the shallots.

The data in Table A.7 indicate that the total number of farmers who planted shallots in the rainy season were fewer when compared to those in dry season 1 and dry season 2. Both groups of farmers indicated that they were more likely to diversify the commodities on their farm land in every different season, and food crops commodities such as maize and rice became their second interest after shallots and chilli (Table A.7).

Adopter farmers started their planting time in dry season 1 through April, May, June (the peak period) and July. Similar patterns also occur for conventional farmers with a fewer numbers of participants in April. In dry season 1, *bima curut* was the favoured variety chosen by both groups of farmers. Adopters had a slightly higher proportion of farmers who were able to produce shallots for seed. Similar patterns were also found during the rainy season and dry season 1. October to November were counted as the most favourable planting times during the rainy season and April to May were selected as the best times for planting shallots in dry season 2. As presented in Tables A.9 – A.11, the total numbers of adopters and conventional shallot growers that were able to produce shallots for consumption and seed decreased during the wet season.

The majority of shallot farmers use their saved seed for their next planting season. Key informant interviews indicated that imported seeds have less fragrance compared to local seeds. The key informants also pointed out that shallots produced using Alternative Pest Management (APM) farming practices had longer storage life than those from conventional practices.

3.4.2.2 ***Acquired Systems for Inputs Used***

Shallot farmers tend to pay all their purchased inputs in cash prior to their purchase. Table A.15 indicates that nearly 90 per cent of the farmers from both groups paid for their seeds in cash. Across all inputs, adopters tend to purchase in cash more than traditional shallot farmers.

3.4.2.3 ***Changes in Inputs Used***

A majority of the adopters participated in IPM farmer field schools. Important results from the diffusion of IPM in Indonesia include the ability of farmers to change their knowledge and attitudes towards insects and pesticides, as explained by Winarto (2004). In particular, Resosudarmo (2012) explored the success of IPM in Indonesia from 1989 to 1999. He found that farmers who were participating in the program were able to reduce the use of chemical pesticide significantly, while maintaining a stable production levels. In relation to the diffusion of IPM technology, Feder, Murgai and Quizon (2004) confirmed that during this period more than 500,000 farmers in more than 10,000 villages received training or joined farmer field schools and more than 20,000 farmers participated as trainers. The rapid diffusion of environmental technologies became the backbone of the training sessions. FFS was acknowledged to be the most successful education and extension worker program (Winarto 2004). FFS modules were delivered using a participatory method of learning for technology adoption and dissemination, as cited by Davis et al. (2012) who measured the impact of IPM-FFS in East Africa.

APM adopter farmers had different approaches in their behaviour towards using pesticides in that the decision to spray their shallots was an informed decision determined by the level of pests. These principles were very useful to reduce the application of pesticides for shallots or famers were able to reduce the amount of chemical inputs in their shallot production.

Around one-third of adopters (31.3 per cent) had reduced the amount of chemical fertilizer compared to conventional farmers, as presented in Table A.16 and the differences were highly significant. More than 43 per cent of farmers who had adopted APM technology also increased the amount of organic fertilizer, while only less than 15 per cent of traditional farmers had adopted. Nearly 24 per cent of adopters reduced the amount of pesticides they used and more than 21 per cent increased the application of bio-pesticides on their shallot plots.

Farmers had various reasons for changes in their behaviour and for their decision to reduce chemical fertilizer and to increase the use of organic fertilizer, as presented in Table A.18. Land fertility continues to pose a significant problem in Indonesian agriculture. Simatupang and Timmer (2008) examined determinant factors that had cause serious damage in Indonesia's agricultural sector. They found that an excessive use of external inputs such as chemical fertilizers and pesticides, as well as over-intensive land use, had contributed to soil degradation. In this study it was found during the survey component that more than 39 per cent of traditional farmers shared similar thinking, that reducing chemical fertilizer and increasing organic fertilizer may potentially improve their land fertility. Having increasing access to better information (such as participation in farmers' groups or training) helped farmers to changes their attitudes towards pesticide application in shallot farming and to see that less pesticide use in this kind of farming is also able to reduce cost and increase quality and land fertility. In this study the differences towards this implementation in practice were highly significant between the adopter and the conventional farmers.

3.4.3 Sales and Marketing

3.4.3.1 ***Shallot Marketing***

This section focuses on various types of shallot marketing such as 'trader-harvester' contracts or *tebasan* marketing, payment periods, location of sales, and modes of transport. Variables such as sales, cost of production and returns from shallot farming are explored in more detail via econometric modelling in Chapter 5.

Trader-harvester contracts or *tebasan* systems have been found to be the most popular marketing system for many agricultural commodities throughout Indonesia. Manning (1988) defined *tebasan* as a contract harvesting system whereby crops are sold prior to harvest by the farmer to a middleman (trader), who employs contract workers to complete the harvest. The current practices of the *tebasan* system are detailed as follows: prior to harvest, the trader visits the targeted shallot farms; upon the visit, the trader is able to estimate the yield; the trader subsequently negotiates a price with the farmer, who is then paid based on the estimated harvest; when the harvesting time begins, the trader brings his hired shallot-harvesters to complete the harvest and conduct post-harvest handling.

Table 3.8 shows that almost 70 per cent (adopter) and 65 per cent (conventional) of shallot farmers who sold shallots for consumption chose this type of sales, and only a small number of these farmers would sell their products under harvested and dried conditions. As a high-value commodity, shallot farmers often face a long period of post-harvest handling. During this time, farmers who choose to have post-harvest handling activities themselves have to deal with significant losses due to the high water content of shallots after harvest.

More than 90 per cent of adopters and 88 per cent of conventional farmers, choose the *tebasan* system (Table 3.8) receiving their payment before harvest or upon delivery. Few farmers accepted a delay in payment.

More than one-third of farmers transported their shallots by foot to closest road. However, more than 13 per cent of adopter farmers used motorbike and approximately 22 per cent used *tossa* (motorbike with cart). However, results from t-test indicate that the differences are not significant in relation to the main vehicles that were used to transport the products from farm or house to selling place.

Table 3.8. Marketing characteristics among shallots growers in Brebes (Central Java) in percentage, 2011

Marketing variable	Shallots for consumption				Shallots for seed			
	All samples (n=564)	Adopter (n=170)	Conventional (n=394)	Diff.	All samples (n=49)	Adopter (n=14)	Conventional (n=35)	Diff.
The form of shallot sales)								
In ground (tebasan)	66.31	70.00	64.72		12.24	7.14	14.29	
Harvested but wet	13.65	8.82	15.74	0.069*	14.29	7.14	17.14	0.100
Harvested and dried	20.04	21.18	19.54	-0.016	73.47	85.71	68.57	-0.171
Payment time								
Before harvest	54.79	62.94	51.27		16.33	7.14	20.00	
At delivery	34.75	28.24	37.56	0.0933*	67.35	64.29	68.57	0.043
1-7 days later	6.38	4.71	7.11	0.024	6.12	7.14	5.71	-0.014
More than a week later	0.89	0.59	1.02	0.004	4.08	7.14	2.86	-0.043
Multiple payments	3.19	3.53	3.05	-0.005	6.12	14.29	2.86	-0.114
Buyer took possession location								
At farm	71.45	72.94	70.81		26.53	7.14	34.29	
At house	17.2	17.65	17.01	-0.006	63.27	71.43	60.00	-0.114
Roadside	6.03	4.12	6.85	0.027	2.04	14.29	2.86	0.029
Collection place	2.48	2.94	2.28	-0.007	6.12		2.86	-0.114
Village market	0.35		0.51	0.005				
Sub-district market	1.24	1.18	1.27	0.001				
District market								
Wholesale market	1.24	1.18	1.27	0.001				
Other					2.04	7.14		-0.071

Note: ***, **, * indicate statistical significance at the $\alpha = 1\%, 5\%, 10\%$, respectively.

Table 3.8. Continued. Marketing characteristics among shallots growers in Brebes (Central Java) in percentage, 2011

Marketing variable	Shallots for consumption				Shallots for seed			
	All samples (n=564)	Adopter (n=170)	Conventional (n=394)	Diff.	All samples (n=49)	Adopter (n=14)	Conventional (n=35)	Diff.
Main vehicles to transport the shallots to selling place								
On foot	30.86	21.74	34.48		18.92	23.08	16.67	
Bicycle	4.94	10.87	2.59	-0.083*	2.70		4.17	0.042
Motorbike	8.02	13.04	6.03	-0.070	27.03	30.77	25.00	-0.058
Rented motorbike	3.09	2.17	3.45	0.013				
Tossa	21.6	21.74	21.55	-0.002	13.51	7.69	16.67	0.090
Rickshaw (*becak*)	6.79	6.52	6.90	0.004	10.81		16.67	0.167
Car	16.67	13.04	18.1	0.051	10.81	7.69	12.5	0.048
Taxi/bus								
Truck	5.56	6.52	5.17	-0.014	2.70	7.69		-0.077
Cart	1.85	2.17	1.72	-0.005	10.81	23.08	4.17	-0.189
Other	0.62	2.17		-0.022	2.70		4.17	0.042

Note: ***, **, * indicate statistical significance at the α =1%, 5%, 10%, respectively.

3.4.3.2 ***End Market and Relationship with Buyers***

This section examines the characteristics and the relationship with the buyer. Having an increasing growth demand for higher safety and quality fresh food products can be translated as a good opportunity for farmers who have adopted safer pest management practices. This growing demand can be understood as a new demand system that might offer adopter farmers premium prices. This has become more important since, as mentioned, previous literature has identified shallots as the most heavily sprayed vegetable commodity, a conclusion which was derived from a study of market assessment for horticultural commodities in Indonesia led by Shepherd and Schalke (1995).

Table 3.9. Marketing channel of shallot growers in Brebes (Central Java) in percentage, 2011

Buyer relations variable	All samples (n = 687)	Adopter (n=214)	Conventional (n=473)	Diff.
Farmers know the end market of their product	63.85	69.63	61.23	0.084*
Source of knowledge of the end market	(n=438)	(n=149)	(n=289)	
From shallots buyer/trader	82.88	77.85	85.47	
Direct communication with traders in end market	5.71	7.38	4.84	-0.025
Heard from neighbour or other farmers who sold products to the same buyer	9.82	11.41	9	-0.024
Others	1.6	3.36	0.69	-0.027*
Type of markets	(n=438)	(n=149)	(n=289)	
Traditional markets	96.12	92.62	97.92	0.053**
Supermarkets	3.65	6.04	2.42	-0.036
Processors	15.53	23.49	11.42	-0.121***
Exporters	5.25	6.04	4.84	-0.012
Hotel, restaurant and caterer	3.88	6.04	2.77	-0.033
Destination of sales	(n=687)	(n=214)	(n=473)	
Java	86.59	89.25	85.38	0.070
Outside Java	33.24	42.52	29.03	0.183

Note: ***, **, * indicate statistical significance at the $\alpha = 1\%$, 5%, 10%, respectively.

More than two-thirds of these shallot farmers knew the end markets of their products, as presented in Table 3.9. The traditional markets continued to dominate as the end-market for shallots from both groups. Adopter farmers appear to have had more end-market options compared to traditional farmers. Although the percentages were not significant for different end-markets, it is apparent that adopter farmers had more exposure to various types of end markets as final destinations for their shallots and sales. Their products were also marketed outside Java.

Relationship variables explored in Table A.19 support the previous findings. Trader-harvester contracts are the most favourable marketing system. More than 75 per cent of farmers had their first communication with the buyer when it was close to harvest while more than 20 per cent contacted their buyer after the beginning of the harvest. Interestingly, despite nearly 80 per cent of the farmers owning a mobile phone, the buyers and traders alike preferred to visit the farmers on farms or to go to the farmer's house when making transactions.

To date purchasing agreements and transactions between farmers and traders were often not recorded in a written contract. Close to 98 per cent of adopters and 96 per cent of traditional farmers made their dealings with verbal agreements, and these would cover issues about price, time of payment, grade and quantity. These types of agreements have been in place for a long time and have been acknowledged as a de-facto arrangement with buyers. Seventy nine per cent of farmers from both groups claimed that over the last five years there had been no change in the purchasing agreements with buyers (Table A.19). Moreover, almost 90 per cent of adopter farmers would usually bargain over the price with their buyer.

3.4.3.3 ***Perceptions of Modern Channels***

Farmers' exposure to modern retailers as market destinations was very small, as presented in Table A.20. Adopters are more likely to have sold to modern markets compared to traditional farmers though the number of participants for this channel are relatively small. Adopters also had more information compared to other farmers in their surroundings who had sold their products to modern channels or retailers.

The main perceived advantages of selling their shallots in the modern channel include higher prices, access to good seeds, technical assistance and the learning of new skills. The latter factors are what prevent farmers from selling their products to modern channels. They mentioned that their lack of experience and information deters them from selling their products to modern channels. As a result, both adopter and traditional shallot farmers suggest that the government should take action to facilitate their access to modern markets as well as access to credit.

3.4.4 Collective Action

This section examines the role of collaboration and shows how the shallot farmers experienced and engaged with this role as members of either farmer groups or water user associations. Another important strategy for maintaining communication and helping farmers remain competitive is collective action through various organisations in local areas, as found by Fischer and Qaim (2014). These authors examined the role of farmer groups in Kenya, especially their contribution in helping smallholder farmers to market their products. In this study, adopter farmers had had significantly more engagement with farmer groups, cooperatives and water user associations (as presented in Table A.21). Farmer groups have been in place for many years in Indonesia as locations to begin the introduction and diffusion of new technology, as well as to introduce extension activities.

In relation to this condition, it is clear that nearly 84 per cent of adopter farmers were members of farmer groups compared with 44 per cent of traditional farmers. The leader or the most progressive farmer in the farmer group would usually be pointed out by the extension officer or agricultural officer as the main participant in any type of training, including farmer field schools. The diffusion of the technology is then expected to be spread from this main participant to the other farmers. Although this study component did not test the relationship of this variable to the decision to adopt the technology, nevertheless being a member of a farmer group is likely to significantly increase farmers' access to the technology and extension services.

Table A.21 also reveals that almost 22 per cent of adopter farmers used farmer groups as a place to learn from other members. This implies that adopters have been using farmer groups to improve their farming practices. Other examples of collective action institutions are cooperatives and water user associations. However, the engagement by adopters and conventional farmers in these organisations is not as significant when compared to engagement in farmer groups.

The findings in this study were similar to an earlier study by Pretty and Ward (2001). They found that people who worked in a group had better results in terms of how the knowledge was sought and incorporated, how planning was initiated, and how the activities were more likely to be sustained after the completion of the project. Moreover, they also claimed that people who had the confidence to invest in collective action were less likely to engage in activities that resulted in negative impacts. Participating in any farmers' group particularly helped the farmers to increase their access to information. Matuschke and Qaim (2009) examined this factor when measuring the adoption rates for hybrid wheat in the state of Maharashtra, India. They found that access to information was considered as an important determinant of adoption.

3.5 Conclusion

In relation to the low rate of technology adoption, results from the descriptive analysis suggest that the existing household-level characteristics may limit traditional farmers' ability to adopt. Traditional farmers are often less educated, and have limited access to media, as well as to household and production assets. Traditional farmers are less likely to be dependent on income from shallot farming as they have more diverse income sources as compared to adopter farmers.

The descriptive analysis also shows that shallot farmers who have adopted APM practices have made quite significant changes to production and on-farm activities, in particular to their ability to reduce dependency on chemical inputs. However, to date, the introduction of APM farming practices has not led farmers to increased exposure to niche markets that would be able to provide them with premium prices.

Conventional farmers are more likely to use credit from input dealers and they are less likely to change the application of their inputs used in shallot farming. Conventional farmers are not familiar with the use of organic fertilizers and bio-pesticides in their farming systems.

Moreover, a potential obstacle for adopter farmers in production systems is the implementation of traditional marketing practices. The majority of their APM shallots end up in traditional markets. As almost 90 per cent of adopter farmers favour receiving cash on delivery, so the *tebasan* or in-the-ground sales are the more preferred marketing system. To date, this system does not differentiate products based on the method of production; the contracted-trader mixes the harvests from both the adopter and traditional farms. As a result, the adopter farmers often lose their identity, and any market advantage, as APM shallot farmers.

Traders also had limited access to niche markets for these high quality and high safety shallots. Thus, there were no incentives for the trader to separate or grade the shallots based on their production systems or pesticide application. Interestingly, almost 20 per cent of adopter farmers kept records on their usage of pesticides and 12 per cent on the application of pesticides. This indicates that adopter farmers were able to develop a simple traceability system. However, this system has to be acknowledged by the trader and finally by the end-markets by providing premium prices for this type of farming. Otherwise, business as usual practices might be difficult to change, and traders will continue to grade their shallots based on size as opposed to usage of pesticides.

Adopter farmers were also less likely to sell the shallots as seed. More than 90 per cent of farmers in this group preferred to sell their shallots for consumption. Although anecdotal evidences indicate that shallots produced using APM farming practices are drier (ASKIP) and have longer storage-time, to date in this study these conditions were not able to attract farmers' attention enough to convince them to switch their sales type.

The data analysis also shows that many traditional farmers were not involved in collective action activities such as being a member of a farmer group or cooperative. The prevailing conditions strongly influenced their willingness to participate in farmer field schools or training for new technology adoption. To date many approaches to the implementation of technology adoption in the field use farmer groups as the main method to involve participants. Consequently, the minimum engagement of traditional farmers in any collective action activities may limit their access to any new technology adoption.

In conclusion, to increase the adoption rate of APM farming practices and other safer pest management technologies in Indonesia, there is a need to consider the ability to create a link or an access for adopter farmers to the niche markets. Providing incentives is also necessary with appropriate improvements in the innovation process. Ideally, every farmer has to have equal opportunity to follow the complete innovation process, especially in receiving training. Recruitment systems have to target wider communities and minimize the inclusion of non-farmer group members. The Indonesian government should also consider the involvement of the private sector, local business entrepreneurs and NGOs as part of the process of technology adoption at various administrative levels.

The following chapters of this thesis (Chapters 4 and 5) will elaborate in more detail the roles of certain important variables in determining the relative preferences of farmers for technology attributes (in this case, sustainable farming practices for shallot growers) and the measurement of technical efficiency and yield loss that are associated with adopting APM farming practices in Indonesia.

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3.7 Appendices

Table A.1. Sample selection based on average and value production of chillies and shallots per sub district in Brebes (Central Java), 2011

No.	Sub Districts	Average production over 2008-2009 Chilies (in 100 kg)	Average production over 2008-2009 Shallots (in 100 kg)	Value of production over 2008-2009 Chilies (in Million IDR)	Value of production over 2008-2009 Shallots (in Million IDR)	Total	Cumulative total (in Million IDR)	Cum within districts	(cum - st_pt)/ interval	No stratification # villages selected
1	Salem	47	16	45	10	55	55	55	-0.44	
2	Bt.Kawung	1,014	2,460	975	1,573	2,548	2,603	2,603	-0.39	0.00
3	Bumiayu	-	-	-	-	-	2,603	2,603	-0.39	0.00
4	Paguyangan	389	-	374	-	374	2,977	2,977	-0.38	0.00
5	Sirampog	-	-	-	-	-	2,977	2,977	-0.38	0.00
6	Tonjong	1,304	90	1,254	57	1,311	4,289	4,289	-0.36	0.00
7	Larangan	110,498	613,869	106,244	392,631	498,875	503,163	503,163	9.65	10.00
8	Ketanggungan	38,121	86,200	36,654	55,133	91,787	594,950	594,950	11.49	2.00
9	Banjarharjo	13,282	24,767	12,770	15,841	28,611	623,561	623,561	12.07	1.00
10	Losari	31,802	76,126	30,577	48,690	79,268	702,829	702,829	13.66	1.00
11	Tanjung	76,087	103,599	73,158	66,262	139,420	842,249	842,249	16.45	3.00
12	Kersana	24,386	65,107	23,447	41,642	65,089	907,338	907,338	17.76	1.00
13	Bulakamba	63,363	316,722	60,923	202,575	263,498	1,170,837	1,170,837	23.05	6.00
14	Wanasari	146,523	597,823	140,882	382,368	523,250	1,694,087	1,694,087	33.54	10.00
15	Jatibarang	27,507	101,466	26,448	64,898	91,346	1,785,433	1,785,433	35.38	2.00
16	Songgom	58,207	110,078	55,966	70,406	126,372	1,911,805	1,911,805	37.91	2.00
17	Brebes	104,799	360,322	100,765	230,462	331,227	2,243,031	2,243,031	44.56	7.00
									Brebes villages	45
									Brebes interval	49,845
									Brebes st point	1,411

Table A.2. Characteristics of Indonesian shallot growers main profession in Brebes (Central Java) in percentage, 2011

Characteristic	Main profession				Secondary profession			
	All samples (n=687)	Adopter (n=214)	Conventional (n=473)	Diff.	All samples (n=687)	Adopter (n=214)	Conventional (n=473)	Diff
Profession of respondent								
Farming/aquaculture	89.52	83.18	92.39		9.32	14.95	6.77	
Self-employed trader	1.16	1.87	0.85	-0.010	10.63	11.68	10.15	-0.015
Self-employed-other	1.46	0.47	1.90	0.014	7.28	8.88	6.55	-0.023
Agricultural wage labor	1.75	2.8	1.27	-0.015	27.37	16.36	32.35	0.160***
Other wage labor	5.53	11.21	2.96	-0.083***	11.06	14.02	9.73	-0.043
Unemployed					0.15		0.21	0.002
Unpaid housework	0.29		0.42	0.004	0.29		0.42	0.004
Student								
Other	0.29	0.47	0.21	-0.003	1.16	1.87	0.85	-0.010
None					32.75	32.24	32.98	0.007
Profession of spouse								
Farming/aquaculture	36.1	31.31	38.27	0.070	23.58	33.18	19.24	-0.139***
Self-employed trader	9.02	10.75	8.25	-0.025	3.35	3.27	3.38	0.001
Self-employed-other	2.33	3.74	1.69	-0.021	2.18	3.74	1.48	-0.023
Agricultural wage labor	3.93	1.40	5.07	0.037*	11.94	6.07	14.59	0.085**
Other wage labor	2.33	4.21	1.48	-0.027*	0.58	0.93	0.42	-0.005
Unemployed					0.15		0.21	0.002
Unpaid housework	41.05		38.9	-0.069	37.55	34.58	38.9	0.043
Student								
Other					15.43	15.42	15.43	
None	5.24	2.90	6.34		5.24	2.80	6.34	0.000

Note: ***,**,* indicate statistical significance at the 1%, 5%, 10%, respectively.

Table A.3. Source of income of shallot growers per year in Brebes (Central Java) in Indonesian Rupiah, 2011

Agricultural land	All samples (n=687)		Adopter (n=214)		Conventional (n=473)		Diff.
	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev	
Agricultural income (on-farm)							
Shallot production	3.15E+07	5.57E+07	4.50E+07	8.36E+07	2.53E+07	3.50E+07	-19700822.3***
Other horticulture production	3.31E+06	8.96E+06	3.69E+06	9.51E+06	3.14E+06	8.71E+06	-5.44E+05
Other crop production	5.57E+06	1.04E+07	7.85E+06	1.54E+07	4.54E+06	6.81E+06	-3307549.0***
Livestock and animal products sales	2.40E+05	1.55E+06	3.85E+05	1.68E+06	1.74E+05	1.48E+06	-2.11E+05
Aquaculture	3.19E+05	6.73E+06	5.77E+04	6.24E+05	4.37E+05	8.10E+06	3.79E+05
Non-agricultural income (off-farm)							
Agricultural trading	3.09E+07	2.78E+08	3.56E+07	3.36E+08	2.87E+07	2.49E+08	-6.93E+06
Non-agricultural trading	2.73E+07	4.21E+08	2.16E+07	1.06E+08	2.99E+07	5.02E+08	8.28E+06
Grain milling business	6.67E+04	1.05E+06	2.14E+05	1.88E+06			-214018.7*
Food processing business	4.12E+05	4.96E+06	5.46E+05	3.78E+06	3.52E+05	5.42E+06	-1.93E+05
Other business	5.32E+06	4.26E+07	4.00E+06	2.03E+07	5.93E+06	4.95E+07	1.93E+06
Agricultural wage labor	1.68E+06	4.88E+06	1.70E+06	7.01E+06	1.66E+06	3.53E+06	-3.28E+04
Non-agricultural employment	3.96E+06	1.71E+07	5.34E+06	1.69E+07	3.33E+06	1.72E+07	-2.01E+06
Remittances, pension, assistance							
Pension	2.84E+05	2.49E+06	3.79E+05	2.97E+06	2.42E+05	2.24E+06	-1.37E+05
Remittances from family members	1.60E+06	1.00E+07	1.32E+06	6.90E+06	1.72E+06	1.11E+07	4.07E+05
Other assistance programs	2.62E+03	4.83E+04	8.41E+03	8.64E+04			-8411.2*
Other income sources	1.60E+06	7.18E+06	2.95E+06	1.16E+07	9.89E+05	3.63E+06	-1957279.4***
Total income	1.14E+08	5.27E+08	1.31E+08	4.08E+08	1.07E+08	5.73E+08	-2.46E+07

Note: ***, **, * indicate statistical significance at the 1%, 5%, 10%, respectively.

Table A.4. Share of income of shallot growers per year in Brebes (Central Java) in percentage, 2011

Agricultural land	All samples (n=687)		Adopter (n=214)		Conventional (n=473)	
	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev
Agricultural income (on-farm)						
Shallot production	27.63	10.57	34.35	20.49	23.64	6.11
Other horticulture production	2.91	1.70	2.82	2.33	2.94	1.52
Other crop production	4.89	1.97	5.99	3.77	4.25	1.19
Livestock and animal products sales	0.21	0.29	0.29	0.41	0.16	0.26
Aquaculture	0.28	1.28	0.04	0.15	0.41	1.41
	35.92		43.50		31.40	
Non-agricultural income (off-farm)						
Agricultural trading	27.11	52.75	27.18	82.35	26.82	43.46
Non-agricultural trading	23.95	79.89	16.49	25.98	27.94	87.61
Grain milling business	0.06	0.20	0.16	0.46	0.00	0.00
Food processing business	0.36	0.94	0.42	0.93	0.33	0.95
Other business	4.67	8.08	3.05	4.98	5.54	8.64
Agricultural wage labor	1.47	0.93	1.30	1.72	1.56	0.62
Non-agricultural employment	3.47	3.24	4.08	4.14	3.11	3.00
	61.08		52.67		65.30	
Remittances, pension, assistance						
Pension	0.25	0.47	0.29	0.73	0.23	0.39
Remittances from family members	1.40	1.90	1.00	1.69	1.61	1.94
Other assistance programs	0.00	0.01	0.01	0.02	0.00	0.00
Other income sources	1.40	1.36	2.25	2.84	0.92	0.63
	3.05		3.55		2.76	
Total income	1.14E+08	5.27E+08	1.31E+08	4.08E+08	1.07E+08	5.73E+08

Note: ***, **, * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Table A.5. Land size, tenure systems and access to irrigation systems of shallot growers in Brebes (Central Java) in hectares, 2011

Agricultural land	All samples (n = 687)				Adopter (n=214)				Conventional (N=473)				Diff.
	Mean	Std. Dev	Min	Max	Mean	Std. Dev	Min	Max	Mean	Std. Dev	Min	Max	
Land Assets													
Farm land	0.410	0.974	0	15.365	0.536	1.289	0	15.365	0.354	0.787	0	10.525	-0.182*
Irrigated farm land	0.345	0.661	0	6.700	0.468	0.823	0	5.075	0.289	0.565	0	6.700	-0.179***
Land size by irrigation system													
Irrigated	0.562	0.843	0	12.335	0.824	1.281	0	12.335	0.443	0.497	0	3.325	-0.381***
Rain-fed	0.064	0.242	0	3.470	0.037	0.142	0	1.100	0.077	0.275	0	3.470	0.0401*
Dryland	0.035	0.387	0	7.515	0.051	0.532	0	7.515	0.028	0.299	0	6.050	-0.023
Forest	0.004	0.038	0	0.500	0.002	0.034	0	0.500	0.004	0.040	0	0.500	0.002
Land size by tenure system													
Owned and farmed	0.283	0.583	0	9.615	0.370	0.842	0	9.615	0.244	0.411	0	3.470	-0.126**
Owned and rent it out	0.019	0.147	0	2.013	0.041	0.215	0	1.700	0.009	0.100	0	2.013	-0.009
Owned and pawned out	0.006	0.046	0	0.800	0.011	0.076	0	0.800	0.003	0.021	0	0.263	-0.008*
Owned and sharecropped out	0.052	0.255	0	2.800	0.059	0.284	0	2.800	0.049	0.241	0	2.800	-0.032**
Owned and not planted	0.004	0.034	0	0.525	0.002	0.021	0	0.245	0.004	0.038	0	0.525	0.002
Owned and lent out	0.004	0.040	0	0.700	0.007	0.060	0	0.700	0.002	0.027	0	0.350	-0.005
Pawned from owner	0.007	0.040	0	0.438	0.006	0.036	0	0.350	0.007	0.042	0	0.438	0.002
Rented from owner	0.156	0.397	0	6.050	0.189	0.428	0	3.850	0.140	0.382	0	6.050	-0.049
Sharecropped from owner	0.077	0.162	0	1.088	0.083	0.176	0	1.050	0.074	0.156	0	1.088	-0.009
Borrow from owner	0.053	0.451	0	9.855	0.132	0.792	0	9.855	0.017	0.087	0	0.968	-0.115**

Note: ***, **, * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Table A.5. Continued. Land size, tenure systems and access to irrigation systems of shallot growers in Brebes (Central Java) in hectares, 2011

Agricultural land	All samples (n = 687)				Adopter (n=214)				Conventional (N=473)				Diff.
	Mean	Std. Dev	Min	Max	Mean	Std. Dev	Min	Max	Mean	Std. Dev	Min	Max	
Land size by irrigation type in rainy season													
Without irrigation	0.089	0.467	0	9.615	0.117	0.728	0	9.615	0.076	0.278	0	3.470	-0.062*
Gravity	0.101	0.239	0	2.800	0.110	0.244	0	1.400	0.097	0.236	0	2.800	-0.181***
Pumped surface water	0.227	0.486	0	7.505	0.334	0.728	0	7.505	0.178	0.310	0	2.800	-0.011
Pumped ground water	0.127	0.375	0	6.050	0.143	0.350	0	3.000	0.120	0.386	0	6.050	0.005
Land size by irrigation type in dry season													
Without irrigation	0.035	0.315	0	7.515	0.078	0.546	0	7.515	0.016	0.091	0	0.968	-0.041
Gravity	0.476	0.648	0	8.850	0.600	0.783	0	5.830	0.420	0.568	0	8.850	-0.013
Pumped surface water	0.028	0.176	0	2.800	0.035	0.188	0	2.000	0.025	0.171	0	2.800	-0.157***
Pumped ground water	0.004	0.041	0	0.700	0.001	0.012	0	0.175	0.006	0.049	0	0.700	-0.023

Note: ***, **, * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Table A.6. Characteristic of shallot growers with access to land and water in Brebes (Central Java) in percentage, 2011

Agricultural land	All samples (n=687)	Adopter (n=214)	Conventional (n=473)	Diff.
Land assets				
Ownership of farm land	61.72	64.49	60.47	-0.04
Ownership of irrigated farm land	57.64	61.68	55.81	-0.06
Percent of shallot growers with land holdings and irrigation systems				
Irrigated	92.43	98.60	89.64	-0.090***
Rain-fed	13.97	8.88	16.28	0.074**
Dry land	5.68	6.54	5.29	-0.013
Forest	1.02	0.47	1.27	0.008
Percent of shallot growers with land tenure systems				
Owned and farmed	57.50	58.88	56.87	-0.020
Owned and rent it out	9.46	10.75	8.88	-0.019
Owned and pawned out	2.77	3.27	2.54	-0.007
Owned and sharecropped out	3.49	6.07	2.33	-0.038*
Owned and not planted	2.04	1.40	2.33	0.009
Owned and lent out	1.46	2.34	1.06	-0.013
Pawned from owner	3.64	2.80	4.02	0.012
Rented from owner	37.99	40.65	36.79	-0.039
Sharecropped from owner	28.97	29.44	28.75	-0.007
Borrow from owner	8.01	13.08	5.71	-0.074***
Percent of shallot growers with access to water in rainy season				
Without irrigation	7.57	11.21	5.92	-0.053*
Gravity	90.54	91.12	90.27	-0.008
Pumped surface water	5.68	6.54	5.29	-0.013
Pumped ground water	1.89	0.47	2.54	0.021
Percent of shallot growers with access to water in dry season				
Without irrigation	17.32	15.89	17.97	0.021
Gravity	27.51	27.57	27.48	-0.001
Pumped surface water	45.56	49.53	43.76	-0.058
Pumped ground water	27.80	28.50	27.48	-0.010

Note: ***,**,* indicate statistical significance at the 1%, 5%, 10% level, respectively.

Table A.7. Shallot growers and cropping pattern for major crops per season in Brebes (Central Java) in percentage, 2011

Crop	All samples (n=687)	Adopter (n=214)	Conventional (n=473)	Diff.
Dry season 1 (June - August) - First commodity				
Shallot	59.24	68.22	55.18	-0.130**
Chilli	16.01	15.42	16.28	0.009
Maize	5.53	4.67	5.92	0.013
Rice	5.24	6.07	4.86	-0.012
Banana	1.16	2.80	0.42	-0.024**
Second commodity				
Chilli	1.31	1.40	1.27	-0.001
Maize	14.99	16.82	14.16	-0.027
Groundnuts	2.18	3.27	1.69	-0.016
Shallot	1.16	2.34	0.63	-0.017
Rice	2.04	2.80	1.69	-0.011
Rainy season (Sept-Feb) - First commodity				
Shallot	50.66	42.99	54.12	0.111**
Rice	1.16	2.80	0.42	-0.024**
Maize	4.37	5.61	3.81	-0.018
Other annual crops	65.50	74.77	61.31	-0.135***
Cucumber	0.15	0.47	0.00	-0.005
Other vegetables	0.87	0.47	1.06	0.006
Second commodity				
Shallot	34.06	46.73	28.33	-0.184***
Rice	15.28	11.68	16.91	0.052
Chilli	5.39	4.67	5.71	0.010
Maize	3.35	2.80	3.59	0.008
Soybeans	2.33	4.67	1.27	-0.034**
Eggplant	1.31	2.34	0.85	-0.015
Dry season 2 (March - April) - First commodity				
Shallot	76.27	77.57	75.69	-0.019
Rice	22.42	22.90	22.20	-0.007
Maize	9.02	6.54	10.15	0.036
Soybeans	9.90	16.82	6.77	-0.101***
Chilli	3.49	3.27	3.59	0.003
Other annual crops	0.15	0.47	0.00	-0.005
Second commodity				
Chilli	23.00	23.36	22.83	-0.005
Shallot	5.39	6.54	4.86	-0.017
Maize	5.68	4.67	6.13	0.015
Groundnuts	3.93	6.54	2.75	-0.038*
Eggplant	2.62	3.27	2.33	-0.009
Rice	3.35	4.21	2.96	-0.013

Note: ***, **, * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Table A.8. Land size of various cropping pattern per season by shallot growers in Brebes (Central Java) in hectares, 2011

Crops	All samples (n = 687)				Adopter (n=214)				Conventional (n=473)				Diff.
	Mean	Std. Dev	Min	Max	Mean	Std. Dev	Min	Max	Mean	Std. Dev	Min	Max	
Dry season 1 - first crop													
Shallot	0.197	0.322	0	3.850	0.290	0.448	0	3.850	0.155	0.234	0	2.100	-0.135***
Chilli	0.041	0.160	0	3.150	0.031	0.097	0	0.775	0.046	0.181	0	3.150	0.015
Maize	0.013	0.068	0	0.730	0.013	0.069	0	0.575	0.013	0.068	0	0.730	0.000
Rice	0.019	0.116	0	2.100	0.023	0.115	0	0.898	0.017	0.116	0	2.100	-0.006
Banana	0.006	0.134	0	3.500	0.019	0.240	0	3.500	0.000	0.010	0	0.214	-0.018
Dry season 1 - second crop													
Chilli	0.040	0.125	0	1.400	0.054	0.162	0	1.400	0.033	0.104	0	1.050	-0.001
Maize	0.008	0.074	0	1.194	0.014	0.101	0	1.194	0.006	0.058	0	1.080	-0.021*
Groundnuts	0.000	0.006	0	0.150	0.001	0.011	0	0.150	0.000	0.000	0	0.000	-0.009
Shallot	0.003	0.034	0	0.500	0.004	0.039	0	0.438	0.003	0.031	0	0.500	-0.009*
Rice	0.004	0.050	0	1.000	0.011	0.083	0	1.000	0.001	0.020	0	0.350	-0.001
Rainy season - first crop													
Shallot	0.160	0.312	0	3.850	0.150	0.352	0	3.850	0.164	0.292	0	3.120	0.014
Rice	0.287	0.446	0	4.400	0.414	0.613	0	4.400	0.229	0.329	0	2.188	-0.006**
Maize	0.014	0.091	0	1.500	0.027	0.148	0	1.500	0.008	0.045	0	0.525	-0.019*
Other annual crops	0.007	0.154	0	4.000	0.021	0.274	0	4.000	0.001	0.013	0	0.230	-0.185***
Cucumber	0.003	0.030	0	0.613	0.007	0.051	0	0.613	0.001	0.009	0	0.175	-0.020

Note: ***, **, * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Table A.8. Continued. Land size of various cropping pattern per season by shallot growers in Brebes (Central Java) in hectares, 2011

Crops	All samples (n = 687)				Adopter (n=214)				Conventional (n=473)				Diff.
	Mean	Std. Dev	Min	Max	Mean	Std. Dev	Min	Max	Mean	Std. Dev	Min	Max	
Rainy season - second crop													
Shallot	0.123	0.289	0	2.930	0.220	0.431	0	2.930	0.079	0.176	0	1.750	-0.141***
Rice	0.047	0.207	0	3.000	0.041	0.223	0	3.000	0.050	0.200	0	2.800	0.009
Chilli	0.014	0.076	0	1.000	0.010	0.054	0	0.525	0.016	0.085	0	1.000	0.007
Maize	0.011	0.090	0	1.780	0.014	0.126	0	1.780	0.010	0.068	0	1.000	-0.004
Soybean	0.005	0.040	0	0.790	0.008	0.040	0	0.350	0.003	0.039	0	0.790	-0.005
Dry season 2 - first crop													
Shallot	0.254	0.352	0	3.850	0.314	0.481	0	3.850	0.227	0.272	0	2.450	-0.087**
Rice	0.095	0.284	0	3.500	0.132	0.376	0	3.500	0.078	0.230	0	2.188	-0.054*
Maize	0.029	0.124	0	1.500	0.028	0.139	0	1.500	0.030	0.116	0	1.050	0.002
Soybeans	0.030	0.129	0	1.570	0.062	0.191	0	1.570	0.016	0.085	0	1.050	-0.046***
Chilli	0.007	0.045	0	0.350	0.005	0.034	0	0.350	0.008	0.049	0	0.350	0.003
Other annual crops	0.007	0.154	0	4.000	0.021	0.274	0	4.000	0.001	0.014	0	0.230	-0.020
Dry season 2 - second crop													
Chili	0.051	0.123	0	1.050	0.048	0.114	0	0.775	0.052	0.126	0	1.050	0.003
Shallot	0.013	0.067	0	1.000	0.022	0.103	0	1.000	0.008	0.041	0	0.350	-0.013*
Maize	0.016	0.101	0	1.750	0.014	0.086	0	1.050	0.017	0.108	0	1.750	0.003
Groundnuts	0.011	0.070	0	0.750	0.023	0.107	0	0.750	0.006	0.043	0	0.675	-0.017**
Eggplant	0.007	0.049	0	0.700	0.012	0.072	0	0.700	0.005	0.033	0	0.360	-0.007
Rice	0.012	0.089	0	1.575	0.019	0.135	0	1.575	0.009	0.057	0	0.525	-0.010

Note: ***,**,* indicate statistical significance at the α =1%, 5%, 10%, respectively.

Table A.9. Characteristics of shallot production in dry season-1 in Brebes (Central Java) in percentage , 2011

Production Variable	All samples (n = 687)	Adopter (n=214)	Conventional (n=473)	Diff.
	Freq.	Freq.	Freq.	
Dry season 1				
Planting time	Freq (n=409)	Freq (n=146)	Freq (n=263)	
March	1.22	0.68	1.52	
April	9.54	11.64	8.37	-0.033
May	22.00	20.55	22.81	0.023
June	39.85	39.04	40.30	0.013
July	21.03	19.86	21.67	0.018
August	3.91	6.16	2.66	-0.035
September	0.73	0.68	0.76	0.001
October	1.71	1.37	1.90	0.005
Variety				
Bima curut	90.71	92.47	89.73	
Other Bima	5.38	2.74	6.84	0.041
Kuning	1.96	2.74	1.52	-0.012
Import	0.73	0.68	0.76	0.001
Hybrid	0.49	1.37		-0.014
Other	0.73		1.14	0.011
Production type				
Consumption	59.41	59.59	59.32	
Seed	21.52	22.6	20.91	-0.017
Both types	18.34	17.81	18.63	0.008
Not yet decided [a)]	0.73		1.14	0.011

Note: [a)] indicate that shallot growers have not completed the harvesting activity, thus some growers were not able to decide the final-type of their harvested shallots

***,**,* indicate statistical significance at the $\alpha = 1\%, 5\%, 10\%$, respectively.

Table A.10. Characteristics of shallot production in wet season in Brebes (Central Java) in percentage, 2011

Production Variable	All samples (n = 687)	Adopter (n=214)	Conventional (n=473)	Diff.
	Freq.	Freq.	Freq.	
Rainy season				
Planting time	(n=511)	(n=156)	(n=355)	
Agustus	5.09	5.13	5.07	-0.001
September	16.05	17.95	15.21	-0.027
October	38.36	39.74	37.75	-0.020
November	21.92	18.59	23.38	0.048
December	12.33	13.46	11.83	-0.016
January	3.30	1.28	4.23	
February	3.33	1.28	4.23	0.001
April	1.37	1.28	1.41	0.003
May	0.20	0.00	0.28	0.003
June	0.20	0.00	0.28	-0.006
July	0.20	0.64	0.00	-0.014
Variety	0.98	1.92	0.56	
Bima curut	91.39	91.67	91.27	
Other Bima	6.65	6.41	6.76	0.004
Maja	0.39		0.56	0.006
Kuning	0.39		0.56	0.006
Import	0.39	1.28		-0.013*
Hybrid	0.20	0.64		-0.006
Other	0.59		0.85	0.008
Production type				
Consumption	46.77	39.10	50.14	
Seed	29.16	35.90	26.20	-0.097*
Both types	24.07	25.00	23.66	-0.013
Not yet decided				

Note: ***, **, * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Table A.11. Characteristics of shallot production in dry season-2 in Brebes (Central Java) in percentage, 2011

Production Variable	All samples (n = 687) Freq.	Adopter (n=214) Freq.	Conventional (n=473) Freq.	Diff.
Dry season 2				
Planting time	(n=535)	(n=169)	(n=366)	
January	1.50	1.18	1.64	
February	8.97	13.02	7.10	-0.059*
March	15.33	13.02	16.39	0.034
April	23.18	26.63	21.58	-0.050
May	33.64	29.59	35.52	0.059
June	15.51	14.79	15.85	0.011
July	1.68	1.18	1.91	0.007
December	0.19	0.59	0.00	-0.006
Variety	(n=535)	(n=169)	(n=366)	
Bima curut	92.08	88.17	90.84	
Other Bima	6.28	7.69	6.73	-0.014
Maja	0.27	0.00	0.19	0.003
Kuning	0.55	1.18	0.75	-0.006
Import	0.00	1.18	0.37	-0.012*
Hybrid	0.00	1.18	0.37	-0.012*
Other	0.82	0.59	0.75	0.002
Production type [a*)]	(n=535)	(n=169)	(n=366)	
Consumption	44.86	43.79	45.36	
Seed	19.25	26.04	16.12	-0.099**
Both types	15.51	13.02	16.67	0.037
Not yet decided	20.37	17.16	21.86	0.047

Note: [a)] indicate that shallot growers have not completed the harvesting activity, therefore some growers were not able to decide the final-type of their harvested shallot.
***, **, * indicate statistical significance at the 1%, 5% and 10% levels, respectively..

Table A.12. Characteristics of shallot production in dry season-1in Brebes (Central Java), 2011

Production Variable	All samples (n = 687)				Adopter (n=214)				Conventional (n=473)				Diff.
	Mean	Std. Dev	Min	Max	Mean	Std. Dev	Min	Max	Mean	Std. Dev	Min	Max	
Dry season 1													
Planted area (ha)	0.197	0.315	0	3.850	0.282	0.429	0	3.850	0.159	0.238	0	2.100	-0.124***
Harvested area (MT)	1.807	4.084	0	44.000	2.507	4.885	0	44.000	1.491	3.626	0	29.997	-1015.5**
Planting time (in hectares)													
a. March	0.004	0.041	0	0.700	0.007	0.061	0	0.700	0.002	0.023	0	0.350	-0.005
b. April	0.027	0.102	0	1.000	0.040	0.144	0	1.000	0.019	0.068	0	0.613	-0.021
c. May	0.076	0.179	0	2.000	0.097	0.239	0	2.000	0.065	0.134	0	1.000	-0.032
d. June	0.148	0.305	0	3.850	0.177	0.388	0	3.850	0.132	0.246	0	2.100	-0.045
e. July	0.062	0.184	0	2.000	0.073	0.224	0	2.000	0.056	0.158	0	1.750	-0.017
f. August	0.009	0.049	0	0.540	0.013	0.056	0	0.400	0.007	0.045	0	0.540	-0.006
g. September - October	0.332	0.350	0.01	3.850	0.414	0.464	0.04	3.850	0.286	0.256	0.01	2.100	-0.128***
Variety (in hectares)													
a. Bima curut	0.294	0.300	0	2.930	0.365	0.369	0	2.930	0.255	0.245	0	2.100	-0.110***
b. Other bima	0.016	0.094	0	1.225	0.014	0.106	0	1.225	0.017	0.087	0	1.050	0.003
c. Kuning	0.004	0.033	0	0.350	0.007	0.045	0	0.350	0.003	0.023	0	0.270	-0.005
d. Import	0.014	0.209	0	3.850	0.026	0.319	0	3.850	0.008	0.109	0	1.750	-0.019
e. Hybrid	0.001	0.009	0	0.150	0.002	0.014	0	0.150					-0.002
f. Other	0.003	0.032	0	0.525					0.004	0.040	0	0.525	0.004
Production type *(in hectares)*													
a. Consumption	0.229	0.340	0	3.850	0.294	0.449	0	3.850	0.193	0.254	0	2.100	-0.102**
b. Seed	0.051	0.143	0	1.500	0.066	0.183	0	1.500	0.043	0.115	0	1.050	-0.023
c. Both types	0.051	0.152	0	1.575	0.054	0.149	0	1.000	0.049	0.153	0	1.575	-0.005
d. Not yet decided[a)]	0.001	0.010	0	0.175					0.001	0.012	0	0.175	0.001

Note: ***, **, * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Table A.13. Characteristics of shallot production in wet season in Brebes (Central Java), 2011

Production Variable	All samples (n = 687)				Adopter (n=214)				Conventional (n=473)				Diff.
	Mean	Std. Dev	Min	Max	Mean	Std. Dev	Min	Max	Mean	Std. Dev	Min	Max	
Rainy season													
Planted area (ha)	0.286	0.404	0	3.850	0.356	0.520	0	3.850	0.255	0.336	0	3.120	-0.101**
Harvested area (MT)	2.548	4.870	0	31.197	3.017	5.118	0	29.500	2.336	4.745	0	31.197	-681.6
Planting time (in hectares)													
a. Agustus	0.025	0.110	0	1.380	0.041	0.151	0	1.380	0.017	0.085	0	1.000	-0.023*
b. September	0.066	0.185	0	2.100	0.087	0.193	0	1.200	0.056	0.181	0	2.100	-0.030
c. October	0.147	0.313	0	3.850	0.202	0.463	0	3.850	0.124	0.214	0	2.100	-0.078**
d. November	0.061	0.148	0	1.225	0.075	0.195	0	1.225	0.055	0.122	0	0.700	-0.020
e. December	0.039	0.173	0	3.120	0.035	0.109	0	0.700	0.041	0.195	0	3.120	0.006
f. January	0.030	0.119	0	1.575	0.024	0.087	0	0.613	0.033	0.130	0	1.575	0.009
g. Feb - July	0.385	0.427	0.02	3.850	0.489	0.553	0.02	3.850	0.339	0.349	0.02	3.120	-0.149***
Variety (in hectares)													
a. Bima curut	0.342	0.389	0	3.120	0.429	0.484	0	2.930	0.304	0.333	0	3.120	-0.125***
b. Other bima	0.029	0.156	0	1.575	0.027	0.143	0	1.400	0.029	0.161	0	1.575	0.002
c. Maja	0.001	0.011	0	0.175					0.001	0.013	0	0.175	
d. Kuning	0.001	0.014	0	0.270					0.001	0.017	0	0.270	0.001
e. Import	0.010	0.176	0	3.850	0.031	0.319	0	3.850					-0.031
f. Hybrid	0.000	0.004	0	0.088	0.001	0.007	0	0.088					-0.001
g. Other	0.003	0.049	0	1.050					0.004	0.059	0	1.050	0.004
Production type (in hectares)													
a. Consumption	0.237	0.367	0	3.850	0.287	0.437	0	3.850	0.215	0.330	0	3.120	-0.071*
b. Seed	0.072	0.148	0	1.050	0.109	0.182	0	0.963	0.055	0.127	0	1.050	-0.054***
c. Both types	0.077	0.201	0	2.000	0.093	0.249	0	2.000	0.069	0.176	0	1.225	-0.024

Note: ***,**,* indicate statistical significance at the α =1%, 5%, 10%, respectively.

Table A.14. Characteristics of shallot production in dry season-2 in Brebes (Central Java), 2011

Production Variable	All samples (n = 687)				Adopter (n=214)				Conventional (n=473)				Diff.
	Mean	Std. Dev	Min	Max	Mean	Std. Dev	Min	Max	Mean	Std. Dev	Min	Max	
Dry season 2													
Planted area (ha)	0.283	0.374	0	3.850	0.349	0.503	0	3.850	0.254	0.293	0	2.450	-0.096**
Harvested area (MT)	2.145	4.737	0	39.996	2.399	4.768	0	39.996	2.031	4.723	0	32.997	-368.7
Planting time (in hectares)													
a. January	0.010	0.051	0	0.525	0.008	0.047	0	0.438	0.010	0.053	0	0.525	0.002
b. February	0.038	0.110	0	1.050	0.048	0.120	0	0.700	0.033	0.106	0	1.050	-0.015
c. March	0.074	0.162	0	1.200	0.081	0.194	0	1.200	0.070	0.146	0	1.000	-0.011
d. April	0.090	0.221	0	2.180	0.120	0.287	0	2.180	0.077	0.182	0	2.100	-0.043*
e. May	0.102	0.191	0	1.575	0.104	0.189	0	0.875	0.102	0.193	0	1.575	-0.002
f. June	0.039	0.160	0	3.000	0.053	0.249	0	3.000	0.032	0.093	0	0.875	-0.021
g. July - Dec	0.364	0.387	0.02	3.850	0.442	0.529	0.04	3.850	0.328	0.294	0.02	2.450	-0.114**
Variety (in hectares)													
a. Bima curut	0.325	0.337	0	2.930	0.374	0.417	0	2.930	0.302	0.291	0	2.450	-0.071*
b. Other bima	0.024	0.131	0	1.575	0.028	0.140	0	1.400	0.022	0.126	0	1.575	-0.006
c. Maja	0.000	0.008	0	0.175					0.000	0.009	0	0.175	0.000
d. Kuning	0.002	0.028	0	0.420	0.004	0.036	0	0.350	0.001	0.022	0	0.420	-0.003
e. Import	0.009	0.172	0	3.850	0.029	0.307	0	3.850					-0.029
f. Hybrid	0.002	0.043	0	1.000	0.006	0.077	0	1.000					-0.006
g. Other	0.002	0.020	0	0.350	0.001	0.013	0	0.175	0.002	0.022	0	0.350	0.001
Production type [a)] (in hectares)													
a. Consumption	0.209	0.335	0	3.850	0.266	0.456	0	3.850	0.183	0.257	0	2.100	-0.083**
b. Seed	0.053	0.193	0	3.700	0.089	0.312	0	3.700	0.037	0.093	0	0.700	-0.052**
c. Both types	0.051	0.148	0	1.575	0.032	0.092	0	0.525	0.059	0.167	0	1.575	0.027
d. Not yet decided [a)]	0.051	0.126	0	0.875	0.055	0.149	0	0.875	0.049	0.114	0	0.875	-0.007

Note: [a)] indicate that shallot growers have not completed the harvesting activity, therefore some growers were not able to decide the final-type of their harvested shallot.
***,**,* indicate statistical significance at the $\alpha = 1\%$, 5%, 10%, respectively.

Table A.15. The acquired systems for inputs used by shallot growers in Brebes (Central Java) in percentage, 2011

Type of input	All samples (n = 687)	Adopter (n=214)	Conventional (n=473)	Diff.
Seed	(n=316)	(n=77)	(n=239)	
Saved-seed	2.53	1.30	2.93	
Cash purchase	87.97	88.31	87.87	-0.004
Credit from buyer of crop	0.32	0.00	0.42	0.004
Credit from input dealer	6.65	9.09	5.86	-0.032
Credit from farmer group	0.00	0.00	0.00	
Other credit	2.22	1.30	2.51	0.012
Provide for free	0.32	0.00	0.42	0.004
Chemical fertilizer	(n=678)	(n=209)	(n=469)	
Self-produced	1.03	1.44	0.85	
Cash purchase	60.03	58.85	60.55	0.017
Credit from buyer of crop	0.44	0.96	0.21	-0.007
Credit from input dealer	36.58	37.80	36.03	-0.018
Credit from farmer group	0.59	0.00	0.85	0.009
Other credit	1.33	0.96	1.49	0.005
Provide for free	0.00	0.00	0.00	
Organic fertilizer	(n=265)	(n=144)	(n=121)	
Self-produced	3.77	5.56	1.65	
Cash purchase	72.45	70.14	75.21	0.051
Credit from buyer of crop	0.75	0.69	0.83	0.001
Credit from input dealer	15.09	13.19	17.36	0.042
Credit from farmer group	3.02	3.47	2.48	-0.010
Other credit	0.75	0.69	0.83	0.001
Provide for free	4.15	6.25	1.65	-0.046
Chemical pesticide	(n=686)	(n=214)	(n=472)	
Self-produced	0.87	1.40	0.64	
Cash purchase	55.10	57.01	54.24	-0.049
Credit from buyer of crop	0.87	2.34	0.21	-0.0169*
Credit from input dealer	40.96	37.38	42.58	0.058
Credit from farmer group	0.73	0.47	0.85	0.009
Other credit	1.31	0.93	1.48	0.005
Provide for free	0.15	0.47	0.00	

Note: ***,**,* indicate statistical significance at the α =1%, 5%, 10%, respectively.

Table A.15. Continued. The acquired systems for inputs used by shallot growers in Brebes (Central Java) in percentage, 2011

Type of input	All samples (n = 687)	Adopter (n=214)	Conventional (n=473)	Diff.
Insect traps	(n=136)	(n=62)	(n=74)	
Self-produced	0.74	1.61	0.00	
Cash purchase	73.53	77.42	70.27	-0.072
Credit from buyer of crop	0.00	0.00	0.00	
Credit from input dealer	23.53	17.74	28.38	0.106
Credit from farmer group	0.00	0.00	0.00	
Other credit	0.00	0.00	0.00	
Provide for free	2.21	3.23	1.35	-0.019
Herbicide	(n=569)	(n=174)	(n=395)	
Self-produced	1.58	2.87	1.01	
Cash purchase	66.78	69.54	65.57	-0.040
Credit from buyer of crop	0.18	0.00	0.25	0.003
Credit from input dealer	30.05	26.44	31.65	0.052
Credit from farmer group	0.35	0.57	0.25	-0.003
Other credit	1.05	0.57	1.27	0.007
Provide for free				
Fungicide	(n=572)	(n=185)	(n=387)	
Self-produced	1.22	1.62	1.03	
Cash purchase	60.49	62.70	59.43	-0.033
Credit from buyer of crop	0.70	1.62	0.26	-0.014
Credit from input dealer	36.19	32.97	37.73	0.048
Credit from farmer group	0.17	0.00	0.26	0.003
Other credit	1.05	0.54	1.29	0.008
Provide for free	0.17	0.54	0.00	-0.005

Note: ***,**,* indicate statistical significance at the α =1%, 5%, 10%, respectively.

Table A.16. Changed in input use in last five years by shallot growers in Brebes (Central Java) in percentage , 2011

Type of input	All samples (n = 687)	Adopter (n=214)	Conventional (n=473)	Diff.
Saved and non-hybrid seed	(n=686)	(n=213)	(n=473)	
Not applicable	1.90	0.94	2.33	
No change in amount per m^2	58.16	58.22	58.14	-0.001
Increased amount per m^2	11.81	11.27	12.05	0.008
Decreased amount per m^2	22.16	22.07	22.2	0.001
Increased and different type	3.94	5.16	3.38	-0.018
No change, but different type	1.31	1.88	1.06	-0.008
Decreased and different type	0.73	0.47	0.85	0.004
Hybrid seed	(n=683)	(n=211)	(n=472)	
Not applicable	72.77	68.25	74.79	
No change in amount per m^2	24.74	29.86	22.46	-0.074^{*}
Increased amount per m^2	1.46	0.95	1.69	0.007
Decreased amount per m^2	0.88	0.47	1.06	0.006
Increased and different type	0.15	0.47		-0.005
Chemical fertilizer	(n=686)	(n=214)	(n=472)	
Not applicable	1.75	1.4	1.91	
No change in amount per m^2	49.27	36.92	54.87	0.180^{***}
Increased amount per m^2	19.68	16.82	20.97	0.042
Decreased amount per m^2	15.31	31.31	8.05	-0.233^{***}
Increased and different type	8.75	7.94	9.11	0.012
No change, but different type	4.23	3.74	4.45	0.007
Decreased and different type	1.02	1.87	0.64	-0.012
Organic fertilizer	(n=681)	(n=213)	(n=468)	
Not applicable	44.93	23.94	54.49	
No change in amount per m^2	22.47	21.13	23.08	0.020
Increased amount per m^2	23.49	42.72	14.74	-0.280^{***}
Decreased amount per m^2	5.43	5.63	5.34	-0.003
Increased and different type	2.2	5.16	0.85	-0.043^{***}
No change, but different type	0.88	0.47	1.07	0.006
Decreased and different type	0.59	0.94	0.43	-0.005
Chemical pesticide	(n=686)	(n=214)	(n=472)	
Not applicable	1.46	0.47	1.91	
No change in amount per m^2	29.88	27.1	31.14	0.040
Increased amount per m^2	29.59	27.1	30.72	0.042
Decreased amount per m^2	16.18	23.83	12.71	-0.133^{***}
Increased and different type	14.87	14.02	15.25	0.024
No change, but different type	6.71	5.61	7.2	0.025
Decreased and different type	1.31	1.87	1.06	-0.012

Note: ***,**,* indicate statistical significance at the α =1%, 5%, 10%, respectively.

Table A.16. Continued. Changed in input use in last five years by shallot growers in Brebes, (Central Java) , 2011

Type of input	All samples (n = 687)	Adopter (n=214)	Conventional (n=473)	Diff.
Bio pesticide	(n=683)	(n=212)	(n=471)	
Not applicable	65.74	47.17	74.1	
No change in amount per m^2	19.03	20.75	18.26	-0.025
Increased amount per m^2	9.66	21.23	4.46	-0.168***
Decreased amount per m^2	3.22	7.08	1.49	-0.056***
Increased and different type	1.9	3.77	1.06	-0.027*
No change, but different type	0.29		0.42	0.004
Decreased and different type	0.15		0.21	0.002
Insect traps	(n=684)	(n=214)	(n=470)	
Not applicable	55.99	44.39	61.28	
No change in amount per m^2	26.61	28.04	25.96	-0.021
Increased amount per m^2	7.89	12.15	5.96	-0.062**
Decreased amount per m^2	5.56	11.68	2.77	-0.089***
Increased and different type	2.49	2.34	2.55	0.002
No change, but different type	1.32	0.93	1.49	0.006
Decreased and different type	0.15	0.47		-0.005
Herbicide	(n=684)	(n=214)	(n=470)	
Not applicable	6.57	5.61	7.01	
No change in amount per m^2	66.13	62.62	67.73	0.051
Increased amount per m^2	14.6	15.42	14.23	-0.012
Decreased amount per m^2	6.42	8.41	5.52	-0.029
Increased and different type	3.21	4.67	2.55	-0.021
No change, but different type	2.77	2.8	2.76	0.000
Decreased and different type	0.29	0.47	0.21	-0.003
Fungicide	(n=684)	(n=214)	(n=470)	
Not applicable	5.84	4.67	6.37	
No change in amount per m^2	53.87	49.53	55.84	0.063
Increased amount per m^2	18.98	21.03	18.05	-0.030
Decreased amount per m^2	8.76	13.08	6.79	-0.063**
Increased and different type	8.18	7.94	8.28	0.003
No change, but different type	3.94	3.27	4.25	0.010
Decreased and different type	0.44	0.47	0.42	0.000

Note: ***,**,* indicate statistical significance at the α =1%, 5%, 10%, respectively.

Table A. 17. Changed in labor use in last five years by shallot growers in Brebes (Central Java) in percentage, 2011

Type of input	All samples (n = 687)	Adopter (n=214)	Conven tional (n=473)	Diff.
Land preparation-planting-watering	(n=686)	(n=213)	(n=473)	
Not applicable	1.46	0.47	1.9	
No change in amount per m^2	77.7	76.06	78.44	0.024
Increased amount per m^2	16.62	18.78	15.64	-0.031
Decreased amount per m^2	3.21	2.82	3.38	0.006
Increased and different type	0.15	0.47		-0.005
No change, but different type	0.87	1.41	0.63	-0.008
Decreased and different type				
Watering	(n=683)	(n=212)	(n=471)	
Not applicable	21.82	24.06	20.81	
No change in amount per m^2	74.82	71.23	76.43	0.052
Increased amount per m^2	1.76	3.3	1.06	-0.022*
Decreased amount per m^2	1.17	1.42	1.06	-0.004
Increased and different type				
No change, but different type	0.44		0.64	0.006
Decreased and different type				
Weeding	(n=685)	(n=213)	(n=472)	
Not applicable	16.06	15.96	16.1	
No change in amount per m^2	73.28	71.36	74.15	0.028
Increased amount per m^2	7.45	7.98	7.2	-0.008
Decreased amount per m^2	2.34	3.29	1.91	-0.014
Increased and different type	0.29	0.94		-0.009*
No change, but different type	0.58	0.47	0.64	0.002
Decreased and different type				

Note: ***,**,* indicate statistical significance at the $\alpha = $1%, 5%, 10%, respectively.

Table A.17. Continued. Changed in labor use in last five years by shallot growers in Brebes (Central Java) in percentage, 2011

Type of input	All samples (n = 687)	Adopter (n=214)	Conventional (n=473)	Diff.
Spraying	(n=682)	(n=212)	(n=470)	
Not applicable	22.29	25	21.06	
No change in amount per m^2	73.61	69.34	75.53	0.062
Increased amount per m^2	2.35	4.72	1.28	-0.034**
Decreased amount per m^2	1.32	0.94	1.49	0.005
Increased and different type				
No change, but different type	0.44		0.64	0.006
Decreased and different type				
Manual insect removal	(n=685)	(n=213)	(n=472)	
Not applicable	12.99	14.08	12.5	
No change in amount per m^2	71.97	69.01	73.31	0.043
Increased amount per m^2	9.34	8.45	9.75	0.013
Decreased amount per m^2	3.8	6.1	2.75	-0.034*
Increased and different type	1.17	1.41	1.06	-0.003
No change, but different type	0.73	0.94	0.64	-0.003
Decreased and different type				
Harvest - post harvest	(n=686)	(n=213)	(n=473)	
Not applicable	9.62	9.86	9.51	
No change in amount per m^2	76.97	73.24	78.65	0.054
Increased amount per m^2	5.69	7.51	4.86	-0.027
Decreased amount per m^2	6.27	7.98	5.5	-0.025
Increased and different type	0.15		0.21	0.002
No change, but different type	1.31	1.41	1.27	-0.001
Decreased and different type				

Note: ***, **, * indicate statistical significance at the α =1%, 5%, 10%, respectively.

Table A.18. Reason for change in input use in last five years by shallot growers in Brebes (Central Java) in percentage, 2011

Type of input	All samples (n = 687)	Adopter (n=214)	Conven tional (n=473)	Diff.
Chemical fertilizer	(n=336)	(n=132)	(n=204)	
To increase land fertility	35.71	31.06	38.73	0.077
To increase yield	26.19	22.73	28.43	0.057
To reduce cost	8.04	11.36	5.88	-0.055
To change in level of pest and disease problems	7.14	8.33	6.37	-0.020
Better information	6.85	9.09	5.39	-0.037
Change in input price	6.55	6.82	6.37	
To increase quality	6.25	9.85	3.92	-0.059*
Change in shallot price	1.49	0.76	1.96	0.012
Organic fertilizer	(n=222)	(n=117)	(n=105)	
To increase land fertility	45.05	50.43	39.05	-0.114
To increase yield	17.57	13.68	21.9	0.082
To increase quality	9.91	11.97	7.62	-0.044
Better information	8.11	9.4	6.67	-0.027
To reduce cost	7.21	4.27	10.48	0.062
Change in level of pest and disease problem	4.95	5.98	3.81	-0.022
Change in input price	2.70	2.56	2.86	
Change in shallot price	0.45		0.95	0.010
Chemical pesticides	(n=429)	(n=142)	(n=287)	
To change in level of pest and disease problems	69.93	53.52	78.05	0.245***
To increase yield	9.09	10.56	8.36	-0.022
Change in input price	4.66	6.34	3.83	
Better information	4.20	7.75	2.44	-0.053**
To reduce cost	4.20	7.75	2.44	-0.053**
To increase quality	3.73	7.75	1.74	-0.060**
To increase land fertility	2.56	4.23	1.74	-0.025

Note: ***,**,* indicate statistical significance at the α =1%, 5%, 10%, respectively.

Table A.18. Continued. Reason for change in input use in last five years by shallot growers in Brebes (Central Java) in percentage, 2011

Type of input	All samples (n = 687)	Adopter (n=214)	Conven tional (n=473)	Diff.
Bio pesticide	(n=104)	(n=68)	(n=36)	
Change in level of pest and disease problem	27.88	22.06	38.89	0.168
Increase land fertility	15.38	14.71	16.67	0.020
Increase quality	13.46	14.71	11.11	-0.036
Increase yield	13.46	11.76	16.67	0.049
Better information	12.5	16.18	5.56	-0.106
To reduce cost	8.65	10.29	5.56	-0.047
Change in input price	0.96		2.78	
Change in shallot price	0.96	1.47		-0.015
Insect trap	(n=119)	(n=59)	(n=60)	
Change in level of pest and disease problem	63.87	59.32	68.33	0.090
To increase yield	15.13	11.86	18.33	0.065
To reduce cost	4.20	6.78	1.67	-0.051
Change in input price	3.36	1.69	5.00	
Better information	3.36	5.08	1.67	-0.034
To increase quality	2.52	5.08		-0.051
To increase land fertility	1.68		3.33	0.033
Change in shallot price	0.84	1.69		-0.017

Note: ***,**,* indicate statistical significance at the $\alpha = $1%, 5%, 10%, respectively.

Table A.19. Relationship with buyer over marketing characteristics of shallot growers in Brebes (Central Java) in percentage, 2011

Relation with buyer variable	Adopter (n=214)	Conventional (n=473)	Diff.
First communication with buyer per production cycle			
Before planting	0.47	1.06	
Between planting & early stages of production	1.87	0.21	-0.017*
Close to harvest	78.04	75	-0.030
After the harvest begins	19.63	23.73	0.041
Communication methods			
Mobile phone	4.21	2.12	
Landline phone	0.47	0.64	0.002
Buyer comes to farm	55.61	64.62	0.090*
Buyer comes to farmer's house	21.5	18.86	-0.026
Farmer goes to buyer's place	4.21	3.18	-0.010
Meet buyer elsewhere	2.8	2.75	0.000
Through intermediary person	11.21	7.84	-0.034
Through cooperative/group			
Time of sale per production cycle			
Before planting	0.00	0.00	
Between planting & harvest	5.61	2.54	
After harvest begins	5.61	13.56	0.080**
Only at time of sale	20.09	21.19	0.011
1-7 days before harvest	68.69	62.71	-0.060
Written agreement			
Yes	2.34	4.45	-0.021
No	97.66	95.55	
Specification in written agreement			
Price	99.53	99.15	-0.004
Quantity	16.82	19.03	0.022
Grade/quality	23.83	22.20	
Variety	10.75	7.61	-0.031
Purposes (seed or consumption)	11.21	8.25	-0.030
Time of payment	79.44	74.42	-0.050
Sorting by size	7.94	6.55	-0.014
Seed provided on credit	0.47	0.21	-0.003
Other inputs provided on credit	0.47	0.63	0.002
Changes level of detail in agreements with buyer over the last five years			
They have become more detailed	17.76	16.53	
No change	78.04	78.81	0.008
They have become less detailed	4.21	3.39	-0.008
Not applicable		1.27	0.013

Note: ***,**,* indicate statistical significance at the $\alpha = 1\%$, 5%, 10%, respectively.

Table A.19. Continued. Relationship with buyer over marketing characteristics of shallot growers in Brebes (Central Java) in percentage, 2011

Buyer relations variable	Adopter (n=214)	Conventional (n=473)	Diff.
Negotiation over shallot price with buyer			
No, I always accept the price	0.93	2.75	
Yes, I sometime bargain	7.48	9.96	0.025
Yes, I usually bargain	90.65	87.08	-0.036
No, I set the price and don't bargain	0.93	0.21	-0.007
Changes on bargaining position over the price with buyer over the last five years			
I have more price bargaining power	42.06	39.62	
No change	35.05	41.53	0.065
I have less price bargaining power	22.90	17.8	-0.051
Not applicable		1.06	0.011
Negotiation over non-price terms with buyer			
No, I always accept the non-price terms	10.75	17.37	
Yes, I sometimes bargain	32.71	30.93	-0.018
Yes, I usually bargain	43.93	40.25	-0.037
No, I set the price and don't bargain	3.27	2.75	-0.005
Not applicable	9.35	8.69	-0.007
Changes on bargaining position over non-price terms with buyer over the last five years			
I have more non-price bargaining power	28.97	18.22	
No change	48.13	64.83	0.167***
I have less non-price bargaining power	14.02	7.63	-0.064**
Not applicable	8.88	9.32	0.004
Farmers' beliefs toward quality requirement from their buyer compare to other buyers	(n=214)	(n=473)	
Higher	26.64	17.58	
Same	70.09	79.45	0.094**
Lower	2.34	2.33	0.000
Don't know	0.93	0.64	-0.003
Farmers' beliefs over prices offered from their buyer compare to other buyers			
Higher	44.86	40.47	
Same	48.13	52.33	0.042
Lower	5.14	6.36	0.012
Don't know	1.87	0.85	-0.010

Note: ***,**,* indicate statistical significance at the α =1%, 5%, 10%, respectively.

Table A.20. Shallot growers' perception of modern channel in percentage, 2011

Variables	All samples (n = 687)	Adopter (n=214)	Conventional (n=473)	Diff.
Farmers knowledge about any farmers who have sold agricultural products that were ended up in:				
Sold in supermarkets	6.55	12.15	4.02	0.093*
Sold to processors	14.99	22.90	11.42	0.142**
Exporters	4.22	7.94	2.54	0.057
Sold to other modern markets	4.08	7.48	2.54	0.052
Farmers knowledge about any farmers who have sold fruit or vegetables that were ended up in:				
Sold in supermarkets	5.68	9.81	3.81	0.104*
Sold to processors	8.15	11.21	6.77	0.087
Exporters	2.47	5.14	1.27	0.057
Sold to other modern markets	2.77	6.07	1.27	0.069
Experience selling into modern channels	(n=138)	(n=67)	(n=71)	
Mostly very positive	17.39	19.40	15.49	
Generally positive	34.06	32.84	35.21	0.024
Some positive, some negative	22.46	28.36	16.90	-0.115
Generally negative	7.97	5.97	9.86	0.039
Mostly very negative	0.72		1.41	0.014
Don't know	17.39	13.43	21.13	0.077
Farmers opinion whether most farmers would be interested in selling to modern channels	(n=684)	(n=214)	(n=470)	
Yes	63.60	72.90	59.36	
No	27.34	21.50	30.00	0.085*
Don't know	9.06	5.61	10.64	0.050*

Note: ***, **, * indicate statistical significance at the $\alpha = 1\%$, 5%, 10%, respectively.

Table A.20. Continued. Shallot growers' perception of modern channel (in percentage), 2011

Variables	All samples (n = 687)	Adopter (n=214)	Conventional (n=473)	Diff.
Main advantages selling to modern channels				
Higher price	52.49	53.74	51.91	
Access to good seed	6.73	9.81	5.32	-0.045*
Technical assistance, learn new skills	3.36	6.54	1.91	-0.046**
Access to other inputs	1.32	1.40	1.28	-0.001
Getting inputs on credit	0.73	1.40	0.43	-0.010
Main factors that may prevent farmers selling to modern channels				
Not enough experience and information	35.96	31.78	37.87	0.061
Farmer not interested	25.44	23.83	26.17	0.023
Buyers don't pay immediately on delivery	5.26	9.35	3.40	-0.059**
Low quality of product	3.65	2.80	4.04	0.012
Do not have equipment needed	3.07	3.27	2.98	-0.003
Buyers require farmers to pack the product	2.92	6.54	1.28	-0.053***
Lack of trust from buyer	2.05	1.87	2.13	0.003
Necessary inputs are too expensive	1.61	1.87	1.49	-0.004
Government supports that can be provided to help more farmers sell FFV into modern markets				
Facilitate the access to modern retail market	30.56	33.18	29.36	-0.038
Provide credit	10.82	13.55	9.57	-0.040
Guarantee price stabilization	6.87	6.54	7.02	0.005
Increase tax on imported agricultural products	5.99	6.54	5.74	-0.008
Provide information on prices and market	4.82	7.94	3.40	-0.045*
Provide sustainable training and assistance	2.78	5.14	1.70	-0.034*
Don’t know/no opinion	12.87	2.80	17.45	0.146***
Improve supply of agriculture chemicals	2.78	0.47	3.83	0.034*

Note: ***,**,* indicate statistical significance at the α =1%, 5%, 10%, respectively.

Table A.21. Shallot growers responses toward their involvement with collective action activities in Brebes (Central Java) in percentage, 2011

Type of collective action	All samples (n=687)	Adopter (n=214)	Conventional (n=473)	Diff.
Recent membership of local organisations				
Farmers group	56.62	84.11	44.19	0.399***
Cooperative	10.48	21.50	5.50	0.156***
Water user association	16.59	25.70	12.47	0.128***
If you're not a member, were you previously a member?				
Farmer group				
a. Yes	4.08	3.27	4.44	0.787***
b. No	95.92	96.73	95.56	
Cooperative				
a. Yes	4.37	6.54	3.38	0.347***
b. No	95.63	93.46	96.62	
Water user association				
a. Yes	1.16	1.40	1.06	0.264***
b. No	98.84	98.60	98.94	
Benefit of being a member of these organisations				
Farmers group				
a. Social interactions	23.73	33.18	19.45	-0.137***
b. Learn from other member	15.14	21.96	12.05	-0.099***
c. Networking/business contracts	6.55	14.02	3.17	-0.108***
d. Technical assistance	2.91	4.21	2.33	-0.019
e. Provision of inputs	1.46	1.40	1.48	0.001
f. Provision of credit	1.31	1.40	1.27	-0.001
g. Participated in FFS/IPM	0.44	1.40		-0.014**
h. Participated in FFS/GAP	0.29	0.93		-0.009*
Cooperative				
a. Provision of credit	3.78	7.94	1.90	-0.060***
b. Social interaction	3.2	5.61	2.11	-0.035*
d. Networking/business contracts	1.16	2.34	0.63	-0.017
e. Learn from other members	0.73	1.87	0.21	-0.017*
f. Crop marketing assistance	0.44	1.40		-0.014**
g. Technical assistance	0.29	0.47	0.21	-0.003
h. Provision of inputs	0.15		0.21	0.002
Water user association				
Social interactions	0.15	0.00	0.21	0.002

Note: ***,**,* indicate statistical significance at the α =1%, 5%, 10%, respectively.

Table A.21. Continued .Shallot growers responses toward their involvement with collective action activities in Brebes (Central Java) in percentage, 2011

Type of collective action	All samples (n=687)	Adopter (n=214)	Conven tional (n=473)	Diff.
Satisfaction level of being a member of:				
Farmers group				
a. Very satisfied	23.00	37.85	16.28	-0.216***
b. Somewhat	23.44	34.11	18.60	-0.155***
c. Not satisfied	10.04	12.15	9.09	-0.031
Cooperative				
a. Very satisfied	3.20	7.94	1.06	-0.069***
b. Somewhat	5.53	10.28	3.38	-0.069***
c. Not satisfied	1.89	3.74	1.06	-0.027*
Water user association				
a. Very satisfied	4.80	6.54	4.02	-0.025
b. Somewhat	8.59	13.08	6.55	-0.065**
c. Not satisfied	3.06	6.07	1.69	-0.044**
Changed in performance compare to 5 years ago				
Farmers group				
a. Improved	29.55	47.66	21.35	-0.263***
b. No change	14.56	20.56	11.84	-0.087**
c. Worsened	6.55	8.88	5.50	-0.034
d. Not applicable	5.39	6.07	5.07	-0.010
Cooperative				
a. Improved	5.24	10.75	2.75	-0.080***
b. No change	2.04	4.21	1.06	-0.032**
c. Worsened	2.04	4.21	1.06	-0.032**
d. Not applicable	1.16	2.34	0.63	-0.017
Water user association				
a. Improved	5.39	7.48	4.44	-0.030
b. No change	7.57	12.15	5.5	-0.067**
c. Worsened	3.06	5.14	2.11	-0.0303*
d. Not applicable	0.44	0.93	0.21	-0.007

Note: ***,**,*, indicates statistical significance at the α =1%, 5%, 10%, respectively.

4 Chapter Four: The Relative Importance of Technology Attributes to Shallot Farmers when Considering Adoption: A Best-Worst Scaling Approach

4.1 Introduction

In chapter 3, this thesis examined the unique characteristics of a sample of 687 Indonesian shallot farmers, and determined the share of farmers in the sample that had adopted a certain type of agricultural technology, specifically farming systems termed Alternative Pest Management (APM). As discussed in Chapter 3, APM refers to the implementation of farming systems that are based on pest management technologies including Integrated Pest Management (IPM) and/ or pesticide-free farming systems. Only 24.5 per cent of 687 shallot farmers had adopted this technology, this is despite almost 30 years of government and non-government (non-profit and private sector initiated) farmer training programs launched to promote the potential benefits from APM, which included both of production and human health benefits.

The analysis in Chapter 3 found several significant differences in characteristics of adopter and non-adopter shallot farmers in the sample, these include the following characteristics: human assets, farm assets (capital) and farm management, and collective action. Results from the descriptive analysis in chapter 3 clearly showed that non-adopter farmers were often less educated, and had limited access to household and production assets. Non-adopter farmers were also less likely to change the application of their inputs used, especially the amount of chemical inputs. Moreover, many non-adopter or traditional farmers were less likely to have been involved in collective action activities such as being a member of a farmer group or cooperative.

The aim of this chapter is add to the findings discussed in Chapter 3 regarding technology adoption among smallholder farmers and to explore farmers' relative preferences for characteristics or attributes of agricultural technologies, which include non-conventional farming systems such as APM systems and new crops such as high value agricultural products. Although a considerable body of research has explored the factors influencing the adoption of agricultural technologies (Feder, Just and Zilberman 1985; Doss 2006; Knowler and Bradshaw 2007; Prokopy et al 2008), very few studies have examined the preferences farmers place on technology attributes and what factors may influence preferences (see Useche, Barham and Foltz 2009) .

Therefore, the objective of this chapter is to examine variation in farmers' preferences for technology attributes, and explore how this variation is related to specific individual, household and farm characteristics, access to various types of capital (e.g. human, social, financial, technical), and behaviour and attitudes regarding collective action (e.g. participation in farmers groups). This is done using the data gathered from the entire sample of respondents for the shallot farmer survey discussed in Chapter 3. In addition to completing the survey, respondents also participated in a Best-Worst (BW) scaling experiment (Finn and Louviere 1992). The BW scaling (BWS) experiment and methods will be discussed in more depth in section 4.3.1.1. of this chapter. Specifically farmers' responses to the BW scaling experiment are analysed to explore farmers' heterogeneity in relative preferences for a set of 11 "technology" attributes when given a scenario of considering whether or not to adopt a new crop or a non-conventional farming system.

After exploring heterogeneity in preferences using a Latent Class model (Vermunt and Magidson 2002) to estimate classes or clusters of farmers, we then attempt to characterise each cluster post-hoc by comparing differences in farm household and individual farmer characteristics. It is hypothesised that preferences for technology attributes may be related to individual, household and farm characteristics such as age, education, farm size, asset ownership, access to capital (including intellectual/ human, social, material, and financial capital) and individual attitudes (e.g. risk attitudes).

The chapter proceeds by first providing a relatively short review of the most relevant agricultural adoption literature, then explaining the BW scaling methodology and BW scaling experiment, and the Latent Class cluster analysis. The results of each step of the analysis are summarised and discussed: 1) aggregate BW scores and relative importance of attributes, 2) latent class clusters, and 3) post-hoc Tukey t-test characterisation. The final section summarises key findings and discusses implications.

4.2 Literature Review

A large body of literature has explored various aspects of agricultural technology adoption, including the adoption of new crops, new varieties of crops and non-conventional farming systems. The aim of this section is to provide a general overview of the relevant adoption literature in order to highlight how this study contributes to this body of knowledge. By no means, have all relevant studies been covered in this review, rather the aim is to highlight seminal work and studies which have summarised previous adoption literature.

Useche, Barham and Foltz (2009) outlined the main differences in agricultural adoption research. They suggest that the "traditional economic approach to technology adoption… (p. 444)" focuses heavily on determinants of adoption, namely heterogeneity in farm and farmer characteristics, and perceived relative advantage of the technology. Conversely the approach taken by other disciplines (e.g. anthropologists and sociologists) focuses on the notion that famers have preferences for attributes of the agricultural technology and their preferences for traits influence their decision to adopt. For example, seminal work by Tornatzky and Klein (1982), discussed the importance of understanding how users (rather than experts) of technology value characteristics of the agricultural technologies. The particular analysis presented in this chapter attempts to connect preferences for attributes with farm and farmer characteristics that have been used in previous studies as determinants of adoption.

The early work by Fliegel and Kivlin (1966) initiated a detailed explanation of the heterogeneity among innovations and farmers' perceptions in understanding the variations in the diffusion process of new technology. Using simple correlation and partial correlation, the authors were able to determine which attributes caused an innovation to stand out under what circumstances. Economic attributes were found to have an important role in determining the decision to adopt. For the adopter, innovations were perceived as the technology or farming practices that were most rewarding and involved the least risk.

Rogers (1968) extended the discussion by introducing five attributes that might be associated with the rate of adoption. These attributes were relative advantage, compatibility, complexity, divisibility and communicability. Relative advantage was defined as the degree to which an innovation is superior to previous ideas that are replaced. At that time, relative advantage was often expressed as the degree of financial profitability, low initial costs, a decrease in discomfort, social prestige, a savings in time and effort and the immediacy of the reward. Meanwhile, compatibility measured the degree to which an innovation appeared to be consistent with the existing values and past experiences of the adopters. Complexity referred to the degree to which an innovation is relatively difficult to understand and hard to implement. Using these definitions, this author found that some innovations have a clear meaning while others may be difficult to understand. Then divisibility was the fourth attribute that Rogers (1968) introduced. It was defined as the degree to which an introduction may be tried on a limited basis. To date this attribute is very important for any technology adoption process in developing countries, since the majority of farmers are smallholders who normally own a small size of land. Rogers (1968) found that individuals at different stages in the process of adopting the technology may translate each attribute differently. Earlier adopters may perceive divisibility as more important than later adopters. The earlier adopter is the one who takes the initiative step, and these farmers evaluate whether the technology can be easily applied on their farms based on the character of the attribute. This author also found that those who lagged behind were in many cases more rapid to move from a trial to full-scale use of the technology. Rogers' (1968) last attribute was communicability which he defined as the degree to which the results of an innovation may be easy to diffuse to others.

Almost two decades later, Tornatzky and Klein (1982) conducted a meta-analysis of over 75 articles that discussed innovation characteristics. The innovation attributes that were most frequently identified through this meta-analysis approach were: 1) compatibility; 2) relative advantage; 3) complexity; 4) cost; 5) communicability; 6) divisibility; 7) profitability; 8) social approval; 9) trialability, and 10) observability. The authors concluded that more research is needed to verify the relationship between innovation attributes and the implementation or adoption of innovations.

In more recent work, Rogers (2003) extended his previous classification of innovation attributes. He kept the first three attributes that had been introduced in 1962, which are: 1) relative advantage, 2) compatibility, and 3) complexity. He then changed the term for the fourth and fifth attributes so that trialability replaced divisibility, and communicability was replaced by observability. Meanwhile, he extended the scope of relative advantage as a definition; it was no longer focussed on economic terms but included social and related issues. The scope of relative advantage included the following dimensions: economic profitability, low initial cost, decrease in discomfort, social prestige, a saving of time and effort, and immediacy of refusal. In this later book, Rogers (2003) also included uncertainty.

Compared to other attributes, the Rogers (2003) stated that the category of relative advantage marked the strongest predictor for determining the rate of adoption. Rogers (2003) confirmed that diffusion of innovation or technology adoption is a process of uncertainty reduction. Therefore, an innovation must be compatible with the following: (1) socio cultural values and beliefs; (2) previously introduced ideas, and (3) clients' need for the innovation. He kept the definitions of complexity and trialability, while observability now referred to the degree to which the results of innovations are visible to others.

To date, relative advantage is found to be the most frequent attribute that has been used in many technology adoption studies examining adoption of non-conventional farming systems. Tey et al. (2013) showed this when comparing 23 studies that examined the perceived attributes of innovations for sustainable agriculture practices. Those attributes were relative advantage, compatibility, complexity, trialability and observability. Tey et al. (2013) found that as an attribute, relative advantage existed in every study, however few studies included all of the attributes of innovation that Rogers (2003) discussed are considered by the adopter.

4.2.1 Factors Influencing Farmers' Adoption of New Technologies and New Farming Systems

The technology innovation-diffusion model based on the work of Rogers (1968) is generally used when illustrating the process of adoption and diffusion of new technologies in agriculture. Several other researchers working more in the field of agricultural economics, expanded the seminal work of Rogers (1968) and found that individual farmer characteristics helped predict whether or not a farmer would adopt a new technology. Many published articles provided summaries of this approach from various technology adoption studies (e.g. see Feder, Just and Zilberman 1985; Doss 2006; Prokopy et al. 2008; Knowler and Bradshaw 2007).

Feder, Just and Zilberman (1985) seminal literature review on the adoption of agricultural innovations in developing countries found that farm size was one of the most important factors related to the farmer's decision to adopt new technology. Risk and uncertainty, human capital such as formal schooling, experiences and entrepreneurial ability, capital formation and tenancy systems were also important factors associated with higher rates of adoption rate.

Doss (2006) provided a very thorough analysis of the existing literature on agricultural technology adoption. She argued that the following variables have to be considered when discussing the rate of adoption of innovations. That is, access to credit or cash, access to information, access to labour markets, and understanding the intra household dynamic process. Doss (2006) also highlighted three major reasons why farmers decided not to adopt technologies: lack of awareness that the introduced-technology provided benefits; misconceptions about the costs and benefits of the technologies; the technology not being available at the time that the farmer needed it, and not being profitable.

Thus, taking account these findings it important to examine whether similar key determinant factors are also important in the adoption of alternative agriculture farming systems. Prokopy et al. (2008) conducted a literature review of 55 studies that focussed on the adoption of agricultural best management practices in the United States over 25 years. Prokopy et al. (2008) found it difficult to confirm variables that consistently determined adoption of best management practices. They found that education levels, income, acres, capital, diversity, labour and access to information were considered as important variables that may increase the rates of adoption. Meanwhile, farmers' experiences and land tenure systems showed a mixed result. They also identified that although social networks were quite complex to measure, the seemed to suggest a positive relationship between having strong social networks or social capital and the adoption of agricultural best management practices. Furthermore, increased information and awareness of best management practices had a potential positive impact on adoption rates.

Knowler and Bradshaw (2007) found similar results when examining 31 technology analyses from 23 adoption studies of conservation agriculture. They used frequency analysis to identify universalities, differences and inconsistency across studies. They categorized the factors that significantly affected farmers' adoption into four groups: 1) farmer and farm household characteristics; 2) farm bio-physical characteristics; 3) farm financial or management characteristics, and 4) exogenous factors. The results from frequency analysis across the studies are presented in the following table (Table 4.1):

Table 4.1. Frequency analysis for the 46 variables from 31 conservation agriculture adoption analyses showing the results for significance and sign on estimated coefficients (number of incidences of variable is shown)

Variable	sig (+)	sig (-)	Insig	Total	Status[a]
Education	7	3	11	21	
Age	3	5	10	18	
Farm size	6	2	10	18	
Tenure (1=leased)	2	2	11	15	
Off-farm activities/income	3	4	4	11	
Rainfall	5	2	3	10	
Experience	4	0	5	9	*
Area planted	3	1	5	9	
Extension/technical assistance	4	1	4	9	
Slope	3	3	3	9	
Attitudes towards conservation	2	0	5	7	*
Source of information	2	0	5	7	*
Income	4	1	1	6	
Importance of livestock	3	1	2	6	
Program participation	4	0	2	6	*
Well-drained soil	1	0	5	6	*
Family labour	1	0	4	5	*
Hired labour	0	0	5	5	**
Gross farm income	3	0	2	5	*
Ease of obtaining information	2	1	2	5	
Management knowledge/skills	3	0	2	5	*
Soil erosion rate	0	1	4	5	*
Temperature	2	0	3	5	*
Farm profitability	2	0	2	4	*
Concern for erosion	2	0	2	4	*
Awareness of environmental threats	4	0	0	4	***
Debt (level, ratio)	0	1	3	4	*
Farm/field type	3	0	1	4	*
Proportion of hectares irrigated	0	2	2	4	*
Conventional tillage equip/animals	0	2	2	4	*
Perceived health threat, agrochemicals	0	1	2	3	*
Output prices	0	1	2	3	*
Emphasis on grain farming	1	0	2	3	*
Importance of crop revenues in income	1	1	1	3	
Availability of machinery	2	0	1	3	*
Wealth indicator	0	0	3	3	
Pesticides applied	2	0	1	3	*
Cropping system/crop rotation	0	0	3	3	**
High productivity soil	0	3	0	3	***
Highly erodible land (yes=1)	2	0	1	3	*
Length of growing season	2	0	1	3	*
Distance to paved road	0	2	1	3	*
Kin as partners	1	0	2	3	*
Membership in organizations	2	0	1	3	*
Concern for groundwater pollution	0	0	3	3	**
Impact of Conservation Agric.on production costs	0	0	3	3	**

Source: Knowler and Bradshaw 2007

Note: [a] (*) indicate variables is a mix of significant and insignificant, but always the same sign when significant; (**) indicates variable is always insignificant; (***) indicates variable is always significant and same sign.

The summary of the Knowler and Bradshaw study provided in Table 4.1 showed divergent results for some of the key independent variables. In relation to the regional differences, North American technology adoption studies were more likely to show a significant effect of education on adoption of conservation agriculture than studies from other regions. On the other hand, land tenure (leased) and farm size appeared to have different impacts on conservation agriculture, for example the result tended to be positive and significant in North America, while the sign was negative and significant in Africa and insignificant in Latin America.

Knowler and Bradshaw (2007) concluded that only a few variables were similar across studies. Education and farm size seemed to show a positive and significant influence while 'awareness of environmental threats' and 'high productivity soil' produced a consistent impact on adoption (significant with the same sign). The results indicated the absence of any clear significant factors that affected conservation agriculture adoption. They showed that the efforts to promote any sustainable or conservation agricultural management practices globally will create a challenge since the results were very specific across methods and location (region).

In exploring the key literature that highlighted drivers that influence the adoption rate of agricultural technology, it was clear that those studies were not considered farmers' preferences toward the technology attributes as the important drivers. Furthermore, few studies have attempted to understand the relationship between farmers' preferences for attributes of innovations and factors shown in previous research to be determinants of adoption (see Useche, Barham and Foltz 2009). Therefore, it was clear that, to date studies that have been conducted to integrate drivers and the preferences that farmers place on technology attributes are very limited. In particular, there is no known study has been conducted to analyse similar key variables in relation to the Indonesia context.

This study component used the data from 2011 Shallot Producer Survey that was conducted in Brebes from June to July 2011 to examine the rate of non-conventional technology adoption. The analysis took place in several stages, starting by measuring the relative importance of technology attributes at aggregate level using best worst scaling methods. The next stages were to identify the heterogeneity both of the relative importance attributes and the key important attributes at individual level. Detailed information regarding the methods and data are presented in the next section.

4.3 Methodology

This section explains the Best-Worst scaling (BWS) experiment and related analytical methods that were used to determine the relative importance of attributes and heterogeneity among shallot farmers in Indonesia. Specifically we discuss the methods used in the multi-step research process from data collection to data analysis. The BWS experiment was then conducted as part of the 2011 Shallot Farmer Survey discussed in Chapter 3. The BW scaling methodology is explained in section 4.3.1.1. To collect the data needed for the analysis, first a number of interviews and pre-tests were conducted to select attributes to be included in the BWS experiment, this is also explained in section 4.3.1.1. below. The individual BW scores are analysed using Latent Class (LC) cluster analysis and Post-Hoc Tukey Honest Significance Difference (HSD) tests. The LC cluster analysis method is explained in section 4.3.2. The results of the aggregate analysis of the BWS experiment and the results of the LC analysis are discussed in results section of this chapter (4.4.1 and 4.4.2).

4.3.1 Best-Worst Scaling (BWS) as method for measuring relative importance

As mentioned earlier, as part of the 2011 Shallot Farmer survey, A BWS experiment was conducted and data collected from the experiment was analysed to examine the relative importance of technology attributes among shallot growers. BWS is a method used to measure relative importance of attributes. Finn and Louviere (1992) explained that the BWS method is underpinned or based on random utility theory for paired comparisons. During BWS experiments, respondents are asked repeatedly to select the best (most important) and worst (least important) options of attributes or items within a set. Balcombe, Rigby and Azapagic (2014) explained that the frequency of selection for each technology attribute as best or worst, shows the strength of preference for that specific technology attribute.

There is growing use of BWS to investigate preferences in a number of fields including health care and marketing research (Auger, Devinney and Louviere 2007; Balcombe, Rigby and Azapagic 2014; Flynn et al. 2007; Cohen 2009; Lee, Soutar and Louviere, 2008). BWS is being used more frequently rather than traditional rating or ranking methods because it requires respondents to make trade-offs among sets of attributes. Forcing respondents to make trade-offs has been shown to result in more accurate measures of relative importance. For example, Flynn et al. (2007) found that BWS was able to address the 'pick one' issue when respondents are asked to rank attributes.

Compared to other methods of eliciting the importance of a large set of independent items, Balcombe, Rigby and Azapagic (2014) found that BWS minimized the likelihood of anomalous choice behaviour. Moreover, they also found that BWS showed an ability to reduce the cognitive load by only asking for the extreme conditions (best or worst) rather than ranking all items. This avoids ‘middling’ of responses which often occurs when respondent’s rate level of importance using Likert scales. Besides avoiding middling responses, BWS is also able to evade the differences in interpretation of ‘very’ and ‘quite’, which are normally used as labels in rating scales.

Thus, a variety of studies found BWS to be a relatively simple method for measuring the relative importance of attributes and it is able to overcome biases resulting from ranking and rating such as middling of responses (Cohen and Neira 2003; Cohen and Orme 2004; Balcombe, Rigby and Azapagic 2014; Flynn et al 2007; Lockshin and Cohen 2011).

One of the most important parts of conducting a BWS experiment is determining the “set” of attributes to be evaluation. The BWS experiment conducted as part of this study consisted of 11 attributes that were selected from a set of 24 technology attributes. The initial 24 technology attributes considered were classified according to Rogers (2003):

1. Relative advantage (includes returns and social approval) - higher expected price, higher profit (returns), expected high yield, increased sustainability of soil fertility, growing market demand, government provided subsidies or incentives to plant, guaranteed access to inputs or financing for inputs;
2. Compatibility - disease resistant crop, crops likely to adapt easily to production environment, other farmers adopted with success, simple farming systems’ method;
3. Costs - low initial investment costs, less labour required, less chemical input required;
4. Efficiency - short time from plant to harvest, less water use;

5. Communicability - availability of education and assistance on how to produce crop, market and price information readily available;
6. Risks - stable yield, stable market demand, stable and consistent price, health concern about pesticide residue in the product, guaranteed buyer or market.

The original 24 attributes were chosen after conducting a substantial review of the technology adoption literature summarised previously in this chapter. In addition to an extensive review of the literature on technology adoption, these 24 technology attributes were refined after conducting many interviews with extension officers, industry leaders such as input suppliers, agricultural officers and farmer group leaders, who work directly with shallot and horticulture farmers. These interviews were designed to obtain industry perspectives on the relative importance of technology attributes to farmers.

Then, this list of 24 attributes was delivered to shallot farmers during pre-survey and questionnaire testing. Each farmer was asked to consider the 24 technology attributes listed and to rank the five most important attributes that would influence their decision to adopt non-conventional farming practices. We repeated the process until we were confident that the technology attributes that were likely to be most important to different farmers were included in the final choice sets (the BWS tasks). This process resulted in the 11 technology attributes listed and defined in Table 4.3. The local language (Bahasa Indonesia) was used throughout the data collection process. Back-translation was used to ensure that the attribute definitions were clear to both the respondents and the trained enumerators conducting the interviews. The attributes and definitions were refined multiple times after consultation with industry experts and pre-testing with farmers.

The eleven attributes defined in Table 4.3. were assigned to sub-sets which using a balanced incomplete block design (BIBD). Cohen (2009) explained in detail the development process of BIBD which organizes the attributes to be analysed in choice sets. Cohen (2009) explained that the BIBD is designed to obtain a full ranking of all attributes in a relatively small number of subsets. Having this advantage, the BIBDs ensure that each attribute appears only once with any other and this is the simplest design of a balance incomplete block or BIB. Cohen (2009) and Orme (2005) both discussed that researchers must make trade-offs between the number of attributes per choice set as against the number of choice sets.

Orme (2005) suggested that 4 to 6 attributes or items per set are optimal for most respondents and most tasks. He also indicated that if the attribute labels are presented in long sentences, then fewer than 6 attributes per set should be considered. In the present study, based on pre-testing and experience with previous BWS tasks in other surveys, the study team chose 11 attributes and assigned them to sub-sets according to a BIBD with 11 sub-sets and a set size of five attributes, where each level was repeated five times. This pattern was adopted from an earlier study that explored the relative importance of buyer attributes for potato growers in Indonesia (Umberger et al. 2013).

Specifically, when the enumerator and the respondent reached the BWS experiment section of the survey process, the enumerator organised 11 cards that each contained one of the 11 BWS sets. They read the following:

> *"I am going to show you 11 cards with characteristics that may be important when adopting a new crop or new farming system. In each case there will be 5 characteristics shown, these will be different from one card to the next (total 11 cards). Please select one attribute that is MOST important to you when considering why you decided to adopt, and then select one characteristic that is LEAST important to you. Please select only one of each. I will guide you through the 11 cards."*

Figure 4.1. shows an example of a choice task used in the survey.

Most Important (tick one box)	**Of these technology or farming practice attributes, which are the Most and Least important to you…**	**Least important (tick one box)**
☐	Stable price and market demand	☐
☐	Expected high yield	☐
☐	Disease resistant crop	☐
☐	Use less water	☐
☐	High expected profit /return	☐

Figure 4.1. An example of the Best Worst Scaling task

In Figure 4.1 there are five attributes if we refer to the attributes as A, B, C, D, and E, and if the respondent selects A as the best (most important) and E as worst (least important), then A > (B&C&D) > E. This process can be expanded and provide preference orderings for 9 of the 10 possible pairwise comparisons (Balcombe, Rigby and Azapagic 2014). In this case the relative importance of each attribute was generated by having repeated choice tasks as mentioned earlier.

4.3.2. Latent Class (LC) Cluster Analysis

LC analysis was used to determine if shallot farmers were heterogeneous in the relative importance they placed on technology attributes. Latent Gold 4.5 was used to conduct the LC analysis and respondents' individual BW scores for each of the 11 attributes are used in the analysis.

Cluster analysis is defined as the classification of similar respondents into clusters without prior information about the number of clusters or about the forms. The form of a group is defined as the parameters of clusters that can be found as means, variances and covariance (Kaufman and Rousseeuw 1990). Vermunt and Magidson (2002) revealed that the forms can also be explained by exploratory Latent Class (LC) analysis, in which objects are assumed to be part of one of a set of *k* latent classes, where the number of classes and their size are unknown. Under these assumptions, these authors confirmed that the objects or samples that belonged to the same class were assumed to have had similar probability distributions.

Vermunt and Magidson (2002) described the history and state of the art of LC cluster analysis in their 2002 article. They highlighted that the LC cluster was developed for the first time by Gibson in 1959 and extended by Lazarsfeld and Henry through their seminal work in 1968. Both studies introduced a single categorical latent variable and a set of continuous indicators. These formats were known as latent structure models. In 1970, Wolf was the first one who made the integration between LC and cluster analysis. Since then, many labels have been introduced and used to describe LC analysis. It has become more popular as a statistical tool for cluster analysis, in particular since high-speed computers have become available. Since then, the dynamic changes in computer technology have made the computation of intensive clustering methods more accessible. Therefore, several software packages are available, such as Latent Gold.

Vermunt and Magidson (2002) demonstrated that the main difference between standard cluster analysis techniques and LC clustering is that the latter is a model-based clustering approach. This means that the data are generated by a mixture of underlying probability distributions. The advantage of LC clustering is the flexibility which means both simple and complicated distributional forms can be used as parameters to determine clusters. The other advantage of this model highlighted by Vermunt and Magidson (2002) is that variables with mixed measurement levels are still relatively easy to estimate. Therefore, as Meghani et al. (2009) confirmed, this model is appropriate for predicting and examining differences in preferences or utilities which are not observed directly.

Similar to previous studies that have used LC cluster analysis to determine heterogeneity (Coltman, Devinney and Keating 2011; Suprehatin et al. 2013; Umberger et al. 2013), here the 658 individual BW scores for all 11 technology attributes were used as indicator variables in the model. This study component also included active covariates active in the model; those variables were household characteristics and attitudinal variables that explained farmers' perceptions towards risks.

Besides identifying the relative importance of attributes at the aggregate (total samples) and individual levels, this study also examined the heterogeneity of key household-level variables. The results from the LC cluster analysis were used to group the farmers in different clusters before this study component examined the heterogeneity. To make this examination, a post-hoc Tukey Honest Significance Difference (HSD) test was selected to determine the differences between clusters.

4.4 Analysis and Results

4.4.1 Relative Importance of Technology Attributes

To apply BWS in this case, each respondent was required to choose the "best (most important)" and the "worst (least important)" attributes from eleven cards or tasks in the choice set. All 658 respondents were asked to identify the most important and least important technology attributes in each of the 11 tasks.

The measurement of relative importance of technology attributes followed several stages. The first step was to obtain individual BW scores ($B_{ij} – W_{ij}$) for all attributes. It was applied by counting the number of times respondent "i" chose attribute "j" as the best (Bij) minus the number of times respondent "i" chose attribute "j" as the worst (Wij) across all choice sets. The second step was to rank the attributes. The process started by subtracting the number of times the attribute was selected as most important (best) from the number of times it was selected as least important (worst) in all choice sets (B-W scores). The average B-W scores were calculated by dividing the totals of B-W scores by the number of respondents (n=658). Positive values indicated that the given attribute was chosen more frequently as best rather than worst, and negative values showed the opposite.

In the final step, the relative importance among attributes was generated by transforming the BW score into a probabilistic ratio scale. A standardisation process was applied by transforming the square root of best divided by worst to a 0 to 100 scale, as introduced by (Mueller, Francis and Lockshin 2009). It was applied by dividing each square root (B/W) by the largest existing value of square root (B/W) which in Table 4.2 is 2.44, and multiplying the ratio by 100. This process transforms the square root into a factor such that the highest square root (B/W) was 100 and is labelled as most important. As a result, all attributes can be compared to each other by their relative ratio, as presented in Table 4.2.

Table 4.2. Relative importance of the 11 technologly attributes of all clusters (n=658)

No.	Attributes	Best	Worst	Sqrt B/W	Sqrt stand	Rank	Mean-BW	Std. Dev BW
1	Higher expected price	1080	326	1.82	74.68	3	1.15	1.84
2	Stable price and market demand	826	423	1.40	57.33	4	0.61	1.80
3	Growing market demand	521	456	1.07	43.86	6	0.10	1.59
4	High expected profit/return	1396	235	2.44	100.00	1	1.76	1.89
5	Time from planting to harvest is short	291	1086	0.52	21.24	9	-1.21	1.90
6	Expected high yield	1072	204	2.29	94.05	2	1.32	1.57
7	Less labour required to produce	224	970	0.48	19.72	10	-1.13	1.64
8	Use less water	133	1454	0.30	12.41	11	-2.01	1.84
9	Disease resistant crop	738	385	1.38	56.81	5	0.54	1.81
10	Crop adapts easily to production	510	762	0.82	33.57	7	-0.38	1.81
11	Low initial investment cost	447	937	0.69	28.34	8	-0.74	1.84

Considering the 11 technology attributes that may influence farmers' decisions to adopt non-conventional technology, at the aggregate level 'higher expected profit or return' was selected as the most important technology attribute. Table 4.2 shows that, on average, the three most important technology attributes for shallot farmers were: 1) high expected profit/ return; 2) expected high yield; and 3) higher expected price. This result confirms findings from Rogers's (1983 and 2003) work which reported that the relative advantages of the technology were the most important technology attribute to farmers. Financial profit-seeking motives are the most important attributes for Indonesian shallot farmers as well.

Meanwhile, other attributes such as compatibility, which was labelled as 'crop adapts easily to production', was ranked as being of relatively low (seventh out of 11 attributes) importance by farmers. Attributes related to input requirements such as 'use less water and 'less labour required to produce' were considered least important (worst) by the shallot farmers. This is interesting considering that the majority of shallot farming in Brebes is cultivated in irrigated wet-land areas, where water is delivered using technical irrigation systems. Furthermore, the majority of the labour used in shallot farming is hired-labour. It appears, from the farmers' perspectives, the additional labour required from the new farming practices would not be a problem as long as the technology was able to produce high yield and high return. Having higher returns would increase the ability of the farmers to pay for any additional labour.

4.4.2 Modelling Heterogeneity

The next stage of analysis was to investigate whether the heterogeneity existed in the data set since it was important to identify whether the relative importance of technology attributes at the individual-farmer level showed similar preferences to the aggregate level. Then, this study examines differences in household and individual level factors across the preference clusters.

Mueller and Rungie (2009) found that the standard deviation of the individual B-W score measured the variation of level of importance that was delivered by all respondents across different attributes. This variation was known as the heterogeneity of the attributes. The greater the value of standard deviation, the large the variation that existed. In contrast, the authors also confirmed the opposite condition: the smaller the standard deviation the more similarity between the respondents. If the standard deviation is equal to zero then it means all respondents agree on the level of importance that has been indicated for the selected attribute.

The data in Table 4.2 showed that almost all attributes had standard deviations above one. Thus, these attributes appeared to have high heterogeneity across shallot farmers. In the same time, two attributes indicated higher agreement in expressing their relative importance. All respondents relatively agreed that 'expecting high yield' and 'growing market demand' were important although the magnitude and level of importance were different. Having had experience with price fluctuation and high production costs, almost all respondents agreed that 'expected high yield' was a very important technology attribute.

Following these detailed discussions about LC cluster and the importance of examining the heterogeneity in preferences for technology attributes and covariates that may influence farmers' decisions to adopt non-conventional technology, this study modelled producer clusters or classes by using 11 Best-Worst attributes as indicators, and farmers characteristics and attitudinal variables as active covariates. Age, level of education and training experience were selected as the farmers' characteristics that were included in the model, while the attitudinal variables that were associated with awareness and risks were also inserted as covariates in the LC clustering analysis. Those risk factors that were included were obtained from the farmers' responses toward the Likert-scale attitudinal measurement about the condition of soil fertility on the farms , health risk, costs of production and yield losses when they considered adopting non-conventional technology adoption.

4.4.2.1 Model Selection

A latent Class cluster analysis was employed to determine the number of clusters and the form of the model. The most common model selection tools in LC cluster analysis are information criteria such as the Akaike Information Criteria (AIC) and Bayesian Information Criteria (BIC) (Vermunt and Magidson 2002). Vermunt and Magidson (2002) demonstrated that the smaller BIC values are preferred and this value is used to determine the number of clusters that have been generated from the LC cluster analysis. The three-cluster model with the 11 indicators and eight active covariates (representing farmer characteristics and farmer attitudes) was chosen as it produced the smallest BIC value and best Wald test (the

F-value was 19.29 and it was highly significant at one per cent level of significance). The descriptive statistics and results of this LC cluster analysis are presented in Tables 4.3 and 4.4.

All crop attributes except for ‘stable price and market demand’ were significant in determining the number of clusters that were generated from the LC cluster analysis. Additionally, covariates representing farmer characteristics (age, education, and awareness of non-conventional farming systems) were significant. However, none of the attitudinal covariates were significant in the model (p-value $\leq$ 0.10).

4.4.2.2 Relative Importance of Attributes Across Three Producer Segments

A detailed description of the three clusters and their average attribute scores is shown in Table 4.5. The results from LC cluster analysis indicated that almost 60 per cent of shallot farmers were assigned to the first cluster, while nearly a quarter of respondents belonged to the second cluster. The third cluster was relatively small with only 18 per cent of the sample. A post hoc Tukey HSD (Honest Significant Difference) test of crop attributes showed all attributes except ‘stable price and market demand’ were significantly different between clusters.

Table 4.3. Descriptive statistics of indicators and covariates used in the LC cluster analysis

Variables	Definition of Variables	Means	Std. Dev	N	Min	Max
Indicators (Technology Attributes)						
Higher expected price	The price for non-conventional shallots is likely to be higher per unit than the conventional ones that I produced	1.146	1.837	658	-5	5
Stable price and market demand	The price and market demand for the non-conventional shallot is expected to be more consistent and less risky, with fewer fluctuations and with a guaranteed market demand.	0.612	1.796	658	-4	5
Growing market demand	The number of buyers seeking the buy the non-conventional shallot is increasing and market Demand for this product is growing	0.099	1.585	658	-5	4
High expected profit/return	The non-conventional shallot is expected to generate higher profits/return per hectare than other conventional shallot I produce	1.764	1.886	658	-5	5
Time from planting to harvest is short	The non-conventional shallot's production cycle from planting to harvest is much shorter than other crops produced	-1.208	1.899	658	-5	5
Expected high yield	The non-conventional shallot is expected to consistently produce a high yielding crop - yield is expected to be less variable than conventional shallot I produce	1.319	1.570	658	-4	5
Less labour required to produce	The non-conventional shallot farming requires less labour than other crops	-1.134	1.636	658	-5	5
Use less water	The non-conventional shallot farming requires the use of less water	-2.008	1.835	658	-5	5
Disease resistant crop	The non-conventional shallot is likely to be resistant to diseases	0.536	1.810	658	-5	5
Crop adapts easily to production	I expect that the non-conventional shallot will easily adapt to my production environment, fits the soil and the climate conditions I am face	-0.383	1.812	658	-5	5
Low initial investment cost	The non-conventional shallot requires less upfront investment compared to other crops I produce	-0.745	1.839	658	-5	5
Active Covariates						
Age of respondent	Age of respondent (years old)	47.514	11.101	658	23	81
Level of education of respondent	Level of education of the respondent (years)	6.020	4.198	658	0	19
Awareness	I am aware of non-conventional farming systems (Likert scale)	4.070	0.802	658	1	5
Concerned about soil fertility	I am very concerned about the soil fertility on my farm is declining (Likert scale)	4.271	0.709	658	1	5
Concerned about health risk	I am concerned about health risks caused by the use of chemicals (Likert scale)	4.076	0.873	658	1	5
Low cost investment	Changing to non-conventional farming systems is easy and not overly costly (Likert scale)	3.830	0.775	658	1	5
Yield risks	Changing to non-conventional farming systems increases the risk of yield fluctuations (Likert scale)	3.097	0.938	658	1	5
Training	1 if respondent ever participated in non-conventional farming farmer field school or training, 0 otherwise	0.522	0.500	500	0	1

Table 4.4. Latent class cluster results

Crop Attributes	Cluster 1	Cluster 2	Cluster 3	Wald	p-value	R^2
Higher expected price	0.816	-0.503	-0.312	40.216	0.000	0.413
Stable price and market demand	-0.027	0.038	-0.010	0.991	0.610	0.002
Growing market demand	0.081	-0.180	0.098	12.324	0.002	0.031
High expected profit/return	0.630	-0.421	-0.209	71.387	0.000	0.347
Time from planting to harvest is short	-0.214	0.182	0.032	35.422	0.000	0.088
Expected high yield	0.139	-0.582	0.443	27.442	0.000	0.194
Less labour required to produce	-0.199	0.392	-0.192	32.980	0.000	0.124
Use less water	-0.079	0.358	-0.279	23.056	0.000	0.135
Disease resistant crop	-0.228	-0.123	0.351	29.890	0.000	0.109
Crop adapts easily to production	-0.363	0.053	0.309	41.769	0.000	0.178
Low initial investment cost	-0.099	0.328	-0.230	32.158	0.000	0.118
Active Covariates						
Intercept	3.286	-1.059	-2.227	19.290	0.000	
Age of respondent	-0.016	0.014	0.002	7.959	0.019	
Level of education of respondent	-0.038	-0.036	0.073	8.473	0.014	
Awareness	-0.120	-0.125	0.245	3.070	0.220	
Concerned about soil fertility	-0.138	0.109	0.029	2.035	0.360	
Concerned about health risk	-0.090	0.094	-0.005	1.580	0.450	
Low cost investment	-0.032	0.009	0.023	0.138	0.930	
Yield risks	0.010	0.050	-0.061	0.388	0.820	
Training	-0.124	-0.373	0.497	6.147	0.046	

Table 4.5. Best-Worst score means for 11 crop attributes for 3-Cluster solution

No.	Cluster means BWS attributes	Cluster 1 N=387 59%	Cluster 2 N=152 23%	Cluster 3 N=119 18%	ANOVA F value	p
1	Higher expected price	$2.19^{a,b}$	$-0.51^{b,c}$	$-0.13^{a,c}$	282.51	0.000
2	Stable price and market demand	0.58	0.74	0.55	0.53	0.587
3	Growing market demand	0.24^{a}	$-0.47^{a,b}$	0.38^{b}	13.76	0.000
4	High expected profit/return	$2.74^{a,b}$	$0.17^{a,c}$	$0.64^{b,c}$	206.06	0.000
5	Time from planting to harvest is short	$-1.68^{a,b}$	-0.36^{a}	-0.76^{b}	33.5	0.000
6	Expected high yield	$1.48^{a,b}$	$0.13^{a,c}$	$2.29^{b,c}$	85.97	0.000
7	Less labour required to produce	-1.49^{a}	$0.03^{a,b}$	-1.47^{b}	58.38	0.000
8	Use less water	$-2.21^{a,b}$	$-0.87^{a,c}$	$-2.81^{b,c}$	48.67	0.000
9	Disease resistant crop	0.15^{a}	0.52^{b}	$1.81^{a,b}$	42.88	0.000
10	Crop adapts easily to production	$-1.05^{a,b}$	$0.16^{a,c}$	$1.08^{b,c}$	92.05	0.000
11	Low initial investment cost	$-0.96^{a,b}$	$0.45^{a,c}$	$-1.58^{b,c}$	54.89	0.000

Note: Means with the same superscript letters are significantly different at $p < 0.05$, post-hoc Tukey HSD (Honest Significant Difference) test.

Table 4.5 also shows the relative importance of the 11 crop attributes for each cluster. The five most important attributes for each cluster are summarised below.

a. Cluster 1: 1) high expected profit or return, 2) higher expected price, 3) expected high yield, 4) stable price and market demand, and 5) growing market demand.
b. Cluster 2: 1) stable price and market demand, 2) disease resistant crop, 3) low initial investment cost, 4) high expected profit, and 5) expected high yield.
c. Cluster 3: 1) expected high yield, 2) disease resistant crop, 3) crop adapts easily to production, 4) high expected profit, and 5) growing market demand.

As mentioned, Cluster 1 (58.8 per cent) represented the largest proportion of respondents, with almost two-thirds of the shallot growers included in this segment. The most important attributes and least important attributes are, not surprisingly, quite similar to the sample average shown in Table 4.2. As economic motives, including both higher prices and higher yields, were considered by the farmers to be the most important attributes then one would expect that conversion to new crops or non-conventional farming practices would occur if the “technology” resulted in higher returns relative to their existing conventional shallot farming practices.

Cluster 2 consisted of almost one quarter (23 per cent) of the total sample. This cluster’s relative preferences for attributes were quite different than the other clusters in how they rated ‘stable price and market demand’ (e.g. most important versus only moderately important for Cluster 1 (fourth) and Cluster 3 (fifth). Further, Cluster 2 placed much higher relative importance on ‘disease resistance’ (e.g. second most important for this cluster versus sixth for Cluster 1) and both Cluster 1 and Cluster 3 with respect to ‘low initial investment costs’ (e.g. third most important for this cluster versus seventh for Cluster 1 and tenth for Cluster 3). It is also interesting to note that Cluster 2 placed relatively low importance (tenth most important) on ‘higher expected price’ relative to Cluster 1 (second most important). The farmers in Cluster 2 appeared concerned about avoiding any instability that may be associated with shallot farming activities, as they appear to be most concerned about price stability, disease resistance and investment costs. This cluster may have limited resources or may be risk averse, which will be explored in the next section.

Cluster 3 accounted for almost 18 per cent of the total sample. It differed most of the other Clusters in the relatively high importance placed on ‘expected high yield’ (most important attribute for Cluster 3 versus third and sixth most important attribute for Cluster 1 and 3, respectively) and ‘crop adapts easily’ (third most important versus eighth and fifth for Clusters 1 and 3, respectively). Cluster 3 was similar to Cluster 2 in rating ‘disease resistant crop’ as second most important compared to this attribute being of relatively moderate importance (sixth) to Cluster

1. Unlike Cluster 2, this cluster placed relatively low (tenth) importance on 'initial investment cost'.

4.4.2.3 Heterogeneity in Characteristics

Having these clusters demonstrate heterogeneity in the relative importance of crop attributes, this study continued the analysis by examining the difference between clusters with respect to socio-demographic and other household-level variables. The objective of this analysis was not only to examine how preferences for crop attributes differed, but also to characterize the differences in shallot growers in each cluster to understand why their preferences might differ. Post-hoc Tukey HSD tests were used to examine the heterogeneity across clusters by exploring differences in the following: 1) farmer and farm household characteristics and assets; 2) adoption of alternative pest management farming systems, and; 3) access and use of inputs and information.

Farmer and farm household characteristics and assets

Table 4.6 provides an overview of summary statistics for key farm and farm household characteristics and assets measured in the study. Variables with the same superscript are significantly different according to post-hoc Tukey HSD test. Considering individual farmer characteristics, the clusters differed significantly with respect to age, education and literacy of both the respondents and the spouses. Interestingly, no significant differences were found in household income, income per capita or household size. However, there were significant differences in respondents also being involved in a secondary profession such as "trading of horticultural products" or "paid agricultural labourer". There were some significant differences found for household and farm assets such as irrigation technology (size and share of land irrigated, ownership of agricultural pump), ownership of facilities to store crops, ownership of a motorbike, ownership of a computer, and access to the Internet,. However no significant differences were found in across clusters with respect to variables representing the total area of land cultivated and irrigated per year, the share of land that is owned, sharecropped or rented.

The respondents and their spouses in Cluster 2 were significantly older than those in Cluster 1 and Cluster 3. However Clusters 1 and 3 were not significantly different with respect to age of either the respondent of the spouse. Farmer age and experience are often associated with an increased aversion to risk, as Lee (2005) and Angeli Kirk, Winters and Davis (2010) found, younger people are often more likely to adopt riskier non-traditional cash crops. These authors also considered the relationship between age and declining health condition, which in some cases may influence the rate of adoption.

Respondents and their spouses in Cluster 3 had completed significantly more years of education than Cluster 1 or Cluster 2. Nearly 30 per cent of respondents in Cluster 3 had completed a high school degree compared to only about 14 per cent for Clusters 1 and 2. Likewise, the literacy rates of both respondents and spouses in Cluster 3 (97 per cent and 85 per cent of respondents and their spouses could read) were higher than Cluster 1 (83 per cent and 79 per cent) and Cluster 2 (80 per cent and 72 per cent).

Education has been found to be the key important variable in many technology adoption studies (Angeli Kirk, Winters and Davis 2010; Asfaw 2004; Knowler and Bradshaw 2007; Lee 2005; Matteson, Altieri and Gagne` 1984). In particular, the technologies discussed in other chapters of this thesis, related to alternative pest management strategies, are likely to require the ability to learn or acquire intensive knowledge. Therefore, farmers need to be able to absorb conceptual information and translate it into real farming practice. The level of education is likely to determine which farmers are able to make this transformation in practice and which are unlikely to be able to.

Respondents in Cluster 3 were more likely to be taking on additional roles as traders of horticultural products compared to Cluster 2. Roughly 14 per cent of respondents in Cluster 3 indicated that they had a second profession as a “trader”, compared to 11 per cent of those respondents in Cluster 1 and only 5 per cent of respondents in Cluster 2. It is also interesting to note that significantly fewer respondents in Cluster 3 indicated a second profession as an agricultural labourer compared to about 30 per cent of those in Cluster 1 and Cluster 2.

Ownership of computers and motorbikes was statistically higher for Cluster 3 households versus the other two clusters, with 17 per cent and 87 per cent owning computers and motorbikes, respectively. Only 9 per cent and 5 per cent of Cluster 1 and Cluster 2 households owned computers, respectively, and roughly 76 per cent of Cluster 1 and Cluster 2 households owned motorbikes. A significantly higher share of Cluster 2 and Cluster 3 households had access to the Internet compared to Cluster 1.

Cluster 3 also had a significantly higher share (70 per cent) of households that owned an agricultural pump for irrigation compared to Cluster 1 (55 per cent). Additionally, Cluster 2 had a significantly higher share of farms (17 per cent) *without* access to irrigation during the dry season. Only three per cent of Cluster 3 households did not have access to irrigation during the dry season.

To summarize this section, the analysis from LC cluster and post hoc Tukey HSD tests for farmer and farm household characteristics supported earlier literatures of technology adoption. Considering the variables discussed above, it appears that

Cluster 3 may have an advantage with respect to farmer and farm household characteristics that may lead to higher rates of technology adoption. For example they are relatively younger than Cluster 2 and compared to the Cluster 1 and 2 they have an advantage with respect to household human capital (education and literacy) and access to technological capital such as computers, motorbikes and agricultural pumps.

Adoption of alternative pest management farming systems

Considering the significant differences across clusters regarding farmer (respondent), spouse, and farm household characteristics and assets discussed in the proceeding paragraphs, we now explore whether there are differences across clusters in the adoption of technology, which is in this case, was alternative pest management farming systems (APM). Farmers were asked a set of questions designed to provide information on rates of adoption and reasons for adopting or discontinuing adoption of four types of APM: 1) pesticide free farming systems, 2) organic farming systems, 3) integrated pest management systems, and 4) good agricultural practises (GAP). Specifically farmers were asked if they had heard of (awareness) each type of APM, whether they had received training on any type of APM, and whether or not they adopted any APM. If they had adopted any type of APM then they were asked to indicate the year they adopted, why they adopted, if they were still using the APM method, and if not, why they had stopped using the APM.

A summary of responses to these adoption questions for the three clusters is provided in Table 4.7. It is interesting, but maybe not surprising considering the characteristics discussed in the previous paragraphs, that relative to the other two clusters, Cluster 3 had a significantly higher share of farmers who were aware of APM (98 per cent for Cluster 3 versus 74 and 66 per cent for Clusters 1 and 2, respectively), had participated in training on APM (61 per cent versus 36 and 33 per cent), went on to adopt APM (44 per cent versus 23 per cent), and were still using APM (39 per cent versus 18 per cent and 21 per cent). Relative to the other cluster, a higher share of Cluster 3 farmers were also the first person in their village to adopt APM (42 per cent versus 17 and 21 per cent).

Table 4.6. Summary statistics by cluster for farmer and farm household characteristics and assets (post-hoc Tukey HSD test)

	Cluster 1	**Cluster 2**	**Cluster 3**
	Most Important Attributes	Most Important Attributes	Most Important Attributes
	58.8% (n = 387)	**23.1% (n=152)**	**18.1% (n=119)**
Most	High expected profit /return	Stable price and market demand	Expected high yield
2^{nd}	Higher expected price	Disease resistant crop	Disease resistant crop
3^{rd}	Expected high yield	Low initial investment cost	Crop adapts easily to production
4^{th}	Stable price and market demand	High expected profit /return	High expected profit /return
5^{th}	Growing market demand	Expected high yield	Growing market demand
Age of respondent (years)	46.72[a]	50.36[a,b]	46.45[b]
Age of spouse (years)	41.14[a]	44.21[a,b]	41.30[b]
Educational level of respondent (years)	5.61[a]	5.36[b]	8.19[a,b]
Educational level of spouse (years)	5.19[a]	4.35[b]	6.50[a,b]
Respondent with high school degree and above (percentage)	14.21[a]	13.82[b]	30.25[a,b]
Spouse with high school degree and above (percentage)	6.98[a]	5.92[b]	17.65[a,b]
Respondent literacy (ability to read - percentage)	82.69[a]	79.61[b]	96.64[a,b]
Spouse literacy (ability to read - percentage)	79.33	72.37[a]	84.87[a]
Income (in million IDR per year)	121.00	121.00	87.90
Income per capita (in million IDR per month)	2.40	2.22	1.77
Trader as secondary profession (percentage)	11.11	5.26[a]	14.29[a]
Agricultural labourer as secondary profession (percentage)	31.27[a]	29.61[b]	13.45[a,b]
Household size (people)	4.21	4.55	4.13
Irrigation farm asset (in hectares)	0.30	0.37	0.41
Irrigated farm land ownership (percentage)	55.30	55.26	67.23
Computer ownership (percentage)	9.04[a]	5.26[b]	16.81[a,b]
Internet access ownership (percentage)	20.67[ab]	31.58[b]	31.93[a]
Motorbike ownership (percentage)	75.45[a]	76.32[b]	87.39[a,b]
Storage ownership (percentage)	5.68	9.87	10.92
Agricultural pump ownership (percentage)	55.21[a]	57.89	69.75[a]

Note: Means with the same superscript are significantly different at $p < 0.05$, post-hoc Tukey HSD test

Table 4.6. Continued. Summary statistics by cluster for farmer and farm household characteristics and assets (post-hoc Tukey HSD test)

	Cluster 1	**Cluster 2**	**Cluster 3**
	Most Important Attributes	Most Important Attributes	Most Important Attributes
	58.8% (n = 387)	**23.1% (n=152)**	**18.1% (n=119)**
Most	High expected profit /return	Stable price and market demand	Expected high yield
2nd	Higher expected price	Disease resistant crop	Disease resistant crop
3rd	Expected high yield	Low initial investment cost	Crop adapts easily to production
4th	Stable price and market demand	High expected profit /return	High expected profit /return
5th	Growing market demand	Expected high yield	Growing market demand
Share of farms without irrigation during dry season (percentage)	7.66	17.22[a]	3.14[a]
Irrigated land cultivation area in year (ha)	0.53	0.58	0.55
Share of land owned and farmed by respondents (percentage)	56.33	53.95	64.71
Share of land sharecropped-land by respondents (percentage)	30.49	28.29	25.21
Share of land rented-land by respondents (percentage)	38.76	36.84	34.45
Shallots yield (ton per ha)	8.58	8.65	8.64

Note: Means with the same superscript are significantly different at $p < 0.05$, post-hoc Tukey HSD test.

Table 4.7. APM technology adoption across clusters conditional on awareness and training

Size	**Cluster 1**	**Cluster 2**	**Cluster 3**
	Most Important Attributes	Most Important Attributes	Most Important Attributes
	58.8% (n = 387)	**23.1% (n=152)**	**18.1% (n=119)**
Most	High expected profit /return	Stable price and market demand	Expected high yield
2nd	Higher expected price	Disease resistant crop	Disease resistant crop
3rd	Expected high yield	Low initial investment cost	Crop adapts easily to production
4th	Stable price and market demand	High expected profit /return	High expected profit /return
5th	Growing market demand	Expected high yield	Growing market demand
Awareness of non-conventional farming systems (percentage)	73.83[a]	65.56[b]	97.48[a,b]
Received training on non-conventional farming methods, conditional on awareness (percentage)	35.66[a]	32.89[b]	61.34[a,b]
Adopted a non-conventional farming method, conditional on training (percentage)	22.74[a]	23.03[b]	43.70[a,b]
Adopted a non-conventional farming method, without training (percentage)	6.2	7.24	10.92
Continue to adopt non-conventional farming method, conditional on training (percentage)	17.83[a]	21.05[b]	38.66[a,b]
Continue to adopt non-conventional farming method, without training (percentage)	2.58	6.58	6.72
Number of years adopting (years)	1.59	1.50	2.16
First person to implement non-conventional farming in village (percentage)	17.14[a]	20.55	41.67[a]

Note: Means with the same superscript are significantly different at $p < 0.05$, post-hoc Tukey HSD (Honest Significant Difference) test.

Access and Use of Inputs and Information

In relation to technology adoption, Feder and Umali (1993) conducted an empirical review of the adoption of agricultural innovations over the last decade. These authors found that the factors associated with limited technology adoption among shallot farmers included lack of credit, limited access to inputs and lack of information regarding how to implement the technology.

In many countries, governments have accelerated the rate of adoption by pursuing general strategies such as the provision of information through extension offers and support of farmer groups, as well as credit and input subsidies and support programs.

In Indonesia, at the time of the study, there were not any government programs focused on providing shallot farmers with either credit or subsidies for the most commonly used inputs, fertilisers and pesticides. However, in some cases, input supply companies did offer farmers credit to purchase inputs. Farmer groups are commonly used in Indonesia as a way for information dissemination. Therefore, in Table 4.8. this study compare across clusters, the share of farmer respondents: 1) who had access to credit for purchasing chemicals (fertiliser and pesticides) commonly used in shallot production, 2) who made changes in chemical use, and 3) who participated in farmers groups. Additionally we include related information of interest including factors motivating farmers to change their use of the chemicals, sources of information for shallot farming, and the share of respondents that kept records on pesticide use.

A significantly higher share of farmers in Cluster 1 (39 per cent) and Cluster 3 (40 per cent) compared to Cluster 2 (27 per cent) indicated they received credit from their input supplier for purchasing chemical fertilisers. Similarly a larger share of Cluster 1 (44 per cent) and Cluster 3 (40 per cent) farmers indicated that they received credit for chemical pesticides. Considering Cluster 3 has a relatively higher share of farmers who indicated they had adopted an APM, it is not surprising that this cluster had a relatively larger share of households indicating decreased use of chemical fertilisers (23 per cent versus 12 per cent and 19 per cent) and chemical pesticides (23 per cent versus 10 per cent and 14 per cent). However, a higher share of Cluster 3 farmers indicated their use of organic fertiliser (39 per cent versus 18 per cent and 24 per cent) and bio-pesticides (19 per cent versus 8 per cent and 9 per cent) was increasing. A statistically higher share of Cluster 3 farmers, over one-quarter, stated that they were shifting to organic fertiliser to increase land fertility.

Significantly more Cluster 3 farmers (71 per cent) were members of farmer groups compared to roughly one-half of Cluster 1 (54 per cent) and Cluster 2 farmers (51 per cent). Less than ten per cent of Cluster 2 farmers believed learning from other members was a benefit of being a member of a farmer group. Only six per cent indicated that farmer groups were their main source of information regarding shallot production methods. These shares were significantly lower than those for Cluster 3 for both membership and source of information (19 per cent and 14 per cent, respectively). Therefore it is not surprising that a significantly higher share of Cluster 1 and Cluster 2 farmers indicated that other farmers are their main source of information for shallot production methods and issues.

Table 4.8. Access to, use, changes in use and reasons for using fertilisers and pesticides across clusters (percentages)

Size	**Cluster 1**	**Cluster 2**	**Cluster 3**
	Most Important Attributes	Most Important Attributes	Most Important Attributes
	58.8% (n = 387)	**23.1% (n=152)**	**18.1% (n=119)**
Most	High expected profit /return	Stable price and market demand	Expected high yield
2nd	Higher expected price	Disease resistant crop	Disease resistant crop
3rd	Expected high yield	Low initial investment cost	Crop adapts easily to production
4th	Stable price and market demand	High expected profit /return	High expected profit /return
5th	Growing market demand	Expected high yield	Growing market demand
Credit from input supplier for chemical fertilizers (percentage)	38.50[b]	26.97[ab]	39.50[a]
Credit from input supplier for chemical pesticides (percentage)	43.93[a]	30.26[a]	40.34
Decreased use of chemical fertilizer per m2 (percentage)	11.89[a]	19.08	22.69[a]
Increased use of organic fertilizer per m2 (percentage)	18.09[a]	24.34[b]	38.66[a,b]
Decreased use of chemical pesticides per m2 (percentage)	9.56[a]	13.82[b]	22.69[a,b]
Increased use of bio-pesticides per m2 (percentage)	7.75[a]	8.55[b]	18.49[a,b]
Reason to use organic fertilizer is to increase land fertility (percentage)	9.56[a]	17.11[b]	26.05[a,b]
Reason to use organic fertilizer is to increase quality (percentage)	2.84	1.97[a]	6.74[a]
Reason to use bio-pesticides is to increase quality (percentage)	2.07	0.00[a]	5.04[a]
Keep records of pesticide use (percentage)	13.70	6.58[a]	15.97[a]
Member of farmer group (FG) (1/0 in percentages)	54.01[a]	51.32[b]	71.43[a,b]
Learning from other members is benefit of being a member of FG	16.02	9.87[a]	19.33[a]
Farmer groups are main source of information for production methods (percentage)	8.53	5.92[a]	14.29[a]
Other farmers are the main source of information for production methods (percentage)	70.03[a]	73.03[b]	53.78[a,b]

Note: Means with the same superscript are statistically different at $p < 0.05$, post-hoc Tukey HSD (Honest Significant Difference) test.

4.5 Summary and Conclusions

The main objectives of this chapter were to determine the relative importance that shallot farmers placed on 11 crop attributes and to explore if farmers were heterogeneous in their relative ratings of technology attributes, in this case crop and non-conventional farming system attributes. This was done using a Best-Worst scaling experiment and Latent Class analysis of individual best-worst scores. Clusters were characterised post-hoc using farmer and farm household characteristics and assets, adoption behaviour, access to credit for inputs, participation in farmer groups and sources of production information. These characteristics were expected to provide insight on why a specific cluster of farmers placed relatively higher or lower importance on specific crop attributes.

For the aggregate sample of farmers, the most important crop attributes are related to the ability to provide high expected profit or return, expected high yield and higher expected price, while crops that require less water and labour are considered to be relatively least important by all respondents. These findings have important implications for researchers and decision makers trying to encourage adoption of new crops and APM such as organic, pesticide free, IPM and GAP systems. If the crop or farming system does not appear likely to offer a relative economic advantage relative to conventional methods, then it is unlikely it will be widely adopted.

In addition to individual BW scores, the age of the respondent, level of education, training experiences and attitudinal variables such as awareness of the technology and concern for soil fertility and health risks were included as active covariates in the LC cluster analysis. Three unique clusters were generated from this process, each with different utilities in relation to technology attributes. Thus, Indonesian shallot farmers were found to be heterogeneous with respect to the relative importance they placed on crop attributes. This study extends the discussion presented in Chapter 3 by identifying the relative importance of technology attributes to farmers in the sample. These results are strongly related to some of the determinants of adoption.

Cluster 1 (58 per cent) was the largest segment and they appeared to be most likely to have a higher utility for technologies that offer higher profit or returns. This cluster seems to represent the general or conventional farmers, as they were more likely to have the following characteristics: a low level of education, working as an agricultural labourer as secondary profession; less exposure to technology information through the media (computer and internet), and have limited ownership of production assets. These characteristics may suggest that these farmers face more constraints that might limit the shallot farmers' willingness to adopt any new crop or non-conventional farming practices, in particular any technologies that are aimed to reduce or minimize the amount of chemical inputs in the production. This cluster was less likely to consider the use of organic inputs in their farming practices and therefore it strongly appears that this cluster had the smallest cohort of respondents who had adopted non-conventional farming practices. The other main factors that limited the adoption are to date there is no guarantee that these technologies would be able to provide them with high returns, a higher expected price and expected high yield.

The shallot farmers in Cluster 2 (23 per cent) were more likely to consider stable price and market demand as their most important technology attributes. Although this cluster had, on average, more farmland than others, almost one-fifth of the respondents in this cluster were not irrigated during the dry season. This suggests that farmers in this cluster may find it difficult to maximize the production potential of their existing land. On average, this cluster was dominated by older farmers and the majority had a low education level. Meanwhile, it had a slightly smaller number of farmers who had previously joined farmers' groups and therefore they also had fewer opportunities to be included in the training or farmer field schools since to date the recruitment system still followed the old practices. Consequently, there is no doubt that the rate of adoption of non-conventional farming practices here appears to be similar to that of Cluster 1.

Cluster 3, which was the smallest segment with only 18 per cent of farmers, stood out as being the most unique of the three clusters. They had a relatively high utility for technology that was able to provide them with an expected high yield. Farmers in Cluster 3 placed a relatively high importance compared to Cluster 1 and Cluster 2 on crops and farming systems, which would easily adapt to the farmer's production environment, including soil and climate conditions. They also placed a relatively higher level of importance on the crop being disease resistant compared to Cluster 1.

Cluster 3 also had significantly different characteristics with respect to socio-demographics and farm characteristics and assets, adoption rates of APM technologies, access to credit for input purchases, and involvement in farmers groups. This cluster was dominated by farmers who had a higher education level where almost one-third of the samples were high school graduates or above. Many farmers in this cluster were willing to take a risk by using and increasing the amount of organic fertilizer and bio-pesticides they used, and decreasing the amount of chemical inputs.

Farmers in this cluster also had the largest proportion of production and household assets. They also had more exposure to computer and Internet. This cluster was relatively younger than Cluster 2. They tended to be more involved in farmer groups and value farmer groups as sources of information. This cluster was also more likely to have adopted an APM, but not necessarily more likely to still be using the APM.

Although through this analysis we identified: 1) that preferences for technology attributes are heterogeneous, 2) that unique clusters or segments exist, and 3) that there are significant difference in the determinants of adoption across clusters, the analysis was not able to shed a substantial amount of light on why preferences for technology attributes are different. These results do suggest that there may be endogeneity issues when attempting to explain adoption decisions using both variables which reflect attitudes towards technology attributes, and traditional determinant variables (e.g. farm and farm household characteristics). This analysis does not allow us to determine how preferences influence the rates of adoption of crops and non-conventional farming practices by smallholder farmers. In order to address the endogeneity issues, further analysis would need to implement a treatment (selection) model such as the multinomial endogeneous treatment model which has recently been used by Suprehatin et al. (2015). More work and different types of analysis are needed to shed light on this issue. The following chapter attempts to examine the decision to adopt APM technology further.

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5 Chapter Five: Productivity and Technical Inefficiency of Alternative Pest Management Compliant and Non-Compliant Farmers: The Case of Shallot Growers in Java

5.1 Introduction

The Green Revolution in Indonesia introduced high yielding varieties of crops, chemical fertilizers, pesticides and special cultivation practices using irrigation systems and agriculture machinery for land preparation and harvesting (Feder and O'Mara 1981). Farmer cooperatives, input subsidies, special agricultural extension services, and food crop stabilization polices also supported the Green Revolution in Indonesia (Pearson et al. 1991).

Winarto (2004) found that Indonesian farmers considered pesticides as medicines for their crops, i.e., farmers applied pesticides for curative and protective purposes. Eventually these practices resulted in pest resistance and environmental degradation. Trumble (1998) found that many growers did not realize the relationship between spraying and risks associated with pest resistance until the eventual yield losses as the sprays failed to work. The over-use of pesticides and lack of information and experience regarding the safety procedures during application has contributed to short-term as well long-term health problems for farmers (Hazell and Wood 2008).

The Indonesian government faces pressure to address environmental issues like over use of pesticides and consumers' food safety concerns across its entire agricultural sector. The aim of this Chapter is to compare productivity and profit implications of Alternative Pest Management (APM) in shallots. Shallots are a good case, as its production involves one of highest uses of pesticides of any horticultural crop in Indonesia.

This Chapter compares the productivity of conventional and APM technology for shallot production systems, an important commodity in the horticultural sector. Conventional and APM shallot farmers are differentiated based on the application of pesticides. Conventional farmers tend to apply pesticides based on a 'standard operating procedure' where the quantity and the timing of pesticide applications are made without observing pest populations or natural enemy populations. APM farmer apply pesticides after observing the level of the pest problems, meaning farmers consider the condition of the threat from pest and the population of natural enemies on shallots farms when deciding how much and at what time pesticide will be applied.

The primary objective of this Chapter is to measure the loss in productivity due to two components involved in the APM adoption: (1) the innate nature of the production technology, and (2) the farmer's technical inefficiency in using APM, an unfamiliar production system. Uncertainty and lack of knowledge regarding the yields for sustainable production systems may be a significant factor limiting adoption. Among the factors that Pretty (2008) indicates could limit technology adoption, risks associated with reducing existing use of pesticides or fertilizers and time constraint to achieve the efficiency in production were found to be important. González-Flores et al. (2014) found that the adoption of new techniques and practices are not always implemented in an efficient manner. These conditions highlighted the measure issues involved when attempting to measure and understand foregone yield.

In this Chapter, yield losses were measured by implementing stochastic production frontier (SPF) analysis. SPF is specified as a Cobb-Douglas production function with two types of error terms: the first error is a normally distributed term representing statistical noise and the second one is a non-negative term representing inefficiency. However, the estimation of SPFs is complicated by the fact that this is not an experimental study. In this study, the farmers being surveyed made a decision on technology adoption based on a non-random process. This creates the self-selection bias (Minot et al. 2013). With selection-bias two groups of farmers (adopters and conventional) may have unobserved systematic differences in their characteristics that affect yields. This endogenous self-selection results in biased parameter estimates for both the technology and technical inefficiency.

A study by Mayen, Balagtas and Alexander (2010) examined a similar situation in dairy farming in the United States, and the authors used Propensity Score Matching (PSM) to address self-selectivity before proceeding to Stochastic Production Frontier method to quantify the yield loss in dairy farming. However, these methods have not been applied to horticultural crops, which tend to be much more dependent on chemical inputs and more likely to gain a higher price-premium for either organic or pesticide-free products. This study is a good case to highlight the above phenomena in the context of the high-value agricultural sector in Indonesia.

5.2 Literature Review

Although many sustainable agriculture or resource-conserving technologies are adopted widely (Lee 2005), the overall adoption rate is relatively low (Pretty 2008). In many cases, the technology is more complicated when compared with conventional systems. During the implementation process at the farm level, it is common for farmers to experience mistakes or mismanagement issues which can lead to considerable yield loss. The result is that new techniques and practices are not always adopted and implemented in an efficient manner (González-Flores et al. 2014), there is a dynamic process of trial and error during the adoption process.

Pretty (2008) stress the importance of designing a precise method for technology adoption to reduce waste and create more environmental benefits. This approach is important in developing country contexts dominated by smallholder farmers living in remote areas with limited access to formal education and market information access (González-Flores et al. 2014). Without price subsidies or a premium market, farmers may feel reluctant to adopt the technology.

In many cases of technology adoption, introducing new farming systems may cause lower yields. Similar debates are raised in the organic farming literature. Analysing the impact of organic farming by measuring the production function using the Stochastic Production Frontier (SPF) method, Sipiläinen and Oude Lansink (2005) contributed to this debate by using panel dairy farm data from 1995 to 2002. The panel data consisted of detailed farm level information on production and costs for 459 dairy farms in Finland. The authors found that in the traditional input-output model, on average the technical efficiency of conventional dairy farming was 10 per cent higher than that of organic farms. They concluded that the organic production system was more risky for the dairy farmers. Moreover, using their panel data set Sipiläinen and Oude Lansink (2005) concluded that the techical efficiency of the dairy farms decreased when dairy farmers began converting from from conventional to organic farming. After 6 to 7 years of the organic implementation, the dairy farmers began increasing yields.

Kumbhakar, Tsionas and Sipiläinen (2009) continued to improve the methodology. Although it was not the case for all farms, the study indicated that organic farms were 5 per cent less efficient. Subsidies played a role accelerating the adoption of organic technology. However, in the long run the authors expected that the organic farms would be as efficient as the conventional. The subsidy would be delivered only if the farmers' experienced declining productivity.

Mayen, Balagtas and Alexander (2010) continued to this line of research by measuring the technical efficiency of organic dairy farmers under USDA's National Organic Program (NOP). In their analysis, the authors used dairy farm data from the 2005 Agricultural Resource Management Survey Dairy Costs and Returns Report. This survey collected information on farm and operator characteristics, revenue and costs of production, marketing practices, production technology and management practices from 288 organic farms and 1194 conventional farms in 24 major dairy states in the US. Under the NOP program, farmers have to exclude the use of synthetic chemicals, antibiotics and hormones in crop and livestock production. The NOP standard also regulates feeding practices. In the Mayen, Balagtas and Alexander (2010) analysis, the results showed that organic technology was less productive and it indicated a decreasing trend in yield. The authors found that the best practice organic farms were not able to produce the same amount of production as the conventional ones at their frontier (highest production possible). This result also indicated that organic dairy farmers may require incentives like price premium prices over conventional milk to remain in the organic market.

Previous literature also discusses the reasons for yield losses associated with adopting "sustainable agriculture" or "green practices". Exploring the source of difference in yield loss is important since it helps policymakers to design more appropriate technology for smallholder farmers. In one yield loss example, Kumbhakar, Tsionas and Sipiläinen (2009) examined the source of productivity differential between the alternative production systems. These authors explained that the differential appeared as a result of technology changes or differences in technical efficiency or both. Sipiläinen and Oude Lansink (2005) noted that many farmers were not familiar with organic farming methods, thus it was important to examine the difference in learning effects, such as: (1) technical efficiency may be different on organic and conventional farms, and (2) technical efficiency may change over time in different ways.

5.2.1. Stochastic Production Frontier

Few studies use Stochastic Production Frontier analysis to measure productivity and efficiency while at the same time also address the self-selectivity problem. Sipiläinen and Oude Lansink (2005) did address both issues in their research estimating the technical efficiency of organic dairy farming and used Heckman’s two step procedure to address the selectivity bias. A probit model estimated the choice between organic and conventional dairy farming from pooled data. Inverse Mill’s Ratio (IMR) from the basis of the probit model was used in the frontier models to address the self-selectivity bias in the organic and conventional models. Kumbhakar, Tsionas and Sipiläinen (2009) improve the method by directly specifying the distribution of the selection bias parameters.. Their analysis utilized three different distributions of the noise term in the adoption equations to model selection-bias.

Finally, Mayen, Balagtas and Alexander (2010) claimed that a formal test of the homogenous technology was missing from the previous two studies and expanded the analysis by highlighting two important methodological issues. First, Propensity Score Matching was used to address the potential self-selection bias in the first stage of analysis. Second, they conducted a formal test of the homogenous assumption of the technology choice before progressing the analysis to the Stochastic Production Frontier.

More recently, Rao, Brummer and Qaim (2012) used a similar approach to measure the impact of farmer participation in a supermarket channel. A meta-frontier analysis followed by the Propensity Score Matching approach was used in the two-stage analysis in their study to examine the impact of supermarket expansion of vegetable farmers in Kenya. Using data from small-scale potato farmers in Ecuador, González-Flores et al. (2014) used Propensity Score Matching to correct the sample selection bias, before using Stochastic Production Frontier. The analyses aimed to measure the impact of a national program (Plataformas de Concertación) on productivity growth. This national program was introduced to help smallholder farmers participate in high-value producer chains by introducing new technologies, providing organizational skill training, and linking them to final markets. Abdoulaye and Sanders (2013) also followed similar methods to analyse the introduction of new sorghum technologies in Sahel, Niger. The new improved sorghum technologies that have been offered to farmers were a package of moderate inorganic fertilizers, new varieties or cultivar (*Sepon 82*), fungicide and agronomic practises.

5.2.2. Self-selection

As in other social science research, sample selection occurs as a generic problem when the researcher is not able to draw a random sample from the population of interest as explained by Winship and Mare (1992). In many technology adoption studies, self-selection has appeared a major methodological problem due to the nature of the definition of adopter, in which the farmers' decision whether or not to adopt the genetic modified (GM) insect-resistant cotton was endogenously determined by the farmers themselves (Crost et al. 2007). These authors used farm-level panel data from Indian cotton farmers and demonstrated that, if a correlation between the technology (in this case Bt Cotton) and high yields is observed, this positive result may be caused by the technology or it may have happened as a self-selection effect. It may occur since farmers who are already very efficient with their farming adopt the technology more rigorously. As a consequence, many recently published papers focuses on the development of new methodologies that are able to solve the endogeneity problem and the simultaneity of farmers' decisions (Doss 2006).

Winship and Morgan (1999) published a seminal paper that highlighted a sampling selection problem in observational data. The problem occurred if the researcher wanted to estimate causal effects from an observational data set such as survey results, census data or administrative records. Here, an explanation of how important the development of the basic conceptual framework of self-selection was initiated by assuming two different groups. One group consisted of farmers assigned to be observed as the treatment (adopter) group, and the second group were assigned to be observed under control (the conventional group).

The nature of the data set that was used in this study contained a similar self-selection problem, in particular when the study team designed the sampling selection for the APM's adopter or treatment group. The APM diffusion process in Indonesia adopted the World Bank's training and visit model. This model organized farmers into farmer groups, and for convenience reasons the grouping was based on the adjoining rice areas (Röling and Van De Fliert 1994). Upon the completion of the establishment of the farmer group, the training program started. This model was known as the Farmer Field School (FFS).

In this study, the decision whether or not the farmers were grouped as adopter or non-adopter was based on whether or not the farmer had adopted the APM practices. In many cases, farmers using APM technologies were actively participating in training programs. The self-selection problem itself occurred during the selection process for the training. The selection problems were found in two ways. First, during the selection of farmers within a farmer group, and second, during the selection of the farmer group. In many cases, the leader, who was normally found to be the most progressive of the farmers, was chosen to represent the farmer group. In this method it was expected that the trained FFS farmer would be able to lead the diffusion process within the group.

Earlier studies found similar problems in the diffusion or introduction process of new technology. For example, the researchers or extension workers aimed to target progressive farmers first (Diagne 2006). Moreover, Feder, Murgai and Quizon (2004) investigated the self-selection occurring during the establishment of the FFS program in communities and found that the selected farmers were most likely to be different from other farmers in the group. Röling and van de Fliert (1994) indicated that the approach of FFS recruitment in the Integrated Pest Management (IPM) program had not been tested in isolated villages. Thus it became obvious that the majority of the program recruited the better informed, more affluent farmers living in easier to reach locations.

5.2.3. Matching Methods

Propensity Score Matching (PSM) is known as an alternative method to estimate treatment effects when random assignment of treatments to subjects is not feasible. This method involves the pairing of treatment and control groups with similar values on the propensity scores and possibly other covariates, and the discarding of all unmatched units (Rubin 2001). The basic idea of the propensity score method is to replace the collection of confounding covariates with only one function that summarizes the confounding covariates or determinants (Rubin 1997). This factor is called the propensity score and in this study the propensity is to adopt APM technology (treated). As a result, the collection of confounding covariates is collapsed into a single factor (predictor). Each APM farmer is matched with an equivalent conventional farmer to serve as a synthetic control for comparison.

Heckman and Navarro-Lozano (2004) explained that matching models can be used if the conditioning of the observable variables is able to replace the sample selection bias. A study by Caliendo and Kopeinig (2008) suggest that the aim in using the propensity score matching method has to meet the underlying assumption which is known as un-confoundedness or selection based on observables or conditional independence. The researcher has to be confident that 1) the underlying identifying assumptions can develop from the information in the data set, and 2) where the sample selection process is well defined during the set-up of the sampling design.

Matching criteria in previous technology adoption studies were selected from variables that are normally used to model farmers' decision in adopting new technology. The variables selected represent the following: a) human assets (farmer and household characteristics) or socio-demographic variables; b) land assets (included production), c) institutional assets and d) farm managements. Human asset variables are defined as any variable that reflect the characteristics of the respondent (in many survey used to be the head of the household) and household members. Some variables that are included in this category are age, education, farming experience (Abdoulaye and Sanders 2013;González-Flores et al. 2014;Mayen, Balagtas and Alexander 2010). In their model, Gonález-Flores et al. (2014) included household size, percentages of male labor force in the household and access to credit. Abdoulaye and Sanders (2013) included household assets such as carts and agriculture equipments as independent variables in a probit model. In certain cases, human assets are used as a proxy of family labour such as number of adults in the household with differentiation by gender (male and female) as mentioned (Mendola, 2007). Lee (2005) included health status in human assets since his study was focussed on the adoption of sustainable agriculture.

Land assets include land size, land tenancy, irrigation systems, and study location (González-Flores et al. 2014;Mendola 2007). González-Flores et al. (2014) also included welfare variables in their model. The authors defined these variables as the ownership of the house, whether the house was built from concrete or brick, ownership of refrigerator, access to water systems and sewage, and ownership of big farm animals. Social capital variables were considered as important variables that may influenced adoption decisions. Some social capital variables included in the model were membership of agricultural associations such as farmer groups (González-Flores et al. 2014; Mendola 2007) or dairy associations Mayen, Balagtas and Alexander (2010). Previous technology adoption studies also include farm management variables. Those variables are selected to measure access to production and marketing information (Mayen, Balagtas and Alexander 2010).

5.3 Methodology

5.3.1 Theoretical Model

This analysis follows the approach of Mayen, Balagtas and Alexander (2010) to measure technical efficiency and yield losses between APM adopters and conventional shallot farmers. The SPF is used to estimate shallot production functions in two regimes (the adopter and conventional).

The Stochastic Production Frontier model is specified as a Cobb-Douglas production function

$$\ln y_i = ln\, x_i\beta + v_i - u_i \qquad (1)$$

where y_i denotes the yield (value of shallot production per hectare) for the *i*th farmer (i = 1,2,….,N), x_i is a vector of production inputs per hectare, $\boldsymbol{\beta}$ is a vector of the parameter to be estimated, v_i is a two-sided stochastic term, and u_i is a non-negative stochastic term representing technical inefficiency.

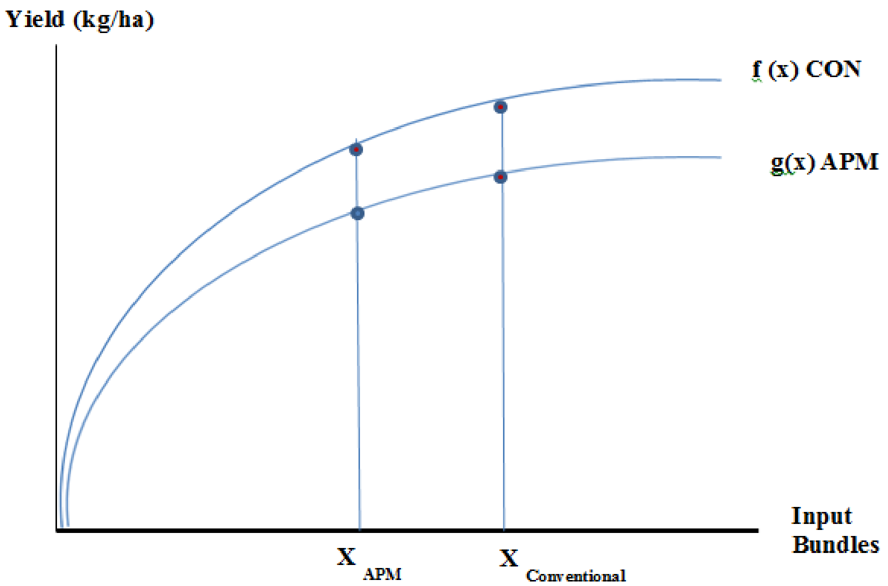

Figure 5.1. Conventional and APM farmers' production functions

Moreover, this study differentiates the APM and conventional farming practices into two regimes.

$$\ln y_{iAPM} = f(x) + v_{iAPM} - u_{iAPM} \quad (2)$$

$$\ln y_{iCON} = g(x) + v_{iCON} - u_{iCON} \quad (3)$$

Where, y_i is the natural logarithm of the production function for shallots produced using APM (y_{iAPM}) and conventional farms (y_{iCON}), respectively; x_i is the vector of production inputs; f(x) and g(x) are vectors of parameters to be estimated; v_i is the two-sided stochastic term that accounts for statistical noise in the APM and conventional production functions and u_i is a non-negative stochastic term which represents inefficiency in both production functions.

In the next stage, this study estimated the output-oriented measurement known as technical efficiency (TE). TE indicates the magnitude of the shallot production as an output of the i-th farmer relative to the output that could be produced in a frontier (fully efficient) farm using the same input bundles (Coelli, 1995), as presented in Figure 5.1.

$$TE_i = \frac{y_i}{\exp\ (x_i\beta + v_i)} = \frac{\exp\ (x_i\beta + v_i - u_i)}{\exp\ (x_i\beta + v_i)} = \exp\ (-u_i) \quad (4)$$

As mentioned earlier, it is important to distinguish the difference in technology in the early stage of the analysis. The aim of this differentiation is to examine whether there are any indications that may appear from the different groups (treatment and control) which was strongly influenced by self-selection problems. This study addressed the self-selection bias by using a matching method as introduced by previous technology adoption studies (Kumbhakar, Tsionas and Sipiläinen 2009; Mayen, Balagtas and Alexander 2010; Rao, Brummer and Qaim 2012).

5.3.2 Empirical model

Based on the nature of APM's diffusion, this study component assumed that the production function for APM farming systems was different from that of the conventional. The production functions were:

$$\ln y_i = ln\, x_i\beta + v_i - u_i \quad (5)$$

where y_i is yield (shallot production per hectare) and x is a vector of inputs. The parameter vector to be estimated is β, v_i is a two sided stochastic term that accounts for statistical noise and u_i is a non-negative stochastic term which represents inefficiency. The vector of inputs in the SPF models were land size, seed, fertilizer, pesticide, insect trap, labour, irrigation costs, assets of production capital and the number of adults in the household.

APM farming is considered to be a knowledge-intensive, task-oriented technology, requiring a relatively high level of education to allow farmers to read, interpret and understand the content and context of the technology package. Winarto (2004) explained that the main message of pest management technology adoption was to balance the numbers of natural enemies in the farms. Farmers need to learn and be able to distinguish the difference between the good and the bad insects through a daily monitoring of pests in their farms. At the same time, since the nature of diffusion is delivered through a group, like FFS, this analysis assumes that being a member of a farmer group provides better access to information and training.

The Propensity Score Matching method was estimated before the production function was analysed. The probit model was estimated to obtain the propensity scores:

$$\Pr\ (APMi = 1) = w_i'\alpha + \ e_i \quad 6)$$

where w_i is a vector of farm, farm management, farmer and household characteristics, and α is a vector of the parameter to be estimated. The propensity score estimates the probability of being an APM adopter for each farmer.

The probability of being an APM adopter is specified as a function of farm, farm management, farmer and household characteristics. It is hypothesised that farm characteristics may influence the propensity to adopt APM technology. The variables of farm characteristics included in the estimation are the share of the irrigated area that has been used for shallot farming and land-tenure systems. Land tenure is total shallot area rented and owned. Farm management variables in the estimation, such as a marketing decision to sell the shallots are included in this model. A dummy variable distinguishes whether or not the farmer has sold their product under a trader-harvester contract (tebasan).

Access to extension workers as the main source of production information is included as a determinant factor of farm management in the probit model. Moreover, farmer and household characteristics such as the age and level of education of the respondents, the total value of production assets, ownership of internet and mobile phone, and household size as a proxy of family labour are included. Total value of production assets for each respondent is measured by adding up the ownership and value of the following assets: motor-cart, cart, water-pump, sprayer, tractor, hand-tractor and grain mill.

Finally attitudinal variable are included: 1) the importance of food certification systems for producing less-pesticides shallots; 2) the importance of farming systems that reduce health risks from chemical exposure; and 3) the importance of the declining of soil fertility on the farm. Natural log transformation was used for all continuous variables in both frontier and probit models.

5.3.3 Data

The type of data that should be used in analyses of technology adoption studies has always been considered a challenging decision. The natural process of technology adoption consists of a dynamic process from the first time that technology is introduced to the farmers and during the diffusion process that often last for years. Ideally, any technology adoption study has to consider the dynamic process that is naturally found either intra household or inside the respondent. Subsequently, the analysis has to model this condition in the estimation. Doss (2006) highlighted this issue and suggested that ideally a researcher who examines the technology adoption process might consider using panel data. At the same time, the process of collecting panel data creates additional obstacles too, since the data collection is very costly in terms of time and resources. As a solution to these problems, many technology adoption studies have still carried out the analysis from a cross section data set with additional complicated methods to address the self-selection bias that is often found in this type of data. Doss (2006) also concluded that in recent decades many technology adoption studies have shifted towards greater focus on these methodological issues.

This study used data that were obtained from the shallot grower survey which was implemented by an expert team (study team) that represented the collaborative research partners in the project. These institutions were the Indonesian Centre for Agriculture Socio-Economic and Policy Studies (ICASEPS), the International Food Policy Research Institute (IFPRI), and the University of Adelaide. This survey was part of the Australian Centre for International Agricultural Research (ACIAR) funded project *Markets for high-value commodities: Promoting competitiveness and inclusiveness*. The data collection process involved 18 trained enumerators and was conducted in Brebes, Central Java, which is known as a major producing area of chillies and shallots in Indonesia. The interview process with selected farmers ran from June to July 2011.

A sample of 687 shallot growers was drawn from two different sampling selection methods. Systematic random sampling was applied to draw 531 traditional or conventional shallot growers, while the remaining samples were drawn from the list of organic fertilizer users that purchased their products from local organic fertilizer suppliers. The study team started the sampling frame processes based on annual chili and shallot production data over the previous five years (2005–2009). The team used this information as a bench mark to select the sub-district, village and household randomly.

The study team who were in charge of the sampling selection process decided to design it in relation to villages based on the proportional value of the means of production over the five years. As a result, any sub-district that had higher production of chilies and shallots was more likely to be selected. Following the serial process we were able to select 47 villages randomly and these selected villages were located in 10 sub-districts (*Kecamatans*). In every selected village, we collected a list of shallot farmers who were also land-tax payers. In the final process, we used an Excel program to randomly select households from the list to be interviewed. By applying these stages of sampling selection, the study team were able to draw around 12-17 household samples in every village. Then, using this list, the trained enumerators worked in a group and interviewed the selected household or respondent face to face using a 24-page structured questionnaire.

Meanwhile, a sampling selection approach for non-conventional shallot farmers was started by interviewing the local organic fertilizer supplier (with the local brand ‘NASA’). The aim of selecting this type of farmer was to explore whether or not the farmer had been exposed to the introduction of APM practices such as IPM and pesticide free. From the provided lists, the study team visited each farmer and asked whether or not they had cultivated shallots over the last five years. Any farmer who indicated a ‘yes’ answer was included into a list of non-conventional shallot farmers. For the next step, the study team randomly selected shallot growers from the list by using the same method that was applied for selecting conventional shallot farmers. Finally, we were able to draw 156 non-conventional shallot growers who were located in 32 villages. Interestingly, in some cases we could find both types of shallot farmers in the same village.

During the interview process the enumerators asked all the questions in the questionnaire to all the respondents in the samples. In the analysis, this study component generated a definition of APM-adopter farmers based on respondents’ responses to serial questions in the technology adoption section of the questionnaire. Serial questions about technology adoption that were covered were whether or not the respondent had heard of APM farming practices, whether they had been trained in them, and whether they had adopted them. If a respondent indicated a ‘yes’ answer to the last question, the respondent was classified as an adopter. From this selection process, the study obtained 214 APM adopter-farmers (120 farmers from the non-conventional group and 94 from the conventional group) while conventional or general farmers were about 473 farmers (36 from the non-conventional group and 437 from the conventional or general farmer group). However, the sample was reduced to the number of respondents that had complete data. As a result this study used samples from 187 treated samples and 420 untreated (control or conventional) samples.

5.4 Result and Discussion

5.4.1 Summary Statistics

Table 5.1 presents summary statistics and the statistical significance of tests of equality of means for continuous variables and equality of proportions for the binary variables of adopters, non-adopters and matched conventional shallot farmers.

On average, APM and conventional farmers operated on the same size of land. The average land size was 0.25 hectares for APM-adopter farmers and 0.21 hectares per cycle for conventional farmers. Farmers who had adopted APM farming practices tended to use fewer inputs compared with the conventional. Descriptive statistics indicate that the APM technology required less seeds, fertilizer, chemical pesticides and hired labour. Nevertheless, this farming practice was also able to reduce costs for irrigation. On average the differences are highly significant between these two group of farmers.

Insect traps are known as one of the alternative solutions for controlling pests. Therefore adopter farmers were more likely to use insect traps to minimise pests and nearly one-third of APM adopters used insect traps. However, only 15 per cent of conventional farmers used insect traps and the differences are highly significant.

The proportion of irrigated area used for APM adopters for shallot farming is 93.7 per cent their total land, while the conventional farmers have a lower proportion (83.3 per cent). APM adopters also have share of own-farmed land relative to rented-land. Both adopters and conventional farmers prefer trader-harvester (*tebasan*) contract as their most efficient option in selling their shallot. In relation to the source of information in production systems, the summary statistics indicate that APM adopters are more likely to use an extension officer. On average, 27 per cent of

APM adopters obtain information extension officers to improve their shallot farming, while only 10 per cent of conventional farmers use extension officers.

Table 5.1. Summary statistics and units for determinant variables in the study component

Variables	Adopters	Non-adopters	Matched-conventional [a]
Age (years)	46.82	47.50	47.09
	(0.788)	(0.536)	(0.824)
Education (years)	7.80	5.24***	6.71***
	(0.285)	(0.192)	(0.291)
Number of adults in the HH (person)	3.16	3.25	3.25
	(0.083)	(0.065)	(0.102)
Assets of production capital (million IDR)	10.82	2.81***	4.87*
	(2.789)	(0.697)	(1.548)
Internet (1/0)	0.37	0.20***	0.26**
	(0.035)	(0.020)	(0.032)
Mobile phone (1/0)	0.86	0.76***	0.81
	(0.025)	(0.021)	(0.029)
Distance (km)	0.01	0.01	0.01
	(0.002)	(0.002)	(0.003)
Share of irrigated land (%)	93.72	83.29***	91.43
	(1.407)	(1.653)	(1.806)
Share of rented land (%)	28.21	25.30	26.99
	(2.852)	(1.845)	(2.794)
Share of own-farmed land (%)	36.30	40.25	36.63
	(2.855)	(2.024)	(2.941)
Sold in contract (1/0)	0.52	0.50	0.49
	(0.037)	(0.024)	(0.037)
Farmer group (1/0)	0.89	0.52***	0.87
	(0.023)	(0.024)	(0.025)
Share of shallot income to total household income (%)	51.28	48.87	50.26
	(1.998)	(1.425)	(2.087)
Factor certification	0.31	-0.10***	0.11*
	(0.077)	(0.047)	(0.069)
Factor risks	0.21	-0.10***	-0.08***
	(0.080)	(0.048)	(0.070)
Extension (1/0)	0.27	0.10***	0.18**
	(0.033)	(0.014)	(0.028)
Area planted (ha)	0.25	0.21*	0.23
	(0.024)	(0.009)	(0.014)
Seed (kg)	1,185.95	1,219.71	1,203.47
	(30.638)	(33.653)	(41.870)
Fertilizer used in cycle (kg)	2,445.59	2,799.76	2,922.27*
	(159.273)	(145.494)	(230.516)
Chemical pesticide used in cycle (million IDR)	5.50	6.55	6.66
	(0.355)	(0.396)	(0.740)
Insect trap used in cycle (1/0)	0.29	0.15***	0.15
	(0.033)	(0.017)	(0.026)
Labour used in cycle (days)	507.36	513.53	561.45
	(23.648)	(25.974)	(35.383)
Irrigation fee in cycle (million IDR)	7.16	12.24***	10.48
	(0.914)	(0. 858)	(1.195)
Yield	6,938.98	6,773.73	7,447.12
	(257.36)	(405.21)	(845.41)
Observations	187	420	187

Note: ***,**,* indicate statistical significance at the 1%, 5% , 10% respectively. Standard errors are in parentheses.

[a]The subsample of conventional farmers matched to APM farmers based on propensity to adopt APM practices.

There are significant differences in farmer and household characteristics between adopters and conventional farmers. Summary statistics indicate that adopters are more educated and wealthier compared to conventional farmers. The value of production capital assets of the conventional farmers is one-fifth less than the adopters. APM adopters are younger and more likely to join a farmer group. In relation to collective action performances, the survey data shows that the adopters are more likely to use a farmer group as a place to learn and maximise the information either from the leader, from members of a farmer group or from the extension officer to improve their farming practices. The differences between these two groups are significant. Nearly 90 per cent of farmers in the adopter group are members of a farmer group while only 52 per cent of conventional farmers are members.

The attitudinal survey results significant differences in relation to their perceptions on the importance of certification, health risks and soil fertility. APM adopters are more concerned about obtaining a certification to guarantee the quality and safety of their shallots. The adopters are also more concerned about the impacts of chemical exposure, and about their health risks and the declining trend in soil fertility on their farm. Finally, the survey results show that income from shallot contributes 50 per cent of total household income and the differences are not significant between adopters and conventional farmers.

5.4.2 Propensity Score Matching Analysis

This analysis y used a Propensity Score Matching (PSM) approach, in this case the probit model, to generate propensity scores that could be translated as the predicted probability of every farmer to adopt APM farming practices. These scores were used to match the APM adopter with conventional farmers. There are two essential findings that resulted from the PSM analysis. First, the probit regression sufficiently predicts the adoption behaviour of shallot farmers, as evidenced by a very high chi-squared statistic from the Wald test which is 203.94 with 16 degrees of freedom (ρ-value = 0.0000) and the pseudo R^2 value is 0.2464. Secondly, the results from the probit regression also indicate that there is a common support which shows as the overlap in the kernel density of adopter and non-adopter propensity scores. The following figures illustrate the kernel density results before and after the matching process.

The estimation results from the probit model are presented in Table 5.2. The table shows that farmer and household characteristics are significantly in the household decision to adopt APM practices. The estimation shows that farmers who have more years of schooling are more likely to use the technology.

The total value of production assets is also statistically significantly as farmers with higher asset values are more likely to adopt. Adopting APM does not mean lower inputs costs, and during initial adoption stages, farmers may rely on production assets to support their efforts.

Table 5.2. Probit estimation of the propensity to adopt APM farming systems

	Coefficient	Standard Error
Constant	-2.589	0.468***
Age	0.014	0.006***
Education	0.062	0.017***
Number of adults in the HH	-0.114	0.163
Assets of production capital	0.209	0.039***
Internet	0.344	0.137***
Mobile phone	-0.210	0.167
Distance	1.123	1.679
Share of irrigated land	0.005	0.002**
Share of rented land	0.000	0.002
Share of owned farmland	-0.005	0.002***
Sold in contract	0.083	0.118
Farmer group	0.895	0.136***
Share of income from shallots	0.003	0.002*
Food certification concern	0.140	0.061**
Health risk and soil fertility concern	0.129	0.058**
Access to extension officer	2.482	0.158***
McFadden Pseudo R^2	0.246	
Log likelihood chi^2 (16)	203.94	
No. of observations	667	

Note: ***,**,* indicate statistical significance at the 1%, 5% , 10% respectively.

The other highly significant variables from the probit estimation as presented in Table 5.2 are farmers' engagement with farmer group and access to extension officer. Farmers who have joined a farmer group are strongly associated with APM-adopters. At the same time, farmers who consider extension officers as their main sources of production information are more likely to adopt APM farming practices. Both these variables suggest a strong relationship and the ability to increase the propensity to adopt APM farming practices.

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The probit model estimates that shallot farmers who are relatively more concerned about the importance of food are more likely to be APM adopters. Adopters place a higher value on health risks from chemical exposure and soil fertility.

The probit model is used to generate a propensity score that can be translated as the predicted probability of every farmer to adopt APM farming practices. In this process, the analysis matched the APM adopters with an equivalent non-adopter farmer. Thus, a sub-sample of conventional shallot farmers is created with the closest propensity score to that of the APM shallot farmers. The following figures show the Kernel Density estimates of the distribution of propensity score for APM adopters (treated) and conventional farmers (untreated), as presented before matching in Figure 5.2, and after matching (Figure 5.3). These indicate that there is common support to facilitate matching, and that matching successfully generated a synthetic control group. The matching process results in a new group called matched-conventional (untreated-matched), this group is the conventional farmers who have similarity in propensity scores that are represented by the collection of significant confounding covariates in probit model.

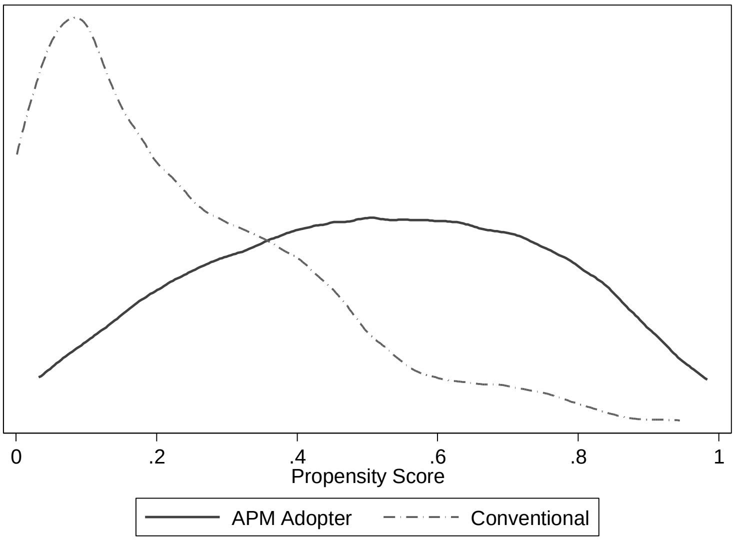

Figure 5.2. Kernel densities for propensity scores before matching

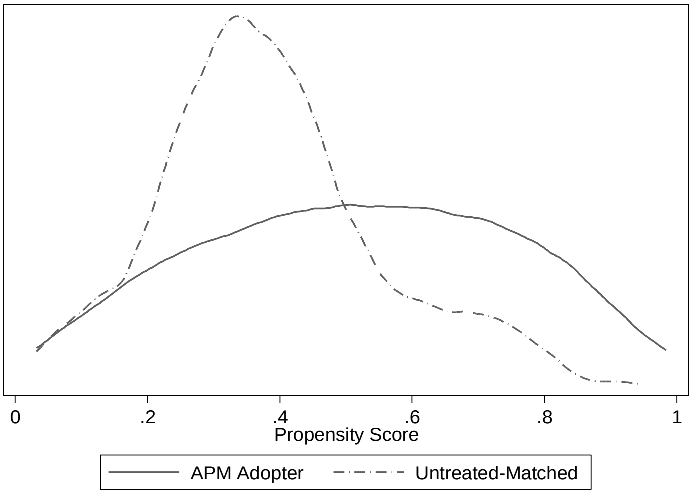

Figure 5.3. Kernel densities for propensity scores after matching

The resulting sub-sample of this group consists of 187 farmers, which is 44.5 per cent of the original conventional farmer number. Ideally, the matched conventional farmers would not have a significant difference from the APM adopters. The descriptive statistics (Table 5.1) show that the majority of the covariates are not significantly different from zero between the adopters (treated) and the matched-conventional (matched-untreated).

5.4.3 Stochastic Production Frontier Analysis

Similar to previous technology adoption studies, this research examined the differences in technology used by APM and conventional shallot growers. This analysis tests to see if all technology parameters in the conventional SPF are equal to the parameters in the APM SPF. This approach is known as the test for homogeneity in the technology. The chi-squared statistic from a Wald test is 31.18 with 10 degrees of freedom (ρ-value = 0.0005). The result showed that at least one of the APM SPF parameters was not equal to the conventional SPF ones. This test concluded that the technologies of APM and conventional farming practices were different.

APM farming practices might require skills and knowledge before the farmers are able to adopt and apply the systems on their farm. For example, Martono (2009) points out that in some cases farmers were trained to understand the basic elements and technology components through the farmer field school of IPM. Through this process he assumed that IPM farmers had improved their knowledge and increased their confidence in producing agricultural commodities with fewer chemical inputs. In being trained, adopter farmers had been taught to monitor the existence of natural pest enemies on their farm. This helped them to justify the economic threshold of the pests and diseases, before they decided to apply the pesticides (Martono 2009).

These illustrations prove that similar to many sustainable agriculture technologies, APM farming practices have been considered as knowledge-intensive tasks which require a high level of education and knowledge of ecosystems. Therefore, the researcher confidently hypothesized that the APM technologies were different from the conventional or traditional shallot farming technology.

The results from the Stochastic Production Frontier models estimation of APM and matched conventional shallot farmers are presented in Table 5.3. The results indicated that all tested inputs affecting the productivity are statistically significant. For conventional production, the parameter estimation for seed, fertilizer, chemical pesticides, insect traps, labour used, irrigation costs and assets are positive and statistically influence productivity. Among these inputs, insect traps have the largest effect on shallot production, followed by chemical pesticides and labour used. As pest and disease are considered as the major problem for shallot farming, these two inputs counted as the most important determinants in conventional shallot production.

The most important indicators in these results are the level of education of the adopter and farmer group membership. These variables are not significant in reducing the level of inefficiency in conventional production systems. The farmers' education level and membership of farmer group are significant in influencing the ability of APM adopter farmers to reduce the level of inefficiency in producing less-pesticides shallots. Like several other studies, the more knowledge-intensive technologies appear to better suit farmers with more years of schooling, findings consistent with other adoption studies (Kabunga, Dubois and Qaim 2012; Lee 2005).

Table 5.3. Estimation of Stochastic Production Frontier of APM adopters and matched conventional farmers (different technology)

Variables	Coefficients	Standard Error
Constant	3.386	0.841***
Area planted	-0.160	0.064***
Seed	0.123	0.070*
Fertilizer	0.135	0.079*
Chemical pesticides	0.185	0.065***
Insect traps	0.324	0.133***
Labour	0.162	0.053***
Irrigation costs	0.010	0.005**
Assets of production capital	0.063	0.031**
Number of adults in the household	-0.227	0.104**
APM	2.847	1.111***
APM x area planted	0.128	0.081*
APM x seed	0.055	0.082
APM x fertilizer	-0.019	0.100
APM x chemical pesticides	-0.145	0.084*
APM x insect traps	-0.290	0.153*
APM x labour	-0.095	0.064*
APM x irrigation costs	-0.011	0.007*
APM x assets of production capital	-0.051	0.038
APM x no. of adults in the household	0.121	0.149
Variance of *v*		
Constant/intercept	-2.212	0.319***
APM	-0.619	0.462
Variance of *u*		
Constant/intercept	-0.256	0.470
APM	1.192	0.604**
Education	0.015	0.032
APM x education	-0.082	0.044*
Farmer group	-0.213	0.357
APM x farmer group	-0.761	0.506*
Wald $chi^2(19)$	180.97	
Prob > chi^2	0.000	
Log likelihood	-307.487	
No. of observations	374	

Note: ***, **, * indicate statistical significance at the 1%, 5% , 10% respectively.

The technical efficiency means and standard deviations for conventional and APM groups are presented in Table 5.4. The distribution of technical efficiency for adopters, matched-conventional and unmatched-conventional are presented in a bar diagram (Fig 5.4). The data indicate little difference in technical efficiency between the two groups of farmers under the PSM subsample or all farms.

Table 5.4. Means and standard deviations of Technical Efficiency for shallot farmers

	APM		Conventional		Difference in means
	Mean	SD	Mean	SD	
PSM subsample	0.596	0.198	0.576	0.190	0.020
All farms	0.596	0.198	0.570	0.194	0.026

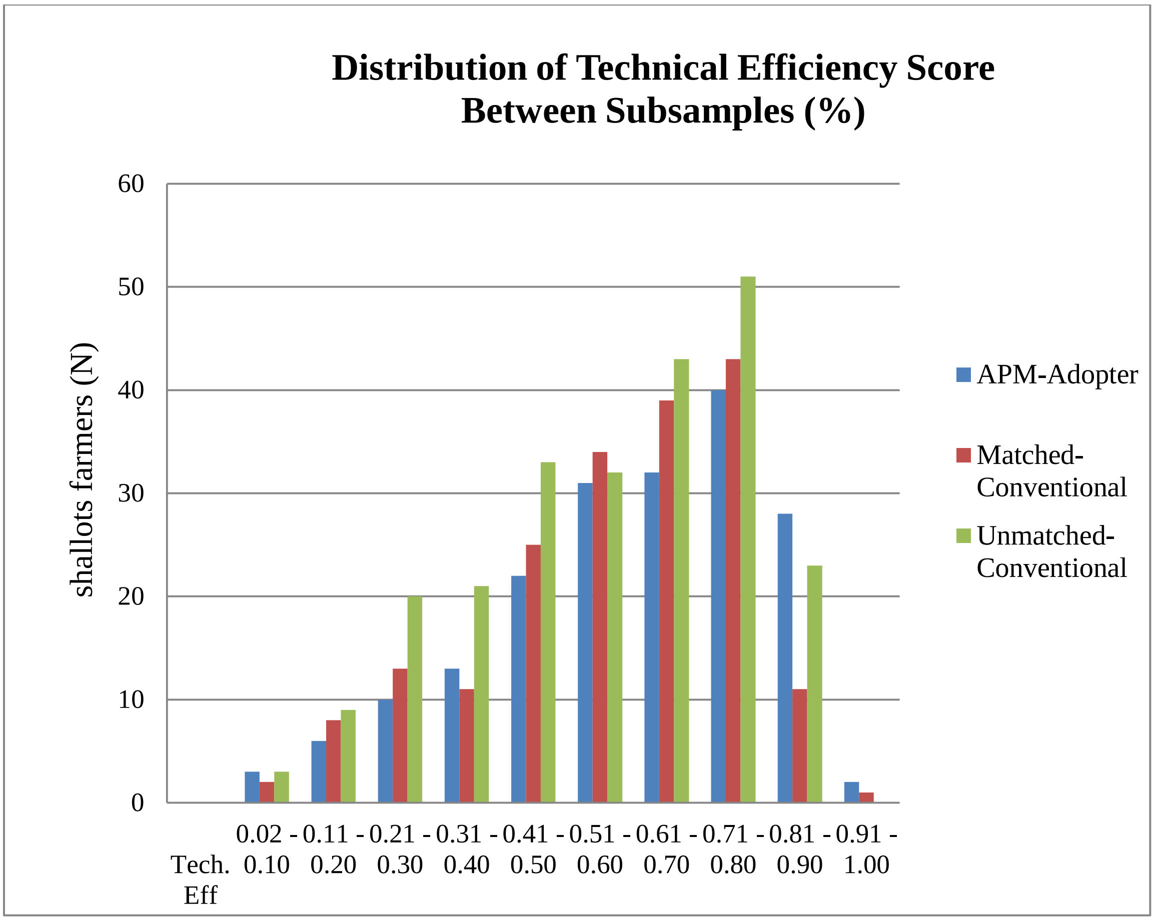

Figure 5.4 The distribution of Technical Efficiency score between PSM subsamples

A bar diagram illustrates the distribution of technical efficiency scores is between the adopter, matched-conventional and unmatched-conventional groups of farmers. As explained in previous section, matched-conventional is a group of conventional farmers who have the closest propensity scores to that the APM-adopter farmers. While, the unmatched-conventional is the remaining conventional farmers who have not similarity in the propensity scores to that the APM-adopter farmers.

Having addressed the self-selection bias, APM adopters are compared with the matched-conventional farmers. The bar diagram indicates that matched-conventional farmers are slightly more efficient when compared to the adopter in particular in the range of the TE score between 0.41- 0.80. The results indicate that the APM-adopter group has higher number of farmers who are able to reach the frontier (0.81-0.90). This result suggests that adopter farmers are able to reach the same efficiency level as the matched-conventional farmers.

The next section illustrates more detailed results, in particular showing the measurement of how much on average was the yield loss that could be associated with technology adoption. The technical efficiency score from the SPF approach shows that APM-adopter farmers had the same competence to reach the efficiency level as the conventional farmers.

5.4.4 Decomposing the Yield Loss

The main objective of this part of the study was to decompose the yield loss that might have been caused by: 1) the nature of the production technology, and 2) the farmer's technical inefficiency. As illustrated in Figure 5.5, this study component built the estimation of yield loss under two production functions, the conventional and the APM. The APM and conventional farmers used different levels of inputs. Conventional farms used more fertilizer, chemical pesticide and paid higher irrigation fee. While APM farms were the opposite condition in using the inputs and more likely to use insect traps. Under the assumption of the different technologies used in the production systems, the analysis continued by examining the differences of total productivity of shallots under the average inputs used for: 1) conventional farming systems and 2) APM farming systems.

The results in Table 5.5 and the illustrations shown in Figure 5.5 show that over the two different input bundles, APM farmers are less efficient when compared with the matched-conventional farmers. APM production resulted in yield loss for the adopter farmers. However, the magnitude of losses for both input bundles as presented in the figure and table is very small (less than 1.5 per cent and 1.1 per cent respectively). It also clearly shows that reducing the amount of pesticide and fertilizer caused the decreasing in yield, but the benefit for implementing APM technology demonstrated that APM farmers are able to produce high quality and safer shallots to consume. If the price premium of less-pesticide shallots available in the market, the APM-adopter farmers are more likely to receive higher returns and increase their income.

Interestingly, these results also confirm the importance of addressing the self-selectivity that might result from the data. Without the matching process, the differences between these two groups of farmers are very small (13.24 kg/ha or 0.12 per cent). Ignoring the self-selection bias might result in upwardly biased information.

Table 5.5. Differences in yield (kg/ha) between PSM subsample and all farms

Input bundles	Technology/frontiers		Differences	
	APM	Conventional	Value	Percentage
With matching (PSM subsamples)				
APM-adopter (N=187)	11,304.43	11,479.61	-175.18	-1.53
Matched-conventional (N=187)	11,493.49	11,623.67	-130.18	-1.12
Without matching (all samples)				
APM-adopter (N=187)	11,304.43	11,291.19	13.24	0.12
Conventional (N=422)	11,493.49	11,331.03	162.46	1.41

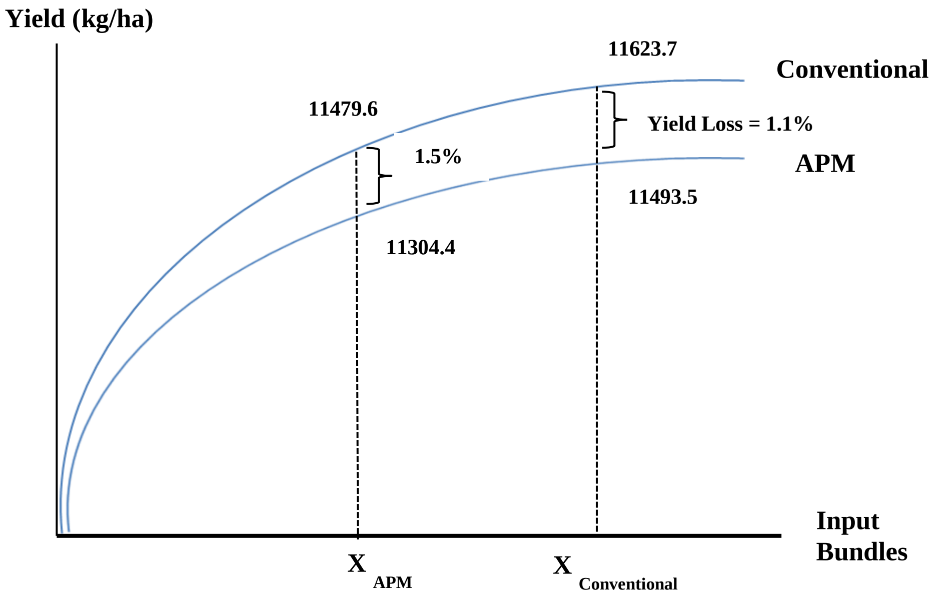

Figure 5.5. Measuring yield loss between APM adopter and matched-conventional farmers

The small yield losses associated with APM technology is promising, suggesting that targeted policies and training activities, especially those aimed at farmer groups can help address environmental concerns as consumer and importing countries increasingly demand higher standards, in particular when this study highlighted the global concerns toward the way of emerging economies in producing their food. This study proved that APM technology was able to produce higher safety and quality shallots since farmers who have been practicing this technology able to reduce pesticides residues on the products. Although, APM farming practices are found less efficient in term of the productivity, but the efficiency can be improved by designing a better format for the training.

As mention earliers, most of the times, the format of training always aimed to target progressive or the smartest farmers in the group. The access to participate in training is not always equally fit for every member in the farmer group or non-farmer group farmers. This exclusion in the future may reduce the number of farmers who are willing to adopt new technology.

Meanwhile, Latent Cluster analysis from Chapter 4 indicated that cluster 3 that has the largest proportion of APM adopter farmers indicated that almost 61.34 per cent of the member of the cluster were participated in training, compare to other cluster 1 (35.66 per cent) and cluster 2 (32.89 per cent). Therefore, it is obvious that almost 42 per cent shallot farmers in cluster 3 considered as the frist person to implement non-conventional farming practices (included APM) in the village. Participating in any technology adoption training can help farmer to become an agent of change.

However, the chains for less-pesticide shallots have to be developed. At the moment, the promising results only appeared at the production level, a unique sales and marketing system for these 'niche' shallots are not developed yet. To date, traceability for fresh food products is underdeveloped in Indonesian market.

At the global level, these findings show that shallots growers in Indonesia have been able to implement sustainable agriculture practices, which means they have the ability to efficiently produce shallots with minimal impact to the environment and health risks for the consumers.

5.5 Summary

Different from previous green-technology adoption research, this study contributes to the literature by analysing the yield loss that is associated with APM technology adoption. This measure of yield loss is generated by estimating differences in technical efficiency between APM and conventional farming systems. APM in this study refers to pest-management based production systems such as IPM and the Pesticide-Free approach. APM allows farmers to reduce the use of chemical pesticides and to increase soil fertility through increasing the amount of natural enemies on farms.

The analysis using SPF reveals interesting and useful results. The SPF method estimates the differences in inputs used over the two technologies. The first stage results indicate that the technologies for producing conventional shallots and APM shallots are different. The results demonstrate that all inputs result in higher productivity in the conventional system compared to the APM technology. The differences are statistically significant for land size, chemical pesticides, insect traps and labour used.

The SPF analysis also indicates that yield loss associated with the adopted APM farming systems is not significant (less than 1.5 per cent). Thus, APM adopter yields can be improved by implementing training and extension methods, especially by focussing on farmer groups. Increasing smallholders' access to training for technology adoption must be provided for all farmers, not just those that are active members of farmer groups. This is because increasing access to training and improving the extension methods may increase the number of farmers who are willing to become an agent of change in shallot industry.

This chapter indicates that APM farming practices are able to improve the quality of shallots and potentially meet growing consumer expectations for higher safety and quality fresh produce in Indonesia. Nevertheless, the market signals and the traceability systems required to gain and maintain consumer confidence are still lacking.

This study indicates that farmers are ready to supply APM products, and that the next step forward is to consider developing a market for APM shallots because currently it does not exist. There are high transaction costs in marketing APM shallots, and reducing these costs may provide market incentives for farmers to shift to APM farming systems and earn higher profit from using more sustainable farming practices.

Ideally, the analysis of technology adoption has to consider the time frame which means should be based on panel data. Further works may target a specific technology adoption and aims to record the dynamic of technology adoption process.

5.6 References

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6 Chapter 6. Summary, Discussion, Conclusions and Policy Implications

6.1 Summary of Key Issues Addressed in Thesis

The main aim of this thesis was to address one aspect of food system transformation in Indonesia, specifically the market for horticultural products produced using non-conventional farming systems, including organic, environmentally-sustainable and alternative pest management (APM) systems. As outlined in Chapter 1 and Chapter 2, one reason for studying this topic is growing evidence to suggest that there is increasing demand in Indonesia for horticultural products produced using less chemicals, particularly pesticides (Posri, Shankar and Chadbunchachai 2006; Ahmad and Juhdi 2010; Mergenthaler, Weinberger and Qaim 2009). This trend in demand might be expected given the substantial economic growth experienced in Indonesia over the last decade and increasing consumer concerns about food safety and quality issues such as pesticide and other chemical residues on food and the impact of the use of these chemicals on the environment (Shepherd 1995).

Smallholders who are willing and able to adopt one of the APM farming systems, which are required to produce food products marketed as “certified organic” or “certified pesticide-free”, may be able to get a premium price. However, as discussed in Chapter 2, this requires a marketing system where the premium price paid by the consumer actually reaches the producer as a price premium. This process also requires a traceability system and possibly a governance system to enable the credence attributes to be verified and products certified as organic or pesticide-free (Hatanaka, Bain and Busch 2005).

Furthermore, buyers of horticulture products from smallholders, including traders, wholesalers and retailers, may not be willing to pay smallholders a premium for products produced using non-conventional methods. Rather, these types of systems may be a requirement or barrier to entering the market. In fact, in many cases, modern food retailers and processors are requiring their suppliers to change their production practices in order to address safety, quality and environmental concerns. Buyers are increasingly requiring their suppliers to provide auditable records of production methods such as use of chemicals (pesticides, herbicides etc.) to meet certain production standards (Reardon et al. 2009).

Therefore, while non-conventional farming systems, such as organic and pesticide-free, may appear to offer an opportunity for smallholders, in reality there are many uncertainties with respect to the both the supply and demand for these products. These issues should be considered before smallholders are encouraged to adopt such non-conventional farming systems.

Prior to the consumer study conducted as part of this thesis (Chapter 2), there were no known published Indonesian studies that considered demand potential for “certified organic” or “pesticide-free” horticultural products in Indonesia. Specifically, information was needed to understand the potential premium for products produced through non-conventional farming systems, such as “certified organic” and the systems required to verify and label these attributes in the market.

Additionally, prior to this research, very little was known about how specific non-conventional farming systems, such as the APM systems explored in this study, affect productivity in Indonesian. If productivity and yield are significantly lower, and yield loss cannot be easily resolved through management and practice change, then one would question why smallholders would be encouraged to adopt such systems – unless of course, these farming systems were a requirement of the market.

Prior to this research, even less was known about the characteristics of adopters of these technologies in Indonesia. Yet, it is important to understand if and how adopters differ from non-adopters in order to gain insight on the entire set of factors that need to be addressed to increase adoption of technologies, including new crops and non-conventional farming systems, which may help Indonesian smallholders.

Finally, it is important to understand 1) what technology attributes are relatively more preferred by smallholder farmers when making a decision about whether to adopt a new crop or non-conventional farming system, and 2) why the relative value placed on technology attributes may differ. For example, are preference differences associated with risk attitudes (which may be difficult to influence), experience in production agriculture that may lead to unique knowledge of production and climate issues, or because of characteristics that could be addressed such as resource constraints (human, social and financial capital). As explained in Chapter 4, no previous research has attempted to understand the relationship between farmers' preferences for attributes of innovations and the determinant factors of adoption (e.g. farm and farmer characteristics). Significantly, there is no known study that has measured these issues using Indonesia as the context of the study

These production issues related to the growing demand for horticultural products produced using APM farming systems were addressed in the second study, the survey of 687 shallot producers, and were presented in Chapters 3-5..

6.2 Summary of Main Findings

The following paragraphs highlight the key findings from the four main analytical chapters (Chapters 2-5) of this thesis.

Chapter 2 addresses the first research question: "What are the determinants that help explain demand for certified organic high-value agricultural products?"

Primary data was collected as part of a consumer food consumption survey of 1180 urban Indonesian households in three cities (Surabaya, Bogor and Surakarta). As part of the survey, consumers indicated their WTP for certified organic mangoes, chillies and chicken products. Consumers were, on average, willing to pay premiums of about 17.3 per cent for certified organic chicken, 18.8 per cent for certified organic chillies, and 21.1 per cent more for mangoes. These findings suggest a strong potential for the growth of certified organic products in Indonesia. The Cragg double-hurdle model was used to analyse the WTP data to better understand the market potential. The results of the analysis revealed the characteristics of organic consumers in Indonesia are similar to other countries experiencing growth of demand for organic fresh produce.

Considering the results of the empirical estimation of the Cragg double-hurdle model, it was suggested that the target market for certified organic food products in Indonesia is likely to be educated females, who live in higher incomes households and frequently shop in modern food retail outlets (supermarkets). For the market to continue to grow and for demand to remain strong, the governance of the "certified organic" food system in Indonesia still needs to be developed in order to minimize asymmetric information between consumers and producers. In particular, there is a need for a guarantee or traceability system to verify the methods used to produce products with claims such as organic, pesticide free or other credence attributes offering enhanced food safety or quality.

Chapter 3 is the first chapter of the second study, which focused on the supply side of the market for horticultural products produced using non-conventional, alternative pest management farming systems. This chapter addressed the second research question: "Are there differences in characteristics between adopters and conventional farmers in terms of socio-demographic, production and marketing decision in shallot industry?" The shallot producer survey data set was divided into two sub-samples: one for conventional farmers and the other for APM-adopter farmers.

A basic statistical analysis found that conventional farmers are often less educated, have fewer production and household assets, have limited access to modern technology such as computers and the internet, are more risk averse and are less likely to join a farmer group. This prevailing attitude towards farmer groups also lowers the probability that traditional farmers are exposed to new technologies. Conventional farmers are more likely to use credit from input dealers and they are less likely to change the application of their inputs used in shallot farming. Conventional farmers are not familiar with the use of organic fertilizers and bio-pesticides in their farming systems.

Shallot farmers who have adopted APM practices have made quite significant changes to production and on-farm activities, in particular to their ability to reduce dependency on chemical inputs. However, to date, the introduction of APM farming practices has not led farmers to increased exposure to niche markets that would be able to provide them with premium prices.

Chapter 4 addresses the third research question: "What factors determine shallot farmers' preferences towards technology attributes relevant to non-conventional farming practices?" Essentially, the results presented in Chapter 4 provide insight on shallot farmers' preferences for technology attributes, specifically crop and non-conventional farming system attributes. The Best-Worst Scaling analysis suggests that the most important attributes for the average Indonesian shallot farmers are related to relative or economic advantage of a new crop or non-conventional farming system. The Latent Class Analysis identifies three unique clusters or segments of producers, which each have unique preferences for technology attributes. Clusters were characterised post-hoc using farmer and farm household characteristics and assets, adoption behaviour, access to credit for inputs, participation in farmer groups and sources of production information. These characteristics were expected to provide insight on why a specific cluster of farmers placed relatively higher or lower importance on specific crop attributes and help explain why they may or may not adopt a technology. Unfortunately the analysis did not lead to a clear story on why preferences for technology attributes are different.

Chapter 5, the last analytical chapter addresses the fourth research question: "Are APM farming systems adopted by shallot farmers in Indonesia less efficient than conventional farming systems?" Specifically the technical efficiency of both conventional and APM shallot production functions was examined to determine if there was yield loss that is associated with the adoption of the APM technology. This measurement of yield loss is determined by estimating the differences in technical efficiency between APM and conventional farming systems.

The Chapter 5 analysis using the Stochastic Production Frontier (SPF) method indicated that the technology for producing conventional shallots and APM shallots were different. The SPF method is used to estimate the difference in inputs used over the two technologies. The conventional method resulted in higher productivity compared to the APM method and there were significant differences in the productivity of the following inputs: land, chemical pesticides, insect traps and labour. However, the yield loss associated with the APM farming system was not significant (less than 1.5 per cent lower). Ultimately APM adopter yields can be improved by implementing training and extension methods, especially through farmers' groups.

6.3 Discussion, Conclusions and Policy Implications

The analysis from the consumer study (Chapter 2) strongly suggests that a viable and growing market exists in Indonesia for certified organic food, particularly considering that household disposable incomes in Indonesia are trending upwards. Adding to these findings, a study by Oberman et al. (2012) projected that by 2030 almost 71 per cent of the Indonesian population will be living in the cities. This prediction indicates that the market for certified or organic products may experience a positive trend and a massive growth. However, as the market grows and consumers become more educated about food production systems, it will be increasingly important for producers and processors to be able to verify the credence attributes they claim, such as organic and pesticide-free.

Although the Indonesian government, in this case the Ministry of Agriculture, has introduced a formal "certified organic" labelling program, consumers are still not familiar with this label. Additionally there is no budget allocated to ensure the label is used appropriately and ensure the claim is credible. At the moment, self-claimed fresh food products with credence attributes are heavily marketed at the high-end modern food retailers. The lack of an organic or pesticide-free standard and the current trend of "self-claimed" marketing of these attributes suggests there is asymmetric information in the market that could eventually result in the failure of organic and pesticide-free markets.

Unfortunately the analysis from the shallot producer survey indicates that only a small number of farmers have adopted the non-conventional APM farming system methods despite a long history of training programs by the government, NGOs and the private sector. The research presented in this thesis suggests that this low rate of adoption is caused by a variety of factors: low levels of education, resources constraints, lack of access to training, less participation in farmer groups, high production costs, and, importantly, no price / market incentives for producing less-pesticide or safer shallots. The nature of shallots as a cash crop characterized by ongoing price volatitly means farmers tend to rely heavily on chemial inputs to maximize yields. This is not surprising considering almost 60 per cent of survey respondents prefer to adopt technology that is able to provide a high expected price or returns, while nearly a quarter of the samples require technology that is able to minimize fluctuations in price. Farmers may perceive APM farming practices to be too risky and similarly perceive APM to not offer enough financial incentives to make up for increased risk.

In contrast, the results from the SPF analysis indicated that the yield loss associated with the implementation of APM farming practices is very small or insignificant. In this situation, shallot farmers have a significant opportunity to produce less chemical shallots, which means to minimize contamination from pesticide residues not only for the benefit of consumers but also for themselves. Encouraging results considering the role of shallots as an essential ingredient in everyday cooking for Indonesian consumers.

The results suggest the importance for the Indonesian government to begin identifying alternative solutions to increase the rate of adoption of APM farming practices. Building on the results of this thesis, some of the solutions that can be translated into policies are as follows:

1) **Price premium**

Farmers must receive a price premium in order fo them to increase the domestic supply of APM-produced fresh food products. However, for consumers to be willing to pay a premium, they must trust that the information provided and/or the claims being made are indeed true. Therefore consumers must trust both the firm selling the product and regulatory system that underpins the claims. Currently there are no such systems in place for marketing of most credence attributes in Indonesia. The marketing channels used by most producers of APM products limits the sharing and transparency of information regarding production methods, which may be valued by the market. Therefore it important to examine whether assymmetric information at both ends of the market may contribute to the failure of organic markets in Indonesia. How to reduce information asymmetry in the market is an important consideratino for future research on this topic in Indonesia

In Indonesia, direct marketing or other cooperative and collective marketing schemes may improve smallhlders' access to niche markets including modern food retailers and organic shops which appear to exist in large metropolitan areas in Indonesia. Currently, the main obstacles to accessing such niche markets are the current practice which is applied by farmers when marketing their products. In many ways, the *tebasan* or contract-trader harvesting decreases the farmer's ability to receive radded value from the credence attributes that could be marketed because of APM used, this is because, many traders are not grading the shallots based on the production systems. The current grading systems are only applied based on size and water content, known in local terms as "askip".

To overcome these obstacles, it is important to involve traders in developing traceability systems as well to include them when establishing a niche market for low-pesticide or pesticide-free shallots. An alternative is for the farmers to maximize collective action through farmer groups to verify that these methods are used and find access to niche market for their products. Thus, it requires the development of farmer-private sector or farmer-government partnerships. Premium prices and niche markets may help to increase the adoption ratees of APM farming practices, particularly if farmers believe there are longer-term financial opportunities. This will encourage more farmers to be more motivated to actually adopt, maintain and replicate these farming systems. In the end, it will increase the production of higher quality and safer shallots in Indonesia.

2) **Providing market access for inputs**

To increase the rate of adoption means to increase and improve the access to any inputs that are required to implement the technology. In APM farming practices, farmers are required to use organic inputs such as organic fertilizer and bio-pesticides. Therefore, providing credit for these specific inputs will help farmers to adopt the technology and to start implementing its application on their farms. In particular concerning shallots as cash crops with large price fluctuations, credit from formal and informal financial sources can reduce the pressure for farmers to gain access to cash for the next cropping season.

3) **Improvement of farming practices for conventional farmers**

The diffusion of APM technology adoption to conventional farmers can be implemented through knowledge sharing and training to improve their regular farming practices. Soil fertility, pests and diseases are key challenges faced by shallot farmers in Indonesia. Therefore the introduction of the APM technology can be applied indirectly by suggesting conventional farmers begin improving soil fertility on their farms by gradually reducing their reliance of chemical inputs such as the use of pesticides and mineral fertilisers and enhance and protect biodiversity. As mentioned this could be done in addition to providing smallholders access to markets for inputs and outputs.

4) **Investment in education**

A lack of educational investment has left many smallholders in developing countries incapable of dealing with the changing food sytems. The nature of diffusion of technology adoption in Indonesia has been applied using the World Bank's training model which relies heavily on Farmer Field Schools (FFS). This model has limited the access to training for any farmers who do not belong to a farmers group. Therefore, to increase the possibility for conventional farmers to participate in the training one must look outside the FFS model of technology diffusion.

This thesis contributes to and complements the existing literature regarding the measurement of demand for fresh food products with credence attributes and it explores various aspects that may related to the low rate of adoption of APM shallot farming systems in Indonesia. It explains in detail the current conditions of urban consumers and smallholder shallot farmers in Indonesia in relation to the early stages of transformation of food systems. There are many opportunities to conduct additional research on this topic. This thesis only examined issues facing two specific segments of the food system, consumers and smallholder producers. Future work work is needed to understand the economic drivers of key players in the food system to identify and understand the barriers preventing price signals and information to flow along the value chain. Additional research should focus on shallot retailers, wholesalers and traders.

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Appendices

ICASEPS

INDONESIA SURVEY OF URBAN CONSUMERS
November 2010
IFPRI - UNIVERSITY OF ADELAIDE - ICASEPS

---CONFIDENTIAL---

IFPRI

THE UNIVERSITY OF ADELAIDE AUSTRALIA
School of Agriculture Food and Wine

Objective:	The purpose of this survey is to improve our understanding of urban food consumption patterns, particularly the role of supermarkets and other "modern" outlets.
Use of data:	The data collected as part of this survey are for research purposes **ONLY.** Household-level data will not be shared with non-research organizations. . Only summary results will be included in published report.

Household ID number

City	Kelurahan	RW number	RT number	Household number

City: 1. Surabaya 2. Bogor 3. Surakarta

Kelurahan: [Codes on back cover]

Enumerator code [Codes on back of cover]

Name of head family	
Name of respondent	
Address/location	
Phone number	
Name of kelurahan	

Hello, my name is ________________. I work for a research institue in Bogor called ICASEPS and we are carrying out a survey on food shopping habits. The survey is intended to improve our understanding of how food shopping patterns are changing and how to help farmers adapt to those changes. You are one of 1200 household in three cities selected to participate. The individual results are confidential - only summary results will be included in the report. We would like about 90 minutes of your time to ask you some questions.

	Date			Name	Sign
	Day	Month	Year		
Interview			2010		
Field check			2010		
Check kantor			2010		
Data Entry - Start			2010		
Data Entry - Finish			2010		

Research funded by a grant from the Australian Centre for International Agricultural Research (ACIAR)

Australian Government
Australian Centre for International Agricultural Research

Back of cover page

Kelurahan codes

City of Surabaya

Code	Kelurahan
11	Jepara
12	Ketabang
13	Simolawang
14	Tegalsari
15	Krembangan Utara
16	Ujung
17	Rungkut Menanggal
18	Mulyorejo
19	Medoan Ayu
20	Klampis Ngasem
21	Tambaksari
22	Tenggilis Mejoyo
23	Pradah Kali Kendal
24	Kedurus
25	Pakis
26	Margorejo
27	Ngagel Rejo
28	Klakah Rejo
29	Sonokawijenan
30	Banjarsugihan

City of Bogor

Code	Kelurahan
41	Curug Mekar
42	Paledang
43	Panaragan
44	Babakan Pasar
45	Tegalega
46	Batu Tulis
47	Sukasari
48	Baranangsiang
49	Bantar Jati
50	KedungBadak
51	Bubulak
52	Gudang
53	Bondongan
54	KedungHalang
55	Menteng
56	Empang
57	Genteng
58	Rancamaya
59	Ciparigi
60	Kayu Manis

City of Surakarta

Code	Kelurahan
71	Purwosari
72	Sondakan
73	Jajar
74	Karangasem
75	Tipes
76	Jayengan
77	Semanggi
78	Kedung Lumbu
79	Tegalharjo
80	Jebres
81	Punggawan
82	Nusukan
83	Kadipiro
84	Banyuanyar

Enumerator codes

Code	Surabaya enumerator
01	Cirama Buavi
02	Deny Ismayanti
03	Destranto Wijanarko
04	Dwi Wahjuni
05	Eko Febriyanto H.
06	Hesti Anisanti
07	Inneke Kumalasari
08	Lintang Widya Retna
09	M. Nur Syamsu
10	Mugi Gumanti
11	Nurul Huda
12	Rohmat Subagyo
13	Ryan Hidayat
14	Slamet Hariyono
15	Himawan Setiajid

Code	Bogor enumerator
20	Atin Supriyatin
21	Dewi Amna
22	Dudi Lesmana
23	
24	Imam
25	Imron
26	Pitriati Solehah
27	Ruhmaniyati
28	Usep Santosa
29	Waluyo

Code	Surakarta enumerator
30	Budiarto
31	Dasriyanto
32	Nunuk Numaliningsih
33	Wahyu Erlianto
34	Temberyanto Setiawan
35	Azis Kuriawan
36	Priyo
37	Arief Kruniawan
38	Danny Ardiansyah

A. CHARACTERISTICS OF MEMBERS OF THE HOUSEHOLD

						Ask these questions only for members 17 years and older			
	Please list the names of members of this household. [list in order of age, from oldest to youngest]	Is [name] a male or female? 1. Male 2. Female	What is the relationship between [name] and the head of household? 1. Head 2. Spouse 3. Son/daughter 4. Son/daughter in law 5. Grandchild 6. Parent or in-law 7. Other related 8. Other unrelated 9. Domestic employee	How old is [name]? [age at last birthday, use 0 if less than 1 yearr old] Years	Ask this question only for members 6 years or older How many years of schooling has [name] completed? (Year)	What is the marital status of [name]? [Select first correct response] 1. Single 2. Married 3. Separated or divorced 4. Widowed	What is the main activity of [name]? [See activity codes on back of page]	On average how many hours a week does he/she work in this activity? [Use 99 for housework, student, retired, & not working]	Is anyone in the household pregnant or lactating? [fill in each row] 1. Yes, pregnant 2. Yes, lactating 3. Yes, both 4. No
A1		**A2**	**A3**	**A4**	**A5**	**A6**	**A7**	**A8**	**A9**
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									

Note: The household is defined as a group of people who live and eat together most of the time. Each member must live with others at least 6 months of the year or 4 days out of the week. The head of the household is defined as the member who makes most of the economic decisions.

AFTER COMPLETING A9, FOLD PAGE TO
← HERE, THEN COMPLETE A10 - A12

Back of Section A

	Record height and weight of each household member		Code whether height and weight are based on measurement or estimation. 1. Estimated by respondent 2. Provided by medical records 3. Measured by enumerator
	Height cm	Weight kg	
A1	**A10**	**A11**	**A12**
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			

Activity codes for A7	
11	Farmer/fisherman
12	Self-employed commerce (e.g. trader, shop-keeper, vendor)
13	Self-employed service (e.g. barber, repairman, electrician, plumber, driver with vehicle)
14	Self-employed manufacturing (e.g. metalwork, carpenter, food processing)
21	Employee, professional active (e.g. doctor, nurse, teacher)
22	Employee, professional less active (e.g. manager, executive, administrator)
23	Employee, semi-skilled active (e.g. policeman, sales, food service, teller)
24	Employee, semi-skilled less active (e.g. secretary, book-keeper, receptionist, driver)
25	Employee, laborers (construction, cleaner, factory worker, security guard)
26	Domestic employee (maid, nanny, gardener, housekeeper)
31	Housework (housewife or other family member)
32	Student (including university)
33	Retired
34	Not working
41	Other (please specify)

Definitions:
Self-employed means the person is paid for each product or service sold
Salaried and laborers are paid by the length of time worked (day, month, or year)

B. HOUSING and ASSETS

Codes for B1	Codes for B2 & B3	
1. Muslim	1. Javanese	6. Balinese
2. Christian	2. Sundanese	7. Arabic
3. Bhuddhist	3. Madurese	8. Chinese
4. Confucious	4. Minangkabaus	9. Other
5. Hindu	5. Makasar	10. No spouse
6. Other		

What is the main religion of the household? ☐ B1

What is the ethnicity of the head of household? ☐ B2

What is the ethnicity of the spouse of the head of household? ☐ B3

What is the main source of drinking water for your household? ☐ B4

1. Indoor tap
2. Outdoor private tap
3. Outdoor shared tap
4. Covered well
5. Collected rainwater
6. River, lake, or pond
7. Water collected in a tank
8. Aqua/bottled water
9. Refill water

What is the main type of toilet used by your household? ☐ B5

1. Flush toilet
2. Latrine with pipe
3. Pit latrine
4. Latrine over canal/river
5. Public toilet
6. Other or none

What is the main type of lighting used by your household? ☐ B6

1. Electric lights
2. Oil lamps
3. Candles
4. Other 5. None

What type of fuel is used by your household for cooking? ☐ B7

1. Electricity
2. LPG
3. Biogas
4. Kerosene
5. Wood
6. Other

What is the distance (in meters) to the nearest public transport? =1)
That is ojek, angkot, bus, etc) B8
(Round to nearest km; e.g. 0.5km = 0; 1.2km =1) ☐ Meters

B9. How many of each of the following items do members of your household currently own or have in household?
[If household does not own, write "0"]

B10. What year did your household first own this type of asset?
. [use two digits e.g. "04"]

	Number		Year	
a refrigerator?		1		1
a microwave oven?		2		2
a rice cooker?		3		3
a stove		4		4
a bicycle?		5		5
a motorbike?		6		6
a car or truck?		7		7
a mobile phone?		8		8
a landline telephone?		9		9
a computer or laptop?		10		10
Internet access? (incl. mobile)		11		11
a radio?		12		12
a television?		13		13
cable television (e.g. Indovision)?		14		14
a fan?		15		15
an air-conditioner?		16		16
a washing machine?		17		17
a generator?		18		18
a debit card?		19		19
a credit card?		20		20

C COOKING AND SHOPPING ATTITUDES AND BEHAVIOUR

Does this household have a cook or housekeeper? [If no, fill in "3" for C1 and C2]

C 1	Does the domestic employee ever help with cooking?		C 1	1. Yes, at least sometimes
C 2	Does the domestic employee ever shop for food?		C 2	2. No, never , 3. Not applicable (no domestic employee)
	Who in the household is primarily responsible for…			
C 3	…deciding what food products to purchase for the family meals?		C 3	1. Adult male family member
C 4	…doing the majority of food shopping for family meals?		C 4	2. Female adult family member
C 5	…deciding what food the family will have for a meal?		C 5	3. Children in family
C 6	…cooking the majority of the family meals?		C 6	4. Domestic employee 5. No one
C 7	Does someone in the household make a written food shopping list?		C 7	1. Yes 2. No
C 8	How many times per week does the majority of your household eat dinner together? [Number should not be greater than 7]		C 8	0 to 7 (times)

In an average MONTH, how often is the food for the evening meal …

				1. Every day
				2. 2-6 times per week
C 9	..."ready-to-eat" meals purchased outside the house, brought home, and eaten at home?		C 9	3. Once a week
C 10	…purchased from a delivery service and eaten at home?		C 10	4. 2-3 times per month
C 11	…purchased and eaten at restaurants?		C 11	5. Once a month
C 12	…purchased from street stalls or vendors and eaten away from home?		C 12	6. Few times per year
				7. Never

On a scale of 1 to 5, how important is each of the following characteristics when deciding where you will purchase food? (USE PINK CARD)

1 = Not at all important; 2 = Somewhat important; 3 = Moderately important; 4 = Important; 5 = Extremely important

		Importance				Importance	
C 13	Low prices (good value)		C 13	C 24	Can purchase small amounts		C2
C 14	Fixed price (no negotiation)		C 14	C 25	Product is unpackaged (can see and feel)		C2
C 15	Flexible prices (able to negotiate)		C 15	C 26	Store is easy to get to		C2
C 16	Store provides discount (sales)		C 16	C 27	Store is close to other non-food shopping		C2
C 17	Ability to purchase on credit		C 17	C 28	Store is close to entertainment & social opp		C2
C 18	High-quality food products		C 18	C 29	Fast service (no waiting in lines)		C2
C 19	Food is safe to eat		C 19	C 30	Cleanliness (including environment) of store		C3
C 20	Food products are fresh		C 20	C 31	Better opening hours		C3
C 21	Food product information (weight, labels, expiry, etc)		C 21	32	Air-conditioning		C3
C 22	Product display is good (easy to find products)		C 22	33	Friendly staff		C3
C 23	Wide variety of food products (good selection)		C 23	C 34	Delivery Service		C3

D. SHOPPING BEHAVIOUR

Code	Type of outlet	How much TIME does it take you to get to the nearest [outlet type]? (minutes)	What is the distance (km) to the nearest [outlet type]? (km) Code to nearest km (e.g. 0.5 = 0km) 999=don't know	How frequently does your household shop for **NON-FOOD** items at a [outlet type]? 1. Every day 2. 2-6 times per week 3. Once a week 4. 2-3 times per month 5. Once a month 6. Less than once a month 7. Never	How frequently does your household shop for **FOOD** at a [outlet type]? (**See Definition of Food Below) 1. Every day 2. 2-6 times per week 3. Once a week 4. 2-3 times per month 5. Once a month 6. Less than once a month 7. Never	**If household shops at outlet (D5 = 1-6)** How do you normally get to the nearest […]? 1. On foot 2. Bicycle 3. Motorcycle 4. Car 5. Public transp. 6. Taxi or ojek 7. Other	What are the main reasons that you purchase food at this outlet? [Do NOT Prompt. Categorize response using codes on back of page. If cannot respond then show list. Ask if second reason, but do not force.] 1st reason	2nd reason
D1		**D2**	**D3**	**D4**	**D5**	**D6**	**D7**	**D8**
1	Hypermarket							
2	Supermarket							
3	Minimarkets/ convenience store							
4	Semi-permanent stand (e.g. fruit)							
5	Small shop (warung)							
6	Traditional wet market							
7	Peddler							

Definitions: **Food includes anything eaten or drunk, including unprocessed food, processed food, meals, and beverages. It does not include tobacco or betel nut.
Hypermarkets include Carrefour, Giant, Macro, & Hipermart (10 or more cash registers). Supermarkets include Hero, Matahari, Asia, & Yogya (2-9 cash registers).
Minimarkets include Alfa & Indomart and modern fruit stores (1-2 cash registers). Peddlers refer to vendors operating on foot, on bicycle, or by car/truck

Back of D

Codes for D7 and D8	
Note: Ask respondent questions without prompting answers. Then code using table below.	
1	Low price (good value)
2	Fixed price (no negotiation)
3	Flexible prices (able to negotiate)
4	Store provides discount (sales)
5	Ability to purchase on credit
6	High-quality food products
7	Food is safe to eat
8	Food products are fresh
9	Food product information (weight, labels, expiry, etc.)
10	Product display is good (easy to find products)
11	Wide variety of food products (good selection)
12	Can purchase small amounts
13	Product is unpackaged (can see and feel)
14	Store is easy to get to
15	Store is close to other non-food shopping
16	Store is close to entertainment & social opp.
17	Fast service (no waiting in lines)
18	Cleanliness of store (including good shopping environment)
19	Better opening hours
20	Air-conditioning
21	Friendly staff
22	Delivery service

E1. FOOD CONSUMPTION (staples and animal products)

				ASK ONLY IF E2 = 1		
		Food Consumption	**Change in Consumption**	**Purchased food**		
		During the past 12 months, has your household consumed any [...]? 1. Yes 2. No	Are members of your household consuming smaller or larger quantities of [...] on a per person basis than 5 years ago? 1. Smaller quantities 2. About the same 3. Larger quantities 4. Never consumed	During the past month, how many times did your household purchase [...]? Number of times	For each purchase, what is the normal value of […] bought for household consumption? Value in Rupiah	Where do you buy most of the […]? 1. Hypermarkets 2. Supermarkets 3. Minimarkets 4. Semi-perm. stand 5. Small shop (warung) 6. Traditional wet market 7. Peddlers , 8. Other
E1	**Food product**	**E2**	**E3**	**E4**	**E5**	**E6**
111	Rice					
112	Maize products					
113	Other grains & flour					
114	Bread and bread products (not cakes)					
115	Breakfast cereals (hot and cold)					
116	Instant noodles					
117	Other noodles (egg and rice) and pasta					
211	Tubers (cassava, sweet potato, taro, sago, etc)					
311	Beans, pulses, and nuts (e.g. kidney, soyabeans, & cashew)					
312	Tofu and tempe					
411	Fresh milk					
412	Other milk (powdered, UHT, long life, & canned)					
413	Other dairy products (e.g. yogurt, cheese, cream etc.)					
414	Eggs (chicken, duck, and other bird)					
511	Beef, lamb, and mutton (not processed)					
512	Poultry (e.g. chicken & duck, not processed)					
513	Other meats (e.g. goat, not processed)					
514	Fish (not processed)					
515	Shrimp (Fresh, not processed or breaded)					
516	Seafood (e.g. shellfish & squid, not Shrimp, not processed)					
517	Processed meat (e.g. sausages, breaded, seasoned, etc.)					
518	Processed fish and seafood (breaded, salted, dried, etc.)					

Note: Codes 511 to 516 refer to products that may be fresh, chilled, or frozen, but are not breaded, seasoned, salted, canned, dried, smoked, or semi-prepared.
Codes 517 and 518 refer to products that are breaded, seasoned, salted, canned, dried, smoked, or semi-prepared in other ways.

E2. FOOD CONSUMPTION (fruits and vegetables)

		Food	Change in Consumption	Purchased food		
			ASK ONLY IF E2 = 1			
		During the past 12 months, has your household consumed any [...]? 1. Yes 2. No	Are members of your household consuming smaller or larger quantities of [...] on a per person basis than 5 years ago? 1. Smaller quantities 2. About the same 3. Larger quantities 4. Never consumed	During the past month, how many times did your household purchase [...]? Number of times	For each purchase, what is the normal value of […] bought for household consumption? Value in Rupiah	Where do you buy most of the […]? 1. Hypermarkets 2. Supermarkets 3. Minimarkets 4. Semi-perm. stand 5. Small shop (warung) 6. Traditional wet market 7. Peddlers, 8. Other
E1	Food Product	E2	E3	E4	E5	E6
611	Chilies					
612	Shallots					
613	Onion					
614	Garlic					
615	Cucumber					
616	Leafy green vegetables e.g Spinach, Water Spinach, Bok					
617	Green bean (buncis)					
618	Tomato					
619	Potato					
620	Carrots					
621	Other fresh and frozen vegetables					
622	Canned or dried vegetables (NOT fried or crisps)					
711	Banana					
712	Mango					
713	Papaya					
714	Mangosteen					
715	Apple					
716	Melon					
717	Pineapple					
718	Orange /mandarins and other citrus					
719	Other fresh fruit					
720	Other fruit (canned, dried, processed, frozen, sweetened)					

E3. FOOD CONSUMPTION (processed food and beverages)

			ASK ONLY IF E2 = 1			
		Food Consumption	Change in Consumption	Purchased food		
		During the past 12 months, has your 1. Yes 2. No	Are members of your household consuming smaller or larger quantities of [...] on a per person basis than 5 years ago? 1. Smaller quantities 2. About the same 3. Larger quantities 4. Never consumed	During the past month, how many times did your household purchase [...]? Number of times	For each purchase, what is the normal value of […] bought for household consumption? Value in Rupiah	Where do you buy most of the 1. Hypermarkets 2. Supermarkets 3. Minimarkets 4. Semi-perm. stand 5. Small shop (warung) 6. Traditional wet market 7. Peddlers , 8. Other
E1	Food Product	E2	E3	E4	E5	E6
811	Coconut and palm oil					
812	Other cooking oils (e.g. maize, soy, etc)					
813	Coconut milk					
814	Fats, butter, and margarine					
821	Spreads (e.g. peanut butter, jam, Nutella)					
822	Bisquits, crackers, cake, and pastries					
823	Chocolate, meisus, and sweets					
824	Sugar and sweeteners					
831	Salt, soya sauce, monosodium glutamate					
832	Chili sauce and other sauces					
833	Other spices and seasonings (e.g. pepper, coriander, etc)					
841	Bottled water (e.g. Aqua, refill water)					
842	Soda, fruit juice, & other non-alcoholic beverages					
843	Coffee (instant & powder) & tea (bags & leaves)					
844	Alcoholic beverages (beer, wine, spirits)					
851	Potato crisps and other snack food					
852	Infant & child formula, adult nutrition drink					
853	Vitamins, dietary supplements, & herbal drinks					
854	Quick prepare meals (soups, frozen meals)					
855	Ready-to-eat meals (take-away or supermarket or restaurant)					
856	Other processed food					
900	Meals & beverages eaten outside home (e.g. at restaurant)					

F. NON-FOOD EXPENDITURE

How much does your household spend on [item] in a typical week, month, or year? [do not include food, durable goods, taxes, or business expenses]		Value (Rp/IDR) Code as "0" if no expenditures.	Time period 1=weekly 2=monthly 3=yearly
F1	Expenditure	F2	F3
1	Household equipment (kitchen items, mats, blankets, etc)		
2	Housing maintenance and minor renovation		
3	Electricity, water, gas, and kerosene		
4	Telephone (fixed line, mobile recharge, and public phones)		
5	Body products, cleaning supplies, cosmetics, tissue, etc		
6	Health expenditures (hospital, clinic, doctor, medicine, etc)		
7	Health insurance		
8	Education expenditures (school fees, English classes, tutor, books, uniforms, etc)		
9	Transportation (bus fare, petrol, etc)		
10	Domestic employees (housekeeper, driver, etc)		
11	Clothing (including shoes and headcover)		
12	Tobacco (cigarettes, cigars, leaves, etc)		
13	Celebrations and ceremonies (excluding food)		
14	Other leisure spending (sports, movies, internet, magazines, etc)		
15	Other non-food consumption spending (e.g. gifts, life insurance)		

Note: Do not include food, durable goods, taxes, or business expenses.

F4 What is the ownership status of your house? [ ] F4

1. Rented; 2. Owned; 3. Use without paying rent

F5 [If F4=1] How much rent does your household pay per year? [ ] F5

(in Rupiah per year)

F6 [if F4=2 or 3] How much would it cost to rent housing like this in this neighborhood? (in Rupiah per year) [ ] F6

G. RETAIL OUTLET USE, PREFERENCES QUALITY, SAFETY AND CONVENIENCE

		If G1 = 1-8 then Ask				
	Where do you usually buy [food type]? 1. Hypermarkets 2. Supermarkets 3. Minimarkets 4. Semi-perm. stand 5. Small shop (warung) 6. Traditional wet market 7. Peddlers 8. From producer 9. Never buy	What is the primary reason that you buy [food type] at this Please use codes below.	Which is the best type of outlet to buy [food type] at a good 1. Hypermarkets 2. Supermarkets 3. Minimarkets 4. Semi-perm. stand 5. Small shop 6. Traditional wet 7. Peddlers 8. From producer	Which is the best type of outlet to buy [food type] that is 1. Hypermarkets 2. Supermarkets 3. Minimarkets 4. Semi-perm. stand 5. Small shop 6. Traditional wet 7. Peddlers 8. From producer	Which is the best type of outlet to buy [food type] 1. Hypermarkets 2. Supermarkets 3. Minimarkets 4. Semi-perm. 5. Small shop 6. Traditional wet 7. Peddlers 8. From producer	Which is the best type of outlet to buy 1. 2. 3. Minimarkets 4. Semi-perm 5. Small shop 6. Traditional 7. Peddlers 8. From
Food Product Categories	**G1**	**G2**	**G3**	**G4**	**G5**	**G6**
1 Fresh meat, poultry meat and offal						
2 Fresh fish and seafood, e.g. shrimp						
3 Fresh fruits						
4 Fresh vegetables						
5 Fresh milk and yogurt						
6 Processed food items (e.g. boxed goods)						
7 Rice						

Codes for G2

1 Low price (good value)	8 Food products are fresh	15 Store is close to other non-food
2 Fixed price (no negotiation)	9 Food product information (weight, labels, expiry,	16 Store is close to entertainment & social
3 Flexible prices (able to negotiate)	10 Product display is good (easy to find products)	17 Fast service (no waiting in lines)
4 Store provides discount (sales)	11 Wide variety of food products (good selection)	18 Cleanliness of store (including good shopping
5 Ability to purchase on credit	12 Can purchase small amounts	19 Better opening
6 High-quality food products	13 Product is unpackaged (can see and feel)	20 Air-conditioning
7 Food is safe to eat	14 Store is easy to get to	21 Friendly staff
		22 Delivery service

H. FACTORS IN FOOD CHOICE

In choosing the food products you purchase, what are the 3 most important factors influencing your decision (apart from halal)?

	Most H1	2nd H2	3rd H3
1. Food in general			

In choosing each of the following types of products, what are the 3 most important factors influencing your decision (apart from halal)?

	Most H1	2nd H2	3rd H3
2. Mango			
3. Other Fresh Fruit			
4. Chilli			
5. Shallot			
6. Other Fresh			
7. Shrimp			
8. Poultry			
9. Meat (beef, lamb)			

Codes for H1 - H3

1	Price	12	Diversit
2	Nutritional content	13	Smell
3	Food safety	14	Colour
4	Quality	15	Appearance
5	Taste	16	Firmness/texture
6	Freshness	17	Variety (e.g. gadung)
7	Easy to prepare	18	Package size
8	Production method (e.g. organic)	19	Expiry date
9	Brand	20	Other labelling info
10	Origin (country or region)	21	Never purchase this
11	Grade, Class		

H4. How often do you use food ingredients and nutrition labels when shopping for food? H4

Codes for H4

1 Always
2 Often
3 Sometimes
4 Never

[If H4 is 1-3] What type of nutritional information do you use or look for?

Ingredients	H5
Calorie content	H6
Sugar	H7
Salt	H8
Fat	H9
Vitamins &	H10
Protein	H11
Fibre	H12
Other	H13

Codes for H5-H13

1. Yes, looks for
2. No, does not look for

What are the first and second most important sources of nutrition information for your household? H14 H15

Codes for H14-

1 Medical professional (doctor, nurse, nutritionist)
2 Government agencies
3 Food companies
4 Media (TV, internet, newspapers, radio, magazines, books)
5 Friends and relatives
6 School
7 Other

I. NUTRITION ATTITUDES AND FOOD CONCERNS

SHOW RESPONDENT GREEN "AGREEMENT" SCALE PROVIDED ON CARD. RESPONDENT SHOULD POINT TO LEVEL OF AGREEMENT

For the next set of questions I1-I27, I am going to read you several statements. After I read you each statement then I would like you to point at the scale and tell me how strongly you agree or disagree with what I have said. 1 = STRONGLY DISAGREE and 5 = STRONGLY AGREE. There is no right or wrong response – I am really just interested in getting your OPINIONS and BELIEFS.**"**

		Agreement	
I 1	When purchasing food and drinks I am concerned about whether or not the product is healthy		I 1
I 2	Consuming some foods can INCREASE the risk of developing certain diseases		I 2
I 3	Consumption of certain foods can DECREASE the risk of certain diseases		I 3
I 4	Diet and nutrition play a major role in my health and the health of my family		I 4
I 5	I have very little control over my health		I 5
I 6	Regular exercise would improve my health or the health of family members		I 6
I 7	Avoiding smoking would improve my health or the health of family members		I 7
I 8	To maintain good health it is important to eat a wide variety of food products		I 8
I 9	I avoid purchasing food containing high amounts of fat or cholesterol		I 9
I 10	I avoid purchasing food containing high amounts of salt		I 10
I 11	I avoid purchasing food & drinks with high amounts of sugar		I 11
I 12	There are so many recommendations about healthy ways to eat that I do not know what to do.		I 12
I 13	The nutrition information on food labels is useful to me.		I 13
I 14	I feel confident that I know how to use food labels		I 14
I 15	Reading food labels makes it easier to choose foods		I 15
I 16	Sometimes I try new foods because of the information on food labels		I 16
I 17	I am concerned about having enough food available (adequate access to food and /or affording food)		I 17
I 18	I am concerned about the safety of my food		I 18
I 19	I am concerned about the nutritional content of my food		I 19
I 20	I am concerned about the use of pesticides to produce my food		I 20
I 21	I am concerned about the use of additives, preservatives and artificial colours in my food		I 21
I 22	I am concerned about bacterial contamination of my food		I 22
I 23	I am concerned about heavy metals or toxic chemicals might be in my food		I 23
I 24	I am concerned about the accurracy of information on food labels and food displays		I 24
I 25	I am concerned about the accuracy of information regarding halal certification		I 25
I 26	I am concerned about food imported from outside Indonesia		I 26
I 27	I am concerned that the food was not stored properly (not kept refrigerated)		I 27

J1. CERTIFICATION AWARENESS, PURCHASES, PERCEPTIONS

	NOTE: ALL CELLS IN THIS TABLE SHOULD BE FILLED OUT!	Have you ever seen or heard of food products that are sold …. 1 = Yes ; 2 = No	Have you ever PURCHASED food and beverages that are sold as … 1 = Yes ; 2 = No; 3 = Do not know, unsure	Would you PREFER to purchase food and beverages that are sold as ... 1 = Yes ; 2 = No 3 = Unsure, do not understand
		J1	**J2**	**J3**
1	…organic or certified organic			
2	…pesticide Free			
3	…chemical Free			
4	…natural			
5	…preservative or additive free			
6	…natural ripening			
7	…safe or safety guaranteed			
8	…healthy			
9	…environmentally friendly or Eco-Friendly			
10	…hydroponic			
11	…hygienic			
12	…from a particular country			
13	…from a particular region of Indonesia			
14	…free of genetically modified organisms (GMO Free)			

		J4 …organic? 1. Yes; 2. No	J5 pesticide free? 1. Yes; 2. No
1	Do you know what it means when a product is labelled or certified as ….		
Do you agree with the following statements. [Complete each column in this section ONLY if the answer in row 1 above = yes. Otherwise leave column blank]		Certified "organic" products … 1 = Yes or 2 = No	Certified "pesticide Free" products … 1 = Yes or 2 = No
2	…are healthier.		
3	…contain no pesticides or residues.		
4	…were produced without pesticides.		
5	…were produced without GMOs.		
6	…are more eco-friendly or environmentally friendly.		
7	…production is overseen by government		
8	…are safer to eat.		
9	…are better tasting.		
10	…are no different (certification is meaningless).		

J2. CERTIFICATIONS

J7	Attribute	Who would you most trust to certify [attribute] in [product]? [Use codes at right] Fruits & Vegetables J8	Shrimp J9	Chicken J10
1	**Safety** ("Clean", "Biosecurity", Expiry Date, No Additives) Agency is inspecting the production processes to ensure that producers and processors are following "best practices" to prevent food-related illnesses. Halal is NOT considered a safety certification.			
2	**Quality** (freshness, weight, grade) Agency inspects the product to guarantee that the product meets specific grades or standards or levels of quality met.			
3	**Production information** (e.g. organic, pesticide free, etc.) Agency inspects and verifies that claims such as organic, pesticide free, natural etc. are truly used.			
4	**Nutrition information** (e.g. fat free, low fat, low calorie, low sugar, high energy) Agency is inspects food manufacturer to make sure any nutritional claims such as fat free, low fat, low calorie, low sugar, high energy etc. are true.			

Codes for J8-J10	
1	The Indonesian Government (e.g. Federal, Ministry of Health)
2	State or local government (Provincial or District)
3	Foreign government organization
4	Farmers & farmer organizations (e.g. HKTI)
5	Food company (brand, e.g. Danone, Indofood, Garuda Food)
6	Retailer/Supermarket (e.g. Matahari, Giant, Carrefour)
7	Independent 3rd party (not for profit)
8	Religious organization
9	Other SPECIFY___________
10	No opinion, Do not Know

			If J12 = yes		If J12 =yes and J14=2
		Does your household ever purchase [product]? 1. Yes 2. No	What is the normal price you pay for this product? Rupiah/kg	If you have a choice between buying conventional [product] and [product] that is labelled "Certified Organic", which one would you buy? 1 = I would <u>NEVER</u> buy the "Certified Organic" product 2 = I would buy the "Certified Organic" product if the price was right.	What is the maximum amount extra that you would be willing to pay for [product] that is labelled as "Certified organic"? (percent)
J11	**Product**	**J12**	**J13**	**J14**	**J15**
1	Chillies				%
2	Mangos				%
3	Shrimp				%
4	Chicken				%

K. DIET RELATED HEALTH AND MANAGEMENT

K1		On a scale of 1 to 5, how concerned are you that each of the following may affect you or your family? 1. Not at all 2. A little 3. Moderately 4. Concerned 5. Extremely 6. Don't know	Have any members of the household been diagnosed by a medical professional as having… 1.Yes 2. No	[If K3 = yes] Which household member was it? 1. Adult(s) 2. Child(ren) 3. Both	[If K3 = yes] What year was a household member <u>first</u> diagnosed? Year	[If K3 = yes] Have any members of your household made any changes in order to manage or prevent these problems? 1.Yes 2. No	[If K6=yes] What have you done to control [problem]? [No prompting, classify up to 3 responses with codes below]		
K1		K2	K3	K4	K5	K6	K7	K8	K9
1	Obesity or overweight?								
2	Underweight or malnourished?								
3	Diabetes?								
4	High blood pressure?								
5	Heart disease?								
6	Cancer?								
7	Food allergies or intolerance?								

Codes for K10-K13
1. All of us
2. Some of us
3. None of us
4. No children

In the last <u>12 months</u> have you or anyone in your household experienced…

...severe diarrhoea? [ ] K10

...illness' related to food poisoning (unsafe food)? [ ] K11

In the last <u>12 months</u>, how many of the adults in the household have seen a medical professional? [ ] K12
(For any reason including check-ups)

In the last <u>12 months</u>, how many of the children in the household have seen a medical professional? [ ] K13
(For any reason including check-ups)

Codes for K7 - K9
1. Decrease fat consumption
2. Decrease sugar consumption
3. Decrease salt consumption
4. Decrease cholesterol consumption
5. Increase fibre consumption
6. Decrease total calories
7. Increase fruit consumption
8. Increase vegetable consumption
9. Eat less processed food
10. Exercise more
11. Decrease alcohol consumption
12. Take medication
13. Take vitamins or alternative med
14. Reduce or stop consuming food related to allergy
15. Other, specify _______________

L. OTHER

On average, how many **hours per day** do the **ADULTS** (18 and over) in your household spend watching TV, videos, or on the internet for entertainment?

L1 hours/day

On average, how many **hours per day** do the **CHILDREN** (5-17 years) in your household spend watching TV, videos, or on the internet? Note: If no children code as 999.

L2 hours/day

On average, how many **hours per week** does each **ADULT** in the household do exercise (e.g. sports, bike riding)?

L3 hours/week

On average, how many **hours per week** does each **CHILD** in the household do exercise (e.g. sports, physical education at school, bike riding, playing outside)? Note: If no children code as 999.

L4 hours/week

Does anyone in your household smoke cigarettes daily?
1. Yes 2. No

L5

How has the **size** your household changed in the last 5 years?

1. Increased (more members)
2. No change
3. Decreased (fewer members)

L6

How has the **health status** of household members changed in the last 5 years?

1. Improved
2. No change
3. Deterioration
4. Don't know/not applicable

L7

[If L7=1 or 3] What is the primary reason for the change in the health status of household members?

1. Household member had an accident
2. Household member fell ill due to disease
3. Medical intervention improved status
4. Change in diet
5. Change in lifestyle (e.g. exercise more, stopped smoking)

L8

What is the approximate **income** of the household?
[This includes the income of all household members including children, but NOT domestic employees. For self-employed members, we want the net income, i.e. business revenue minus

1 Less than 50,000 IDR/month
2 50,000 to 100,000 IDR/month
3 100,000 to 200,000 IDR/month
4 200,000 to 500,000 IDR/month
5 500,000 to 1,000,000 IDR/month
6 1,000,000 to 2,000,000 IDR/month
7 2,000,000 to 5,000,000 IDR/month
8 5,000,000 to 10,000,000 IDR/month
9 More than 10,000,000 Rp/month

How has the **standard of living** of your household changed in the last 5 years?

1 Improved significantly (>30%)
2 Improved somewhat (10-20%)
3 No change (-10% to 10%)
4 Deteriorated somewhat (-10-30%)
5 Deteriorated significantly (>-30%)

[If L10=1,2,4,5] What is the primary **reason** for the change in the standard of living?

1 Household member(s) found/lost job(s)
2 Household member(s) earning more/less from same job(s)
3 Change in health of household members
4 Losses associated with crime (e.g. theft)
5 Losses associated with natural disaster
6 New expenses associated with illness
7 New expenses associated with newborn
8 New expenses associated with education
9 Inheritance

ICASEPS

SURVEY OF HORTICULTURAL GROWERS IN NORTH COAST JAVA

June - July 2011

IFPRI - UNIVERSITY OF ADELAIDE - ICASEPS

IFPRI

THE UNIVERSITY OF ADELAIDE AUSTRALIA

School of Agriculture Food and Wine

Objective: The purpose of this survey is to improve our understanding of agricultural marketing patterns in Indonesia, particularly the relationship between farmers and traders/supermarkets/companies that buy shallot, chilli or other high value agriculture crops from them

Use of data: The data collected as part of this survey are for research purposes ONLY.
Household-level data will not be shared with non-research organizations. .
Only summary results will be included in published report.

Household ID number

Village code				Enumerator code		Household code		

		Code in A1
Name of head family		
Name of respondent		
Address/location		
Phone		
Village		
Sub-district		
District		

Respondent is from which sample: [ ]
1. Main random sample
2. Sample designed to include non-conventional farmers

	Date			Name	Sign
	Day	Month	Year		
Interview			2011		
Field check			2011		
Cross Edit Check			2011		
Data Entry			2011		

Australian Government
Australian Centre for International Agricultural Research

Research funded by a grant from the Australian Centre for International Agricultural Research (ACIAR)

Village codes

Code	Sub-district	Village
1101	Larangan	Larangan
1102	Larangan	Rengas Pendawa
1103	Larangan	Kedung Bokor
1104	Larangan	Siandong
1105	Larangan	Luwung Gede
1106	Larangan	Pamulian
1107	Larangan	Karang Bale
1108	Larangan	Sitanggal
1109	Larangan	Kamal
1110	Larangan	Selatri
1201	Ketanggungan	Ciseureuh
1202	Ketanggungan	Bulakkelor
1301	Wanasari	Glonggong
1302	Wanasari	Sisalam
1303	Wanasari	Sidamulya
1304	Wanasari	Siasem
1305	Wanasari	Lengkong
1306	Wanasari	Pebatan
1307	Wanasari	Pesantunan
1308	Wanasari	Kupu
1309	Wanasari	Dumeling
1310	Wanasari	Dukuhringin
1311	Wanasari	Sawojajar
1312	Wanasari	Klampok
1313	Wanasari	Sigentong
1314	Wanasari	Pandansari
1315	Wanasari	Kebuledan
1316	Wanasari	Wanasari
1401	Losari	Kedunggeneng
1402	Losari	Randusari
1403	Losari	Prapag Kidul

Village codes

Code	Sub-district	Village
1501	Tanjung	Kemurang Wetan
1502	Tanjung	Kemurang Kulon
1503	Tanjung	Sengon
1601	Kersana	Limbangan
1701	Bulakamba	Bangsri
1702	Bulakamba	Banjaratma
1703	Bulakamba	Siwuluh
1704	Bulakamba	Karangsari
1705	Bulakamba	Grinting
1706	Bulakamba	Kluwet
1707	Bulakamba	Petunjungan
1708	Bulakamba	Bulusari
1709	Bulakamba	Tegal Glagak
1801	Songgom	Songgom
1802	Songgom	Geger Kunci
1803	Songgom	Jatimakmur
1805	Songgom	Songgom Lor
1901	Jatibarang	Buaran
1902	Jatibarang	Pamengger
1903	Jatibarang	Klampis
1904	Jatibarang	Rengas Bandung
2001	Brebes	Pemaron
2002	Brebes	Krasak
2003	Brebes	Limbangan Kulon
2004	Brebes	Limbangan Wetan
2005	Brebes	Kaligangsa Kulon
2006	Brebes	Pagejugan
2007	Brebes	Banjaranyar
2009	Brebes	Pulosari
2010	Brebes	Tangki

Village codes

Code	Sub-district	Village
2101	Sirampog	Batursari
2102	Sirampog	Sridadi
2103	Sirampog	Wanareja
2104	Sirampog	Mendala
2105	Sirampog	Kaligiri
2106	Sirampog	Plompong
2107	Sirampog	Igir Klanceng
2108	Sirampog	Dawuhan
2201	Paguyangan	Pandansari
2202	Paguyangan	Cipetung

Enumerator codes

Code	Enumerator
01	Pitriati Solihah
02	Dewi Amna
03	Atin Supriatin
04	Riyan Hidayat
05	Ruhmaniyati
06	Ida Dewi Yuliati
07	Inneke Kumalasanti
08	Usep Santosa
09	Temberyanto Setiawan
10	Aziz Kurniawan
11	Arief Kurniawan
12	Danny Ardiansyah
13	Himawan Setiajid
14	Yeni Yuniarti
15	Wahyu Kurniawan
16	Bruri Anita

A. CHARACTERISTICS OF MEMBERS OF THE HOUSEHOLD

	Name	What is the relationship between [name] and the head of household? 1 Head 2 Spouse 3 Son/daughter 4 Son/daughter in law 5 Grandchild 6 Parent or in-law 7 Other related 8 Other unrelated	Is [name] a male or female? 1 Male 2 Female	How old is [name]? [age at last birthday, use 0 for < 1 yr] Nbr of years	Ask these questions only for members 6 years or older: How many years of schooling has [name] completed? Nbr of years	Can [name] read in any language? 1 Yes 2 No	Can [name] speak Bahasa? 1 Yes 2 No	Ask tthese questions only for members 17 yrs and older: What is the marital status of [name]? 1 Single 2 Married 3 Widowed 4 Separated 5 Divorced	What are the main activities of [name]? 1. Farming/aquaculture 2. Self-employed trader 3 Self-employed - other 4. Agricultural wage labor 5. Other wage labor 6. Unemployed 7. Unpaid housework 8. Student 9. Other 10. None (for A10) Main	Secondary
A1		A2	A3	A4	A5	A6	A7	A8	A9	A10
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										

Note: The household is defined as a group of people who live and eat together most of the time. Each member must live with others at least 6 months of the year unless a new member (baby or new in-law)
The head of the household is defined as the member who makes most of the economic decisions.

B. HOUSING

What is the approximate area of your house and yard in square meters? [ ] B1

[If house owned] What is the approximate value of your house without farmland? [ ] B2a

[If house rented] What is the annual rent that you pay for your house (without farmland)? [ ] B2b

What is the main source of drinking water for your household? [ ] B3

1 Indoor tap	5 Collected rainwater
2 Outdoor private tap	6 River, lake, or pond
3 Outdoor shared tap	7 Spring
4 Covered well	8 Aqua/bottled water
	9 Other

What is the main type of toilet used by your household? [ ] B4

1 Flush toilet	4 Latrine over water
2. Latrine with pipe	5 Public toilet (all types)
3 Pit latrine	6 Other or none

What is the main type of lighting used by your household? [ ] B5

1 Electric lights	4 Others
2 Oil lamps	5 None
3. Candles	

What type of fuel is used by your household for cooking? [ ] B6

1 Electricity	4 Kerosene
2 LPG	5 Wood/charcoal
3 Biogas	6 Other

What is the distance in kilometers from the house to the nearest…

...road of any type?	[use 999	B7
…asphalt road?	if respondent	B8
…market?	doesn't know	B9
…district or city market?	the distance]	B10

C. ASSETS

	How many of each of the following asset did your household own five years ago? Number		How many of each does your household currently own? Number		What is the current value of each asset? [Rp]	
a radio?		C1a		C1b		
television?		C2a		C2b		
a fan?		C3a		C3b		
an air conditioner?		C4a		C4b		
a computer?		C5a		C5b		
a washing machine?		C6a		C6b		
a refrigerator?		C7a		C7b		
landline telephone?		C8a		C8b		
a mobile phone?		C9a		C9b		
internet (0=no, 1=yes)		C10a		C10b		
a bicycle?		C11a		C11b		
a motorbike?		C12a		C12b		
a car?		C13a		C13b		
a truck?		C14a		C14b		C14c
a Tossa?		C15a		C15b		C15c
a cart?		C16a		C16b		C16c
a water pump for ag?		C17a		C17b		C17c
spraying equipment?		C18a		C18b		C18c
a tractor or hand tractor?		C19a		C19b		C19c
a storage house?		C20a		C20b		C20c
a grain mill?		C21a		C21b		C21c
cattle/buffalo?		C22a		C22b		
goats/sheep?		C23a		C23b		
poultry?		C24a		C24b		

	Area	Unit code	Area	Unit
farm land?	C25a	C25u	C26a	C26u
irrigated farm land? [technical irrigation at least 1 season]	C27a	C27u	C28a	C28u

Unit codes:
1 Hectare
2 Bau
3 Bata
4. Tumbak
5. Ru
6. M2
7. Patok

Crop codes

Category	Code	Crop
Grains	101	Rice
	102	Maize
	199	Other grains
Tubers	201	Cassava
	202	Sweet potato
	299	Other tubers
Pulses	301	Red bean
	302	Groundnuts
	303	Soybeans
	304	Mung bean
	399	Other beans/pulses
Vegetables	401	Babycorn
	402	Broccoli
	403	Cabbage
	404	Caisin/bok choi
	405	Carrot
	406	Chili
	407	Chinese cabbage
	408	Cucumber
	409	Eggplant
	410	Gherkin
	411	Ginger
	412	Green bean (buncis)
	413	Leek
	414	Lettuce
	415	Other leafy greens
	416	Kangkung
	417	Onion
	418	Potato
	419	Shallot
	420	Spring onion
	421	String bean
	422	Tomato
	499	Other vegetable

Category	Code	Crop
Fruit	501	Avocado
	502	Banana
	503	Mango
	504	Mangosteen
	505	Melon
	506	Papaya
	507	Strawberry
	508	Watermelon
	599	Other fruit
Other	601	Flower
	602	Other spices
	603	Grass or forage crops
	604	Other annual crops
	605	Tea
	606	Coconut
	699	Other perrenial crops

D. AGRICULTURAL LAND

	1. Yes 2. No		Value (Rp)	Area	Area unit	1 Hectare		1 Yes 2 No
Have you **purchased** farm land over the past 5 years?		If yes, how much land did you buy and what was the total value?				2. Bau 3 Bata	Purchase from family?	
	D1		D2v	D2a	D2u	4. Tumbak		D2f
Have you **sold** farm land over the past 5 years?		If yes, how much land did you sell and what was the total value?				5. Ru 6. M2	Sale to family?	
	D3		D4v	D4a	D4u	7. Patok		D4f

Draw a simple map of the CROP land **owned or farmed** by members of the household in 2010-11 on the opposite page. Then number plots and complete this form.

Plot nbr	What is the area of this plot? Area	Unit 1 Hectare 2 Bau 3 Bata 4. Tumbak 5. Ru 6. M2 7. Patok	What type of land is this? 1. Irrigated 2. Rainfed 3. Dryland 4. Forest	What is the **current** land tenure arrangment for this plot? 1. Owned and farmed 2. Owned and rent it out 3. Owned & pawned out 4. Owned & sharecropped out 5. Owned and not planted 6. Owned and lent out 7. Pawned from owner 8. Rented from owner 9. Sharecropped from owner 10. Borrow from owner 11. Now, not farmed or owned	What is the distance from this plot to your house? Distance in meters	[If D8=1-6] How was this plot acquired? 1 Inherited 2 Gift 3 Purchased 4 Allocated by government	Ask these questions only for seasons that the household farmed the plot. What type of irrigation does this plot have in the … RAINY season 1 None 2 Gravity 3 Pumped surface water 4 Pumped groundwater 5. Manual	DRY season 1 None 2 Gravity 3 Pumped surface water 4 Pumped groundwater 5. Manual	What were the main two crops grown in each plot during each season of 2010/2011? Dry season (planting about June 2010) 1st Crop code	2nd Crop code	Rainy season (planting about Sept 2010) 1st Crop code	2nd Crop code	Dry season (planting about Mar-April 2011) 1st Crop code	2nd Crop code
D5	D6a	D6u	D7	D8	D9	D10	D11r	D11d	D12	D13	D14	D15	D16	D17
1														
2														
3														
4														
5														
6														
7														
8														
9														
10														

Note : In D8, Bengkok land is coded as 10. Do not record tree crop if fewer than 5 trees. Record tree crops in each season.

E1. SHALLOT PRODUCTION (harvest)

Complete Section E and F if shallot production in past 12 months (see D12-D17). If no shallot production, go to Section G.

Season of **2010/11**		Plot number	What is the area of this plot?		In what month were the shallot planted?		What type of shallots were harvested from this plot during this season?		Has harvest of these shallots been completed or partly completed?	What is the actual quantity harvested so far of shallots on this plot in this season?
		[ENTER PLOT NUMBERS IN WHICH SHALLOT WERE GROWN FROM PART D FOR EACH SEASON]	Area	Unit codes 1 Hectare 2 Bau 3 Bata 4. Tumbak 5. Ru 6. M2 7. Patok	1. Jan 2. Feb 3. Mar 4. Apr 5. May 6. Jun 7. Jul 8. Aug 9. Sep 10. Oct 11. Nov 12. Dec	Year (write 2010 or 2011)	1. Bima curut 2. Other bima 3. Maja 4. Sumenep 5. Kuning 6. Import 7. Hybrid 8. Other	1. Consumption 2. Seed 3. Both types in same plot 4. Not yet decided	1. Completed 2. Partly completed 3. Not yet started	kilogrammes [DK = 9999]
	E2	E3	E4	E5	E6	E7	E8	E8t	E9	E10
Dry season (planting about June 2010)	1									
	2									
	3									
	4									
	5									
	6									
Rainy season (planting about Sept 2010)	11									
	12									
	13									
	14									
	15									
	16									
Dry season (planting about Mar-April 2011)	21									
	22									
	23									
	24									
	25									
	26									

E2. SHALLOT PRODUCTION (input use)

What is the ROW number in question E2 for the largest shallot plot in the most recently completed shallot harvest? [ ] E13

	Type of input	For the 1 Yes 2. No	[If E13=yes] (Rp)	[If E13=yes] How were most of the [inputs] acquired? 1. Made by household 2. Cash purchase 3. Credit from buyer of crop 4. Credit from input dealer 5. Credit from farmer group 6. Other credit 7. Provide for free	How has [...] changed compared to five (or more) years ago? see codes	[If change] What are the reasons for this change? see codes
E14		E15	E16	E17	E18	E19
1	Saved seed					
2	Non-hybrid seed					
3	Hybrid seed					
4	Chemical fertilizer					
5	Organic fertilizer					
6	Chemical pesticide					
7	Organic/bio pesticide					
8	Insect traps					
9	Herbicide					
10	Fungicides					
11	Transport of inputs					
13	Hired labor for ...					
14	..seedling preparation					
15	..land preparation					
17	..planting					
18	..fertilization					
19	..watering					
20	..weeding					
21	..spraying					
22	..manual insect removal					
23	...harvest					
24	..post-harvest					
25	Irrigation					
26	Land rent					
27	Land tax					
28	Other costs					

Codes for E18 (change)

1. Not applicable (e.g. never used, new farmer)
2 No change in amount per m2
3 Increased amount per m2
4. Decreased amount per m2
5 Increased amt per m2 and different type
6 No change in amount, but different type
7 Decreased amount per m2 and different type

Codes for E19 (reason)

1. Change in input price
2. Change in shallot price
3. To increase yield
4. To increase quality
5. To increase price obtained
6. Better information
7. To meet demands of buyer
8. To reduce cost
9. To increase land fertility
10. Change in level of pest and disease problems
11. Others

Do you keep written records on	1. Yes 2. No	
... the amount of pesticides used on shallots?		E20
... the dates of pesticide application on shallots?		E21
... the prices received for shallot sales?		E22
... the quantities of shallots sold?		E23
... the input costs		E24

	1. Yes 2. No	
[If yes to any] Do you keep these records at least one year after being paid?		E25

F1. SHALLOT MARKETING (sales)

For the LARGEST plot in the MOST RECENT SEASON for which shallot harvest is complete (see E1)

				Ask only if there were some sales (F4>0)						
	What was the quantity of shallots harvested from this plot in this season? kg	What was the type of the shallots on the [..] harvest? 1 Seed 2 Small consumption 3 Medium consumption 4 Large consumption 5 Mixed sizes	Of this amount, how much was sold? Kg	How much did you earn from the sale of these shallots? Rp	In what form were the shallots when buyer took possession? 1. In ground 2. Harvested but wet 3. Harvested and dried	When were you paid for the shallots? 1. Before harvest 2. At delivery 3. 1-7 days later 4. More than week later 5. Multiple payments (across categories)	Where did the buyer take possession of the shallots? 1. At farm 2. At house 3. Roadside 4. Collection place 5. Village mkt 6. Sub-dist mkt 7. District mkt 8. Wholesale market 9. Other	[If not at farm] What is the distance from the field to the selling place? (km) [nearest tenth of km, e.g. 0.6 km]	[If not at farm] What was the main way they were transported there? 1. On foot 2. Bicycle 3. Motorbike 4. Rented motorbike 5. Tossa 6. Becak 7. Car 8. Taxi / bus 9. Truck 10. Cart 11. Other	[If not at farm and 100% hired transport] How much did it cost to transport it from the field to the point of sale? [blank if less than full transport cost] Rp
F1	F2	F3	F4	F5	F5f	F6	F7	F8	F9	F10
1 Consumption harvest										
2 Seed harvest										

F2. SHALLOT MARKETING (buyer relations)

How many different shallot buyers did you [.....]
- 1. speak to about the sales of your shallots last year ? F14
- 2. sell your shallots to last year? F15

When in the shallot production cycle do you usually first communicate with a buyer? F16
- 1, Before planting
- 2. Between planting & early stages of production
- 3, Close to harvest
- 4. After the harvest begins

How do you usually communicate with your shallot buyer(s)? F17
- 1. Mobile phone
- 2. Landline phone
- 3. Buyer comes to the farm
- 4. Buyer comes to farmer' house
- 5. Farmer goes to buyer 's place
- 6. Meet buyer elsewhere
- 7. Through intermediary person
- 8. Through cooperative/group

When in the shallot production cycle do you usually agree on the sale with the buyer? F18
- 1, Before planting
- 2. Between planting & harvest
- 3, After harvest begins
- 4. Only at time of sale
- 5. 1-7 days before harvest

Do you usually have a written agreement with the shallot buyer? F19
- 1. Yes 2. No

What is specified in the agreement with the buyer? 1.Yes; 2.No

Price	F20
Quantity	F21
Grade/quality	F22
Variety	F23
Purposes (seed or consumption)	F24
Time of payment	F25
Sorting by size	F26
Seed provided on credit	F27
Other inputs provided on credit	F28
Other (specify) ____________ ____________ ____________	F29

Has the level of detail in your agreements with shallot buyers changed compared to five (or more) years ago? F31
- 1. They have become MORE detailed
- 2. No change
- 3. They have become LESS detailed
- 4. Not applicable (e.g. started to grow shallots 1-4 yrs ago)

Do you negotiate with the shallot buyer over the price? F32
- 1. No, I always accept the price the buyer offers
- 2. Yes, I sometimes bargain over price with the buyer
- 3. Yes, I usually bargain over price with the buyer
- 4. No, I set the price and don't bargain.

Has your price bargaining postion with shallot buyers changed compared to five (or more) years ago? F33
- 1. I have MORE price bargaining power than I used to.
- 2. No change in price bargaining power.
- 3. I have LESS price bargaining power than I used to.
- 4. Not applicable (e.g. first time)

Beside prices, do you negotiate with your shallot buyer over non-price terms of the agreement [e,g, F21 - F29]? F34
- 1. No, I always accept the non-price terms of agreement that the the buyer offers
- 2. Yes, I sometimes bargain over non-price terms of the agreement.
- 3. Yes, I usually bargain over non-price terms of the agreement.
- 4. No, I set the non-price terms of the agreement and don't bargain.
- 5. Not applicable (e.g. no non-price terms in agreement)

Has your non-price bargaining position with shallot buyers changed compared to five (or more) years ago? F35
- 1. I have MORE non-price bargaining power than I used to.
- 2. No change in price bargaining power.
- 3. I have LESS non-price bargaining power than I used to.
- 4. Not applicable (e.g. first time, no non-price terms in agreement)

F3. SHALLOT MARKETING (buyer relations 2)

In the last season, did your buyer provide [...]? — 1. Yes;2.No

Shallot seed	F 36
Pesticides	F 37
Other agricultural chemicals	F 38
Information on how to produce shallots?	F 39
Inputs on credit	F 40
Financial loan	F 41
Guarantee of a specific price before planting	F 42
Guarantee to purchase specific quantity	F 43

Have you had any problems with your shallot buyer? — 1. Yes;2.No — F 44

[If F44 = 1] What were the main problems ?
(list up to three)

1. Poor quality seed provided by buyer
2. Poor quality fertilizer provided by buyer
3. Poor quality pesticide provided by buyer
4. High cost of inputs provided by buyer
5. Delays in delivery of inputs by buyer
6. Buyer did not give promised price
7. Delay in collecting harvest
8. Delay in paying for harvest
9. Manipulation of grading to pay lower price
10. Product rejected for low quality
11. Market price higher than fixed price
12. Others, specify ______________________

F 45

F 46

F 47

[If F44=1] Did any of these problems (F45-F47) cause you to change your shallot buyer? — 1. Yes; 2.No — F 48

Do you know what is the type of end market for your shallots? (e.g. supermarket, processor, traditional market) — 1. Yes; 2.No — F 49

[If F49=yes] How do you know what the end market of your shallots is? — F 50

1. My shallot buyer /trader told me
2. I work or communicate directly with traders in end market
3. Heard from my neighbour/other farmers who sold the product to the same buyer
4. Others, specify,_______________

[If F49=yes] Are your shallots eventually sold in any of the following types of markets? — 1. Yes; 2.No

Traditional markets	F 51
Supermarkets	F 52
Processors	F 53
Exporters	F 54
Other modern buyers (schools, restaurants, hotels, etc)	F 55

Are your shallots eventually sold in Java or in other parts of Indonesia? — 1. Yes; 2.No 3 Don't know

Java	F 56
Outside Java	F 57

Do you believe that your buyer requires higher or lower quality standards than other buyers ? — F 58

1. Higher
2. Same
3. Lower
4. Don’t know

Do you believe that your buyer offers higher or lower prices than other buyers ? — F 59

1. Higher
2. Same
3. Lower
4. Don’t know

HORTICULTURAL VARIETY CODES

Code	Commodity	Variety
1	Cabbage	Qianty
2	Cabbage	MRP 45
3	Cabbage	OR Pride
4	Cabbage	Hybrid
5	Cabbage	Others
6	Caisin/bok choi	Patas
7	Caisin/bok choi	Dakota
8	Caisin/bok choi	Others
9	Stringbean	Panji
10	Stringbean	Talia Hijau
11	Stringbean	Rizki
12	Stringbean	Others
13	Tomato	Ananta
14	Tomato	Diva
15	Tomato	Mania
16	Tomato	Maliqai
17	Tomato	Nikita
18	Tomato	OR Safari
19	Tomato	Hibryd
20	Tomato	Local
21	Tomato	Others

Code	Commodity	Variety
22	Potato	Granola
23	Potato	Atlantis
24	Potato	Dea
25	Potato	GM 08
26	Potato	Other
27	Cucumber	Alexis
28	Cucumber	Berta Hijau
29	Cucumber	Others
30	Greenbean	Logawa
31	Greenbean	Tresna
32	Greenbean	Others
33	Chilli	Hot beuty*
34	Chilli	Hot chili*
35	Chilli	Biola*
36	Chilli	Other TW*
37	Chilli	Keriting*
38	Chilli	Tanjung (local)*
39	Chilli	Rawit*
40	Chilli	Others*
61	Other vegetables	Local
62	Other vegetables	Hybrid
71	Other fruits	Local
72	Other fruits	Hybrid

G1. SECOND HORTICULTURAL CROP PRODUCTION (harvest)

What is the most valuable horticultural crop that you have produced in the last year (excluding shallots)? [horticlture=fruit+vegetable]
[Complete Sections G and H regarding this crop. Crop will be labeled [hort crop]].

________________ [write crop name] | [ ] G1 [use crop code from Section D]

Season of 2010/11		Plot number [ENTER PLOT NUMBERS IN WHICH [HORT CROP] WAS GROWN FROM PART D FOR EACH SEASON]	What is the area of this plot? Area	What is the area of this plot? Unit codes 1 Hectare 2 Bau 3 Bata 4. Tumbak 5. Ru 6. M2 7. Patok	In what month was [hort crop] planted? 1. Jan 2. Feb 3. Mar … 10. Oct 11. Nov 12. Dec 13. Multiple months 14. Tree crops	In what month was [hort crop] planted? Year [2010 or 2011 for annual; other years for tree crops]	What variety of [hort crop] was planted in this plot? [see codes on back of previous page]	Has harvest of [hort crop] been completed or partly completed? 1. Completed 2. Partly completed 3. Not yet started	[Ask either G10 OR G11 & G12] [Ask G10 if easier to give production per plot] What is the actual quantity harvested so far of [hort crop] on this plot in this season? Kg of product	[Ask G11 & G12 if easier to give production per plant and plants per plot] How many plants/trees are in this plot? plants/trees per plot	What is the amount harvested quantity per plant/tree? kg per plant/tree
	G2	G3	G4	G5	G6	G7	G8	G9	G10	G11	G12
Dry season (planting about June 2010)	1										
	2										
	3										
	4										
	5										
Rainy season (planting about Sept 2010)	6										
	7										
	8										
	9										
	10										
Dry season (planting about Mar-April 2011)	11										
	12										
	13										
	14										
	15										

G2.SECOND HORTICULTURAL CROP PRODUCTION (input use)

What is the ROW number in question G2 for the largest [hort crop] plot in the most recently completed [hort crop] harvest? [ ] G13

	Type of input	For the LARGEST [hort crop] PLOT in the most recent completed season, did you use [..]? 1 Yes 2. No	[If G16=yes] For this same plot, how much did you spend on […]? (Rp)	[If G16=yes] How were most of the [inputs] acquired? 1. Made by household 2. Cash purchase 3. Credit from buyer of crop 4. Credit from input dealer 5. Credit from farmer group 6. Other credit 7. Provide for free	How has […] changed compared to five (or more) years ago? see codes	[If G18=3-7] What are the reasons for this change? see codes
G14		G15	G16	G17	G18	G19
1	Saved seed			X		
2	Non-hybrid seed					
3	Hybrid seed					
4	Chemical fertilizer					
5	Organic fertilizer					
6	Chemical pesticide					
7	Organic/bio pesticide					
8	Insect traps					
9	Herbicide					
10	Fungicides					
11	Transport of inputs					
13	Hired labor for …			X		
14	..seedling preparation			X		
15	..land preparation			X		
17	..planting			X		
18	..fertilization			X		
19	..watering			X		
20	..weeding			X		
21	..spraying			X		
22	..manual insect removal			X		
23	…harvest			X		
24	..post-harvest			X		
25	Irrigation			X		
26	Land rent			X		
27	Land tax			X		
28	Other costs			X		

Codes for G18 (change)

1. Not applicable (e.g. never used, new farmer)
2. No change in amount per m2
3. Increased amount per m2
4. Decreased amount per m2
5. Increased amt per m2 and different type
6. No change in amount, but different type
7. Decreased amount per m2 and different type

Codes for G19 (reason)

1. Change in input price
2. Change in [hort crop] price
3. To increase yield
4. To increase quality
5. To increase price obtained
6. Better information
7. To meet demands of buyer
8. To reduce cost
9. To increase land fertility
10. Change in level of pest and disease problems
11. Change in climate
12. Other

Do you keep written records on ….	1. Yes 2. No	
… the amount of pesticides used on [hort crop]?	[ ]	G20
… the dates of pesticide application on [hort crop]?	[ ]	G21
… the prices received for [hort crop] sales?	[ ]	G22
… the quantities of [hort crop] sold?	[ ]	G23
... the input costs for [hort crop]	[ ]	G24

	1. Yes 2. No	
[If yes to any] Do you keep these records at least one year after being paid?	[ ]	G25

H1. SECOND HORTICULTURAL CROP MARKETING (sales)

For the LARGEST PLOT of [hort crop] in the most recent season for which harvest is complete (see Section G1)

				Ask only if there were some sales (H4>0)					
Period of harvest season	How many [hort crop] harvests did you have during the [...] period of the harvest season? number	What was the average amount harvested per harvest? kg	Of the amount harvested, how much was sold (rather than being kept for seed or home consumption)? kg	What is the average price you received for the [hort crop]? Rp/kg	When were you paid for the [hort crop] harvest? 1. Before harvest 2. At delivery 3. 1-7 days later 4. More than week later 5. Multiple payments (across categories)	Where did the buyer take possession of the [hort crop]? 1. At farm 2. At house 3. Roadside 4. Collection place 5. Village mkt 6. Sub-dist mkt 7. District mkt 8. Wholesale market 9. Other	What is the distance from the plot to the main selling place? (km) [nearest tenth of km, e.g. 0.6 km]	[If not at farm] How did you transport it there? 1. On foot 2. Bicycle 3. Motorbike 4. Rented motorbike 5. Tossa 6. Becak 7. Car 8. Taxi / bus 9. Truck 10. Other	[If not at farm and 100% hired transport] How much did it cost to transport it from the field to the point of sale? [0 if no cash cost] Rp
H1	H2	H3	H4	H5	H6	H7	H8	H9	H10
1 Early									
2 Middle									
3 Late									

Note: For chilies and other crops that are harvested multiple times, record information on Early, Middle, and Late harvests.
For horticultural crops that are harvested just once per season, record information in Middle row. Also record H2=1.

H2. SECOND HORTICULTURAL CROP MARKETING (buyer relations)

How many different [hort crop] buyers did you [.....]
1. speak to about the sales of your [hort crop] last year ? H14
2. sell your [hort crop] to last year? H15

When in the [hort crop] production cycle do you usually first communicate with a buyer? H16
1, Before planting
2. Between planting & early stages of production
3, Close to harvest (ijon)
4. After the harvest begins

How do you usually communicate with your [hort crop] buyer(s)? H17
1. Mobile phone
2. Landline phone
3. Buyer comes to the farm
4. Buyer comes to farmer' house
5. Farmer goes to buyer 's place
6. Meet buyer elsewhere
7. Through intermediary person
8. Through cooperative/group

When in the [hort crop] production cycle do you usually agree on the sale with the buyer? H18
1, Before planting
2. Between planting & harvest
3, After harvest begins
4. Only at time of sale
5. 1-7 days before harvest

Do you usually have a written agreement with the [hort crop] buyer? H19
1. Yes 2. No

What is specified[..] in the agreement with the buyer? 1.Yes;2.No;

Price	H20
Quantity	H21
Grade/quality	H22
Variety	H23
Color	H24
Time of payment	H25
Sorting by size	H26
Removal of stems	H27
Seed provided on credit	H28
Other inputs provided on credit	H29
Other (specify) ________________________	H30

____
____

Has the level of detail in your agreements with [hort crop] buyers changed compared to five (or more) years ago? H31
1. They have become MORE detailed
2. No change
3. They have become LESS detailed
4. Not applicable (e.g. started to grow shallots 1-4 yrs ago)

Do you negotiate with the [hort crop] buyer over the price? H32
1. No, I always accept the price the buyer offers
2. Yes, I sometimes bargain over price with the buyer
3. Yes, I usually bargain over price with the buyer
4. No, I set the price and don't bargain.

Has your price bargaining postion with [hort crop] buyers changed compared to five (or more) years ago? H33
1. I have MORE price bargaining power than I used to.
2. No change in price bargaining power.
3. I have LESS price bargaining power than I used to.
4. Not applicable (e.g. first time)

Beside prices, do you negotiate with your [hort crop] buyer over non-price terms of the agreement [e,g, H21 - H30]? H34
1. No, I always accept the non-price terms of agreement that the buyer offers
2. Yes, I sometimes bargain over non-price terms of the agreement.
3. Yes, I usually bargain over non-price terms of the agreement.
4. No, I set the non-price terms of the agreement and don't bargain.
5. Not applicable (e.g. no non-price terms in agreement)

Has your non-price bargaining position with [hort crop] buyers changed compared to five (or more) years ago? H35
1. I have MORE non-price bargaining power than I used to.
2. No change in price bargaining power.
3. I have LESS non-price bargaining power than I used to.
4. Not applicable (e.g. first time, no non-price terms in agreement)

H3. SECOND HORTICULTURAL CROP MARKETING (buyer relations 2)

In the last season, did your buyer provide [...]? — 1. Yes;2.No

- [hort crop] seed — H 36
- Pesticides — H 37
- Other agricultural chemicals — H 38
- Information on how to produce [hort crop]? — H 39
- Inputs on credit — H 40
- Financial loan — H 41
- Guarantee of a specific price before planting — H 42
- Guarantee to purchase specific quantity — H 43

Have you had any problems with your [hort crop] buyer? — 1. Yes;2.No — H 44

[If H43 = 1] What were the main problems ?
(list up to three) — H 45, H 46, H 47

1. Poor quality seed provided by buyer
2. Poor quality fertilizer provided by buyer
3. Poor quality pesticide provided by buyer
4. High cost of inputs provided by buyer
5. Delays in delivery of inputs by buyer
6. Buyer did not give promised price
7. Delay in collecting harvest
8. Delay in paying for harvest
9. Manipulation of grading to pay lower price
10. Product rejected for low quality
11. Market price higher than fixed price
12. Others, specify ______________________

Did any of these problems (H45 - H47) cause you to change your [hort crop] buyer? — 1. Yes; 2.No — H 48

Do you know what the end market for your [hort crop]? — 1. Yes; 2.No — H 49
(e.g. supermarket, processor, traditional market)

[If H49=yes] How do you know what the end market of your [hort crop] is? — H 50

1. My first buyer /trader told me
2. I work or communicate directly with traders in end market
3. Heard from my neighbour/other farmers who sold the product to the same buyer
4. Others, specify,_______________

[If H49=yes] Are your [hort crop] eventually sold in any of the following type of markets? — 1. Yes; 2.No

- Traditional markets — H 51
- Supermarkets — H 52
- Processors — H 53
- Exporters — H 54
- Other modern markets (school, restaurant, hotel, etc) — H 55

Are your [hort crop] eventually sold in Java or in other parts of Indonesia? — 1. Yes; 2.No 3 Don't know

- Java — H 56
- Outside Java — H 57

Do you believe that your buyer requires higher or lower quality standards than other buyers ? — H 58

1. Higher
2. Same
3. Lower
4. Don't know

Do you believe that your buyer offers higher or lower prices than other buyers ? — H 59

1. Higher
2. Same
3. Lower
4. Don't know

I. PERCEPTION OF MODERN CHANNEL

Do you know any farmers who have sold **any agricultural products** over the last year that ended up …

1 . Yes
2. No
3. Don't know

- …being sold in supermarkets? [ ] I1
- …being sold to a processor? [ ] I2
- … being exported? [ ] I3
- …being sold to other modern markets? [ ] I3a

Do you know any farmers who have sold any **fruit or vegetables** that ended up ...?

1 . Yes
2. No
3. Don't know

- …being sold in supermarkets? [ ] I4
- …being sold to a processor? [ ] I5
- … being exported fresh? [ ] I6
- … being sold to other modern markets? [ ] I6a

experience selling into these three modern channels? [ ] I7

1. Mostly very positive
2. Generally positive
3. Some positive, some negative
4. Generally negative
5. Mostly very negative
6. Don't know

Do you think most farmers would be interested in selling into the modern channels? [ ] I8

1 . Yes
2. No
3. Don't know

What do you see as the main advantages of selling into the modern channels? (up to 3) [ ] I9 [ ] I10 [ ] I11

1. Higher price
2. Access to good seed
3. Access to other inputs
4. Getting inputs on credit
5. Technical assistance, learn new skills
6. No advantage to selling to modern channel
7. Don't know

8. Others, please specify ___________________

What factors do you think prevent farmers from selling into the modern channel? (up to 3) [ ] I12 [ ] I13 [ ] I14

1. Small farms, small quantities
2. Location far from buyers
3. Low quality of product
4. Can't supply all year (lack of irrigation)
5. Not enough experience and information
6. Necessary inputs are too expensive
7. Do not have equipment needed
8. Buyers don't know or trust them
9. Buyers require record keeping
10. Buyers require farmers to packge the product
11. Buyers don't pay immediately on delivery
12. Buyer require certification
13. Farmer not interested e.g. price, small demand
14. Don't know
15. Others, please specify ______________________

What do you think the government could do to help more farmers sell fruits & vegetable into the modern [ ] I15 [ ] I16 [ ] I17

1. Provide training in production methods
2. Provide training in grades & standards and marketing
3. Provide sustainability training and assistance
4. Guarantee price stabilization
5. Provide information on prices and markets
6. Improve supply of horticultural seed
7. Improve supply of agricultural chemicals
8. Invest in irrigation
9. Help organize farmers into groups
10. Improve roads in rural areas
11. Provide credit
12. Increase tax on imported agricultural products
13. Promote exports (e.g. reduce export tax & other costs)
14. Facilitate the access to modern retail market
15. Don't know / no opinion
16. Others, please specify _________________

J. PRODUCTION AND MARKETING INFORMATION

Source of information		Over the past 5 years, what have been your main sources of information about horticultural PRODUCTION METHODS (ask for up to 3 sources)? 1. Main 2. Second 3. Third	[For these 3 sources] How would you rate the quality of the production information? 1. Good 2. OK/Moderate 3. Poor	Over the past 5 years, what have been your main sources of information about horticultural PRICES & MARKETS (ask for up to 3 sources)? 1. Main 2. Second 3. Third	[For these 3 sources] How would you rate the quality of the market information? 1. Good 2. OK/Moderate 3. Poor
J1		J2	J3	J4	J5
1	Extension workers				
2	Research institute				
3	DINAS & other govt institutions				
4	Farmer/relative/neighbour				
5	Village leaders (formal & informal)				
6	Trader				
7	Processor				
8	Input sellers				
9	Input companies				
10	Cooperative				
11	Farmer group				
12	Water user association				
13	NGO				
14	TV				
15	Radio				
16	Newspaper/magazine				
17	Internet (www)				
18	Mobile info service				
19	Other ___________				

K. FARMER ATTITUDINES TOWARDS NON-CONVENTIONAL FARMING SYSTEMS

"We would like to explore farmer's beliefs and attitudes about c**onventional** and **non-conventional** farming. Non-conventional farming means trying to reduce the use of pesticides and other agricultural chemicals to make the food safer. I am going to read you several statements, then I would like you to tell me how strongly you agree or disagree with what I have said. 1=STRONGLY DISAGREE and 5=STRONGLY AGREE. There is no right or wrong response - we are really just interested in getting your OPINION and BELIEFS. "

[Show respondent green "agreement" scale provided on card. Respondent should point to level of agreement]

1	I am aware of non-conventional farming systems.		K 1
2	I am very concerned about the soil fertility of my farm land declining.		K 2
3	I am concerned about health risks caused by the use of chemicals in farming		K 3
4	The government should give farmers financial assistance to switch to non-conventional.		K 4
5	Producers of organic fertilizer and pesticides should help farmers switch to non-conventional farming		K 5
6	NGOs provide enough assistance to help farmers switch to non-conventional.		K 6
7	We need certification systems so that consumers know when food has been produced with less pesticides		K 7
8	The government should manage food certification programs.		K 8
9	Certification requirements are too costly and prevent farmers from switching to non-conventional.		K 9
10	The government should make sure that farmers get a higher price for producing food with less pesticides and chemicals.		K 10
11	Changing to non-conventional farming systems is easy and not overly costly.		K 11
12	Changing to non-conventional farming systems increases the risk of yield fluctuations.		K 12
13	Conversion to non-conventional farming systems is risky because of price fluctuations.		K 13
14	Small farmers can NOT compete with large commercial farms in non-conventional farming.		K 14
15	Non-conventional farming requires higher labour costs.		K 15
16	Non-conventional farming systems help me to reduce my input costs.		K 16
17	Non-conventional farming allow me to sell to supermarkets and other modern markets.		K 17
18	Non-conventional farming systems reduce our health risks from exposure to chemical inputs.		K 18

L1. ADOPTION OF INNOVATIONS (new commodities)

1. Yes ; 2.No

Over the last 5 years, did you start growing any crop for the first time within the last five years? [ ] L1

IF L1=NO, THEN SKIP TO SECTION L2. IF L1=Yes, COMPLETE THE FOLLOWING TABLE

No	List the crop codes of the most important new commodities [see codes in Section D]	What year did you first grow [crop]? [e.g. 2007]	What are the main reasons you decided to grow the crop? [use codes below]		Are you still growing this crop? 1.Yes;2.No	[If L6=2] What are the main reasons you stopped growing the crop? [use codes below]	
L2		L3	L4	L5	L6	L7	L8
1							
2							
3							
4							
5							
6							

Codes for L4 - L5 (reasons for adopting)
1. To reduce cost of inputs
2. To reduce risks
3. To earn higher prices or returns
4. New technology become available
5. See neighbors adopting with good results
6. Recommended by other farmers
7. Recommended by extension agent
8. Recommended by a trader or processor
9. Recommended by other government officials
10. Others, please specify _______________

Code for L7-L8 (reasons for discontinuing)
1. Lack of information about production & marketing
2. Costs of obtaining information too high
3. Farm management too complicated
4. Cost of production higher than expected
5. Labour requirements excessive
6. Price of the crop lower than expected
7. Yield lower than expected due to pests and diseases
8. Yield lower than expected due to soil or climate
9. Benefits too far in the future
10. Limited availability of inputs
11. Other farmers recommend changing crops
12. Extension agent recommends changing crops
13. Other government officials recommend changing crops
14. Others, please specify ___________________

L2. ADOPTION OF INNOVATIONS (adoption of non-conventional farming)

					Ask these questions only if L12=yes or partially Ask these questions only if L10=yes					
	Non Conventional Farming Systems	Have you heard of […]? 1. Yes 2. No [If no, skip to next row]	Have you received training in [..] ? 1. Yes 2. No	Have you adopted […]? 1. Yes 2. Partially 3. No [If no, skip to next row]	What year did you start [..] ? (year) [e.g. 2009]	What are the main reasons you adopted this farming system? [use codes below]		Are you still using this method? 1. Yes 2. Partially 3. No [If to next row]	[If L16 = No] What are the main reasons you stopped using this farming system? [use codes below]	
L9		L10	L11	L12	L13	L14	L15	L16	L17	L18
1.	Pesticide-free farming (growing crops without using pesticide)									
2.	Organic farming systems (growing without agricultural chemicals)									
3.	Maximum Residue Limit (MRL) principle (minimizing pesticide in the final product)									
4.	Integrated Pest Management (IPM) (reducing pesticide use with bio-controls)									
5.	Good Agriculture Practices (GAP) (international standards for farming)									

Code for L14 - L15 (reasons for adopting)
1. To reduce cost of inputs
2. To reduce risks
3. To earn higher prices for my products
4. New technology become available
5. See neighbors adopting with good results
6. Recommended by other farmers
7. Recommended by extension agent
8. Recommended by a trader or processor
9. Recommended by other government officials
10. To reduce health risk related to using chemicals
11. To reduce health risk of eating food with pesticide
12. To reduce health risk of consumers eating my products
13. To reduce negative impact on water and environment
14. To be able to access new markets
15. To take advantage of promotions by chemical vendors
16. To benefit from credit and other assistance programs
17. Take an initiative to implement after training
18. Others

Code for L17-L18 (reasons for discontinuing)
1. Lack of information about production & marketing
2. Costs of obtaining information too high
3. Farm management too complicated
4. Cost of production higher than expected
5. Labour requirements excessive
6. Price of the crop lower than expected
7. Yield lower than expected due to pests and diseases
8. Yield lower than expected due to soil or climate
9. Benefits too far in the future
10. Limited availability of inputs
11. Other farmers recommend stopping
12. Extension agent recommends stopping
13. Other government officials recommend stopping
14. Lack of government support or credit
15. Sharecroppers complained
16. Landlord complained
17. Others

L3. ADOPTION OF INNOVATIONS (experience with non-conventional farming)

If respondent is using one or more of these methods (L16 = Parital or Yes in at least one row), please fill in the appropriate rows. If not, skip to Section M.

No	Non - Conventional Farming Systems	What crops are you growing using [farming system]? see crop code on back of previous page			How were you first introduced to this farming system? (see code)	Are you the first person in your village to implement this farming systems ? 1. Yes 2. No 3. Don't know	Did you experience with any problems with this farming system? 1. Yes 2. No	[If L25=yes] What were the most serious problems you had in using this farming system? (see code)	
L19		L20	L21	L22	L23	L24	L25	L26	L27
1.	Pesticide free farming								
2.	Organic farming								
3.	Maximum Residue Limit (MRL) principle								
4.	Integrated Pest Management (IPM)								
5.	Good Agriculture Practices (GAP)								

Code for L23
1. Head of farmers group
2. Local village staff
3. Extension officer
4. Head of sub village
5. Agriculture officer
6. NGO Staff
7. Friends, relative
8. Cooperative
9. Others

Codes for L26-L27 (problems)
1. Lack of information about production & marketing
2. Costs of obtaining information too high
3. Farm management too complicated
4. Cost of production higher than expected
5. Labour requirements excessive
6. Price of the crop lower than expected
7. Yield lower than expected due to pests and diseases
8. Yield lower than expected due to soil or climate
9. Benefits too far in the future
10. Limited availability of inputs
11. Other farmers recommend stopping
12. Extension agent recommends stopping
13. Other government officials recommend stopping
14. Lack of government support or credit
15. Sharecroppers complained
16. Landlord complained
17. Others farmers not yet implemented the system
18. Marketing channel similar with the conventional (no incentive)
19. Implemented the farming system on other people's land
20. Others

L4. ADOPTION OF INNOVATION (input use with non-conventional farming)

If respondent is using one or more of these methods (L16 = Partial or Yes in at least one row), please fill in the appropriate rows. If not, skip to Section M.

No	Non - Conventional Farming Systems	How has the quantity of inputs used per m2 for the SAME crop(s) changed since you started using non-conventional farming systems? [use codes below]								
		Seed	Chemical Fertilizer	Organic Fertilizer	Chemical pesticide & herbicide	Organic pesticide & herbicide	Hired Labour	Family Labour	Agriculture Equipment/ Machinery	Time spend on record keeping
L28		L29	L30	L31	L32	L33	L34	L35	L36	L37
1.	Pesticide free farming									
2.	Organic farming									
3.	Maximum Residue Limit (MRL) principle									
4.	Integrated Pest Management (IPM)									
5.	Good Agriculture Practices (GAP)									

Code for L29-L37 (change in input use)
1 = Increased a lot (more than 50%)
2 = Increased a little (10-50%)
3 = Stayed about the same (-10% to +10%)
4 = Decreased a little (10-50%)
5 = Decreased a lot (more than 50%)
6 = Didn't use input in either period
7 = Not applicable (e.g. first time grow ing crop)
8 = Don't know

L5. ADOPTION OF INNOVATION (certification)

If respondent is using one or more of these methods (L16 = Yes in at least one row), please fill in the appropriate rows. If not, skip to Section M.

No	Non - Conventional Farming Systems	Does someone certify that this farming system was used? 1. Yes 2. No	Ask if L39=yes: Who certifies you? 1 = Self claimed 2 = Buyer 3 = Third party certification agency	Ask if L39=yes: [If L 40 = 3d party] Which 3d party ? 1. Sucofindo 2. Mutu Agung Lestari 3. Lesos 4. Biocert 5. Inofis 6. Persada 7. LSO Djantho* 8. Other	Ask if L39=no: What are the main reasons you are not certified? [up to two] [use codes below]		Regardless of whether you are currently certified, what do you think are the main advantages of being certified? [up to two] [use codes below]		What are the main ways certification could be improved? [up to two] [use codes below]	
L38		L39	L40	L41	L42	L43	L44	L45	L46	L47
1.	Pesticide free farming									
2.	Organic farming									
3.	Maximum Residue Limit (MRL) principle									
4.	Integrated Pest Management (IPM)									
5.	Good Agriculture Practices (GAP)									

Note : LSO stands for Lembaga Sertifikasi Organic (Organic certification agency)

Code for L42-L43 (reasons for not being certified)

1. Not required
2. I'm just started the farming not yet ready for certifications
3. There is no guarantee that I will get premium prices if certified my products
4. I just marketed the product locally
5. Too stressed with all the requirements
6. The number of growers still limited in my areas thus we're not sufficient enough to meet the minimimum requirements on size
7. The prices for certification quite expensive (too costly)
8. Limited access to the certification bodies
9. Limited access to the information about certification
10. Don't know anything about certification
11. Others

Code for L44-L45 (advantages of certification)

1. I can obtain premium prices from the sold products
2. Allow me to supply supermarket or modern retail outlets
3. Allow me to export my products
4. Put me as a role model for organic growers
5. Give me a change to enter a new market with high returns
6. Allow me to give a certain guarantee systems to my customers
7. Improve family health condition
8. Don't believe there are any advantages
9. Don't know / no opinion
10. Others

Code for L49-L50 (ways to improve certification)

1. Simplify the procedure
2. Provide more education to farmers
3. Guarantee on premium price for certified product
4. Need assistance from government, NGO, trader, modern retail supplier
5. Reducing the costs
6. Don't know / no opinion
7. Others

M1. DESIRED ATTRIBUTES FOR NEW CROPS & DIVISION OF LABOR IN HORTICULTURE

	M1	M2
	Are you involved in [activity] for horticultural production? 1. Yes 2. No	[If M1=1] Who has the main responsibility for [activity}? 1. Husband 2. Wife 3. Both
1 Preparing the land		
2 Buying farm equipment		
3 Buying inputs		
4 Spreading seed		
5 Mulching		
6 Planting		
7 Installing stakes		
8 Fertilizing		
9 Spraying chemicals		
10 Weeding		
11 Watering		
12 Harvesting		
13 Transporting product to buyer		
14 Sorting and grading		
15 Record keeping		
16 Negotiating with buyer		
17 Preparing meal		

M2. DESIRED ATTRIBUTES ON ADOPTION

When considering whether or not you will adopt a new crop, what 3 things are most important to you? [record an attribute code in each of the three boxes according to the importance of the attribute]

M3	M4	M5

1 Stable market demand
2 Stable and consistent price
3 Growing market demand
4 Higher expected price
5 High expected profit /return
6 Expected high yield
7 Disease resistant crop
8 Less labour required to produce
9 Time from planting to harvest is short
10 Less chemical inputs required
11 Use less water
12 Crop will adapt easily to my production environment
13 Low initial investment costs
14 Stable yield
15 Easy to get pesticides and herbicides
16 Easy to get good quality seeds
17 Health concern about pesticide residue in the product
18 Guaranteed buyer/market
19 Prevent a sustainability of soil fertility
20 Simple farming systems' method
21 Availability of education and assistance on how to produce crop
22 Market and price information readily available
23 Guaranteed access to inputs or financiing for inputs
24 Other farmers have adopted and are successful
25 Government provides subsidies or incentives to plant

I am going to show you 11 cards with characteristics that may be important when adopting a new crop or new farming system. In each case there will be 5 characteristics shown, these will be different from one card to the next (total 11 cards). Please select one attribute that is MOST important to you when considering why you decided to adopt, and then select a characteristics that is LEAST important to you. Please select only one of each.

	A	B	C	D	E	F	G	H	I	J	K
Best											
Worst											
	M6	M7	M8	M9	M10	M11	M12	M13	M14	M15	M16

N. CASH INCOME ACTIVITIES

Income activity	Code	In the past 12 months, have members of your household been involved in [activity]? 1. Yes 2. No	Ask these questions only if N2 = Yes How many units out of the past 12 months did members of this household receive income from [activity]? Units (e.g. days, months, harvest, etc)	For each of these units that your hoursehold w as involved in [activity], how much gross revenue did you make from this activity? Rp/unit (e.g. Rp/day, Rp/month, Rp/harvest)	For each of these units, how much does your household spend in BUSINESS expenses related to this activity? Rp/unit (e.g. Rp/day, Rp/month, Rp/harvest)	Compared to 5 years ago, has this activity become more or less important as a share of your income? 1. More important 2. No change 3. Less important 4. Not applicable (e.g new)
	N1	N2	N3	N4	N5	N6
Shallot production	101					
Other horticultural production	102					
Other crop production	103					
Livestock & animal product sales	104					
Aquaculture	105					
Agricultural trading	106					
Other trading	107					
Grain milling business	108					
Food processing business	109					
Other business	110					
Agricultural w age labor	111					
Non-agricultural employment	112					
Pension	113					
Remittances from family members	114					
Other assistance programs	115					
Other income sources (1)	116					
Other income sources (2)	117					

O. CHANGES

		Ask if O2=No	Ask questions if O2=Yes				
	Do you currently belong to any of the following? 1. Yes; 2. No	Were you previously a member? 1. Yes; 2. No	What are the most important benefits of being a member of this organization? [use codes at right, list top three]			How satisfied are you with the group? 1 Very satisifed 2. Somehwat 3. Not satisfied	How has the performance changed compared to 5 years ago? 1. Improved 2. No change 3. Worsened 4. Not applicable
O1	O2	O3	O4	O5	O6	O7	O8
1. Farmers' group							
2. Cooperative							
3. Water user assoc.			X	X	X		

Codes for O4-O6
1 Provision of inputs
2 Provision of credit
3 Crop marketing assistance
4 FFS/IPM
5 FFS/GAP
6 Other tech assistance
7. Learn from other members
8 Social interaction
9 Networking/business contacts
10 Other

How has the area you plant to shallots changed over the last five years? [ ] O9

[If change] What is the main reason that you changed the shallot area? [ ] O10

How has the shallot yield on your farm changed over the last five years? [ ] O11

[If change] What is the main reason your shallot yield has changed? [ ] O12

How has the area you plant to horticultural crop changed over the last five years? [ ] O13

[If change] What is the main reason that you changed the area planted with horticulture? [ ] O14

How has the yield you get from horticultural crops changed over the last five years? [ ] O15

[If change] What is the main reason the yield of your horticulture has changed? [ ] O16

Codes for O9, O11, O13, O15 (change)
1. Increased
2. No change
3. Decreased
4. Not relevant e.g. new crop, doesn't grow

Codes for O10, O12, O14, O16 (reason)
1 Change in price of the crop(s)
2 Change in the price of inputs
3 Change in ability to pay for inputs
4 Change in availability of credit
5 Change in services offered by buyer
6 Change in knowledge of growing crop
7 Change in rainfall patterns
8 Change in quantity of inputs used
9 Change in amount of farm land
10 Change in amount of irrigated farm land
11 Change in ownership of ag equipment
12 Change in soil fertility
13 Other

[At the end of the interview, thank the respondents for their time and ask them if they have any questions.]