CHAPTER 1: INTRODUCTION

1.1 Background to the Study

Poultry has been a significant part of the lives of Indonesians. Apart from an alternative source of protein for consumers, it is an opportunistic agribusiness enterprise for smallholders and large multinational companies. Table 1.1 summarises poultry production and consumption in Indonesia from 2011 to 2012 and forecasts for 2013 to2016.

Table 1.1 Poultry production and consumption in Indonesia, 2011-2016

Year	Poultry production ('000 tonnes)	Poultry consumption ('000 tonnes)
2011	1,515	1,515
2012	1,540	1,540
2013	1,570	1,579
2014	1,600	1,618
2015	1,640	1,667
2016	1,700	1,717

Source: Business Monitor International (2012)

According to BMI (2012), Indonesian meat consumption experienced an increase of 46 % between 1990 and 2005, with poultry consumption per capita almost doubling within the time period. Although considered low by international standards, in 2011 annual poultry consumption reached 6.3 kg per capita. As seen in Table 1.1, it is expected that by 2016 poultry consumption will increase 13.3 % to 1.7 million tonnes. It is also predicted that consumption per capita will rise by 8 % in 2016. The increase for demand in poultry is believed to be a result of improvement in income, which has increased the ability of Indonesians to afford meat (BMI, 2012).

Poultry production takes place in many provinces in Indonesia, including Bali. In this regard, poultry produced in the province is mainly to satisfy local demand. There is a range of birds raised, including native and non-native (broiler and layer) chickens, ducks, muscovy ducks, quails and pigeon, with chicken being the most popular.

Table 1.2 presents the chicken population for each regency in Bali. The population of non-native chicken is more than double the population of native chickens. Buleleng and Karangasem have the largest population of native chickens while Tabanan and Bangli have the largest population of non-native chicken. Furthermore, Denpasar has the smallest population of both native and non-native chickens. The fact that Denpasar is the capital city of Bali, where agricultural activities have been replaced by other businesses, may be the cause of small populations. Although native chickens can be raised for their meat, non-native chickens, particularly broilers, are more commonly raised as a farm enterprise.

Table 1.2 Chicken population in Bali, 2011

Regency/Municipality	Native	Non-native
Jembrana	621,552	623,000
Tabanan	566,704	3,568,412
Badung	558,246	803,000
Gianyar	484,451	584,415
Klungkung	183,169	356,000
Bangli	398,192	2,238,560
Karangasem	675,969	2,099,952
Buleleng	829,588	285,140
Denpasar	78,303	6,000
Total	**4,396,174**	**10,564,479**

Source: BPS Bali (2012)

Poultry production in Indonesia involves local and multinational stakeholders from smallholder farmers to multinational companies. The United Nation's Food and Agriculture Organisation (2004) has divided the country's poultry industry into four sectors. Sector 1 are industrial farms, which comprise farms owned and operated by the eight major multinational companies in Indonesia. These corporations include Charoen Pokphand Indonesia (CPI), Japfa Comfeed Indonesia (JCI), Wonokoyo, Sierad Produce (SP), Super Unggas Jaya (SUJ), Cibadak, Malindo-Leong, and Shinta. Among these companies CPI and JCI are the two largest. These multinational companies dominate the poultry industry producing broiler and day old chicks (DOC). The companies also have complete control over farm inputs and outputs. Many companies operating in commercial broiler farming are foreign owned, such as the Thailand-based Charoen Pokphand and

Malaysian Sierad Produce. These two companies share approximately 70 % to 80 % of the domestic market (ICN, 2009).

Sector 2 involves breeding farms, some of which are industrial farms owned by the eight large multinational companies. Specific management and licensing is required of the breeding farms. Sector 3 comprise the small commercial producers. In this sector, layer farms are generally independently owned and managed, while broiler farms mostly adopt the contract farming approach to production. In this regard, many companies from Sector 1 act as contract providers to the Sector 3 broiler farmers. Sector 4 is known as the backyard chicken sector (FAO, 2004).

Charoen Pokphand Indonesia (CPI) has provided contracts to broiler farmers since 1987. Farmers participating in the contract are required to rear at least 5,000 chickens each. CPI is currently contracting thousands of broiler farmers across Indonesia, including in Sumatra, Java, Kalimantan, Bali and Nusa Tenggara Barat. Similarly, PT. Wonokoyo has established partnerships with smallholders since 1999 in which farmers are required to have at least 1,000 chickens. Sierad Produce has at least 1,000 farmers contracted in Java alone. The company produces approximately 1.5 million day old chicks (DOC) weekly, 900,000 of which are distributed to their contract farmers (ICN, 2009).

Contracts between smallholders and large companies in Sector 1 involve the provision of production inputs including feed, vaccine, vitamins, and DOC; technical advice; access to markets; and occasionally loans to start a poultry business (ICN, 2009). These contract providers also agree to market the broilers and buy them from the smallholders at a pre-agreed price. In return, farmers are responsible for electricity, labour, fuel, extra feed, managing farm operations, providing appropriate chicken shed, and ensure the management of feed and poultry health is in accordance with the company's standards (Patrick *et al.,* 2008).

Although the responsibilities of both parties are often the same in different companies' contracts variations in contracts may be observed in terms of payment settlements. In general, farmers receive a contract price per kilogram chicken sold. Similar to other commodities managed under contractual agreements, certain standards are set including the efficiency of feed consumption, weight at sale, and mortality rate. Contractor companies evaluate the flock's performance according to these standards. Beside the contract price, contractor companies provide performance incentives (bonuses) to encourage the improvement of cohort performance. These incentives act as additional income to the farmers.

The types and amount of bonuses provided varies from one contractor company to another. However, there are three bonuses that are generally observed in contract broiler production. These include feed conversion ratio (FCR) bonus that reflects the flock's efficiency in converting feed into meat; the market price bonus which accrues when there is a difference between retail price and contract price; and the mortality rate bonus that rewards low mortality rates.

The efficiency of chicken rearing has become the major role of farmers participating in contracts. The aforementioned standards of poultry management and flock performance are set to ensure efficiency in production. The objective is that both parties, smallholder and contractor companies, receive the best possible income from the production system. However, disease can reduce successful performance in poultry production. It is known that disease spread does not only affect individual farms but may also cause disruption to the operation of the entire poultry industry and the health of the wider community. The recent emergence of Highly Pathogenic Avian Influenza (HPAI) in South East Asia, including Indonesia, demonstrates the devastating effects of disease outbreak on the poultry industry.

The occurrence of HPAI was first recorded in August 2003, in several areas in Indonesia particularly West Java. The disease spread to other provinces including Bali, East Java, Central Java and West Kalimantan in January 2004. More than 3.8 million poultry died, with the highest number of deaths of 1.5 million birds recorded in West Java. The incidence of HPAI in Indonesia is related to a lack of biosecurity in poultry breeding and smallholder farms (Tambyah & Leung, 2006).

It is expected that that the scale of operations and risks of loss in Sector 1 ensures that they adopt better biosecurity, compared to smallholder Sector 3 farmers. Although the Government of Indonesia has invested in the improvement of biosecurity along the market chain, there is a new realisation that more attention on biosecurity is needed in order to improve HPAI control in Sectors 3 and 4. These smallholders are generally contracted to companies in Sector 1.

The HPAI outbreak has not only caused the loss of poultry but has also triggered human fatalities. Tambyah and Leung (2006) assert that the first human case occurred in South Sulawesi in February 2005 and the second occurred in July 2005. From 12 July to 15 December 2005, there were 16 confirmed human cases, with 69 % fatality. The estimated poultry loss by November 2005 was 16 million, 4.7 million birds due to HPAI infection and the rest due to culling to prevent disease spread. This demonstrates that HPAI does not only have the ability to trigger fatal human disease and global pandemic, but also can cause severe economic loss. Beside farmers, marketers and other stakeholders involved in the poultry market chain are affected by this loss.

The poultry trade has been affected by HPAI in three ways; a decline in poultry production, a decrease in poultry meat consumption, and a ban on importing or exporting from infected countries (Vanzetti, 2007). Changes in consumer demand for poultry meat due to the outbreak have altered the national supply and production of the commodity. Following the HPAI spread in 2003, poultry production in 2004 experienced a 15 % decline. It has been recorded that in the same year the poultry meat consumption per capita in the country declined by 11 % (Taha, 2007). Although this decline was recovered within the following year, further exposure to HPAI and other poultry diseases may result in future declines.

1.2 Research Problem

The significant economic loss in the poultry industry ensures that control of HPAI remains a priority for Indonesia. With the increasing realisation of the importance of improving biosecurity particularly in Sectors 3 and 4, the Australian Centre for International Agricultural Research (ACIAR) has established a project in Indonesia *Cost-effective biosecurity for Non Industrial Commercial Poultry Sector operations in Indonesia*. This project aims to identify efficient and effective biosecurity measures for NICPS farms. NICPS comprises commercial smallholder producers, managing poultry between 500 and 20,000 birds. Over the years, the project has conducted biosecurity training activities and development of support institutions for the improvement of biosecurity implementation in the industry. The project has also conducted surveys on broiler and layer smallholders, developed a farm biosecurity scoring system, and established clean market chains for products from biosecure farms.

As the majority of Sector 3 farmers manage poultry through a contract, the project encourages contractor companies to improve biosecurity implementation through training and advice. Currently there are no market incentives to encourage biosecurity adoption by the farmers. However, performance incentives (bonuses) that is originally utilised to ensure better cohort performance, may serve as motivation for farmers to adopt biosecurity. Moreover, the vast number of contractor companies providing contracts to smallholders and variations observed in contract may lead to an understanding of the behaviour of farmers in selecting a contract provider.

Given this background, two research questions can be drawn as follows:

1. What factors influence farmers' selection of contractor company?
2. Which contract bonus system best reward farmers for the adoption of biosecurity?

1.3 Research objectives and hypotheses

In view of the above discussion, the aims of the present study are as follows:

1. To identify the factors affecting farmers' selection of contractor company.
2. To define a bonus reward system that best encourage biosecurity adoption.

In accordance with the above stated objectives, the following hypotheses are tested:

1. Farmers' selection of a contractor company.
   Age, education, farming experience, main occupation, non-broiler income, farm size, size of contractor company, contract price, and number of bonuses provided by the contractor company influence farmers' selection of contractor company.
2. Identification of a bonus reward system that best encourages biosecurity adoption.
   The larger the proportion of bonuses provided by the contractor companies leads to the best reward system for the encouragement of biosecurity adoption.

1.4 Scope and Outline of the Study

The study is limited to the analysis of farmers' selection of seven contractor companies involved in broiler operation in Bali. From these companies, six contracts are investigated to evaluate the bonus system that best rewards farmers for biosecurity adoption. Given the limited resources, time and the willingness of the companies to participate, the study does not provide an investigation of the entire Balinese broiler industry, where twenty one contract providers are involved. The dissertation has six chapters. An introduction presenting the background to the study, research problems, research objectives and hypotheses is presented in this chapter (Chapter 1). Chapter 2 reviews concepts of contract farming and biosecurity implementation in poultry production. A description of the methods employed in sample selection and data gathering is presented in Chapter 3. The econometric models and gross margin approach used in the analysis are also presented in Chapter 3. Chapter 4 contains the results and discussions of factors influencing farmers' selection of a contractor company, and this leads to an evaluation of the results of bonus systems that best reward farmers for biosecurity implementation, presented in Chapter 5. The dissertation is completed with Chapter 6, that provides a summary of findings, conclusions and policy implication, and the limitations of the study.

CHAPTER 2: REVIEW OF THE LITERATURE

2.1 Introduction

Concepts of contract farming and biosecurity implementation in poultry farms are reviewed in this chapter. The assessment of the general theory in this chapter guides the analysis of research objectives discussed in Chapter One. The concept of contract farming is presented first, providing an overview of the definition and benefits of contract farming, the types of contracts generally observed, application of discrete choice models on contract farming participation and contract farming in the poultry industry. The chapter is concluded with a review of biosecurity implementation on poultry farms.

2.2 Concept of Contract Farming

Contract farming is a part of agricultural development particularly in developing countries and many studies conducted within this context have contributed to the growing literature. This section defines the concept of contract farming and then discusses the general types of contracts observed in agriculture. This review of contract farming is concluded with a discussion on the implementation of the contract farming concept in the poultry industry.

2.2.1 Definition and benefits of contract farming

Among other agribusiness activities, contract farming reflects the most direct and complex relationship between growers and companies. Glover and Kusterer (1990) define contract farming as a concept that replaces company production with purchases from local farmers through arranged contracts. Contracts generally specify the conditions of sale, and the companies are obligated to provide farmers with technical assistance, input and other services. Glover and Kusterer (1990) further assert that contract farming is a method of allocating the distribution of risk between the contractor company and farmers. Farmers bear the production risks, while companies bear the risks of marketing.

Although farmers may enjoy benefits from the distribution of risks, some researchers believe that managing production under a contract may result in farmers losing their independence in on-farm decision making. Key (2005) asserts that in general farmers under production contracts are obliged to submit to farm management rules imposed by the contractor companies. Hayenga *et al.* (2000) in Key (2005) further assert that submitting their control in management may be a great disadvantage for farmers participating in a contract. Production standards imposed by the companies may restrict farmers' independence in farm management.

Despite the presence of disadvantages associated with the restricted role of farmers in farm management, Setboonsarng *et al.* (2006) have summarised the advantages of participating in contract farming, which agree with other studies including Barrett *et al.* (2012), Glover and Kusterer (1990), and Knoeber and Thurman (1995). These advantages include:

A. Farmers

1. Access to markets

   Production under contractual arrangements provides farmers with access to markets, where price and demand of the commodity is generally more favourable.
2. Access to credit

   Contract providers extend credit to farmers in the form of input provision, which are paid for after harvest. In cases where firms do not provide credit to farmers, banks may accept the contracts as collateral.
3. Access to technology

   Firms may provide farmers with training and assistance in the introduction of new technologies to improve farm management and production efficiency.
4. Access to input

   Participation in contract farming provides farmers with access to timely quality input that may not be accessible when farmers manage their farm independently.
5. Increase income

   In cases where contract farming is used in the production of non-traditional crops that are sold at a premium, contract farming may result in the improvement of farmers' incomes.
6. Reduced price risk

   The pre-agreed contract price may protect farmers from losses caused by price fluctuations in the market.
7. Reduced production risk

   Contract farming arrangements facilitate risk distribution from production failures due to uncontrollable circumstances such as disease outbreak or natural disasters.

B. Contract providers

1. Control over volume and consistency

   Contract farming provides contractor companies with the assurance of consistent production throughout the production cycle, improves quality and in some cases increases yields.

2. Improves cost efficiency

   Costs are reduced with the adoption of the contract farming approach, as firms are no longer required to purchase land or hire labour directly. The classic principal-agent theory associated with moral hazard may also assist in the reduction of supervision costs.

Apart from the above advantages, contract farming also addresses the problem of transaction cost by spreading the risk between the contractor and the contract provider. The type of commodity produced will influence the marketing system necessary and the transaction costs incurred (Patrick, 2004). According to Key and Runsten (1999), the development of the production process and marketing systems in contract farming has been under the influence of market failure. There are a number of significant market failures that disadvantage smallholders when participating in spot markets.

a. Credit

   Access to credit is an important factor in the contract farming context. Non-traditional crops are generally more expensive to produce compared to traditional crops.

b. Insurance

   Significantly higher production costs associated with the non-traditional crops impose a higher risk compared to traditional crops. Prices of non-traditional crops tend to vary as yield are to supply and demand forces. Yield can vary due to the fact that non-traditional crops are genetic hybrids and are therefore more susceptible to pests. Contracting firms can offer smallholders a forward contract to reduce the risk of price and yield fluctuation.

c. Information

   By implementing production management contracts, companies are able to solve missing market information and pass on production and technology information to smallholders.

d. Factors of production

Markets for inputs and other services needed in the production process of non-traditional crops are often missing, especially in developing countries. Vertical integration and contract farming can be utilised by the firms to attain power over specialised input and knowledge.

e. Product markets

Contract farming enables firms to obtain consistent quality and punctual delivery of product.

2.2.2 Types of contracts

MacDonald *et al.* (2004, p.3) define agricultural contracts as "contracts used to arrange for the transfer of agricultural products from farms to downstream users such as processors, elevators, integrators, retailers, or other farms". There are four methods of transferring agricultural commodities from producers to consumers. These include spot markets, vertical integration, production and marketing contracts. The latter are closely associated with contract farming and act as substitutes for procuring products from spot markets and vertical integration. MacDonald *et al.* (2004) describe the two types of contracts as follows:

a. Production contracts

Production contract is one alternative to spot market, aside from marketing contracts and vertical integration. It is generally specific with regards to the assignment of responsibilities between contract provider and farmer. Contractors are responsible with the provision of inputs, including crops or young animals, feed and medication, while farmers provide labour and production factors (Glover & Kusterer, 1990; Knoeber & Thurman, 1995; Setboonsarng *et al.*, 2006; Barrett *et al.*, 2012). In addition, contractor companies typically retain the ownership of the crops or animals. Production contracts also specify payment settlements, where livestock are generally paid per animal at a base rate (contract price). Aside from this base payment, the provision of incentives is often observed, where farmers earn additional income if mortality rates are low or feed is used efficiently.

b. Marketing contracts

   It is believed that with marketing contracts farmers retain more control over farm management compared to production contracts. Marketing contracts specify the quantity of production and delivery time of product to the contractor company. The contract often sets standards for the production process and specify the precise agricultural commodity being produced. With regard to payment settlements, similarly to production contracts, market contracts determine a base price or pricing formula. However, as payment settlements are generally based on spot market prices, where fluctuation in price is often observed.

A study on contract farming in Indonesia, conducted by Patrick (2004), revealed four types of contracts that commonly operate in the country. Plasma and nucleus contracts, require the nucleus (contract provider) to provide input, technical advice with regard to production process, and purchase of the produce. In return, farmers are responsible for the production of the commodity. The second type of contract, involves companies providing inputs to a third party and sub-contracting production to farmers. This contract production approach is often referred to as a sub-contract. The third type of contract is the harvest and pay approach. This contract involves a local trader providing credit to smallholders, with an agreement that the produce will be sold to the trader by the smallholders. Fourth is the *Kerja sama operasional (KSO),* in which firms not only provide farmers with input but also compensate for the use of land. This compensation serves as a base payment.

Variation of contracts between contract providers and smallholders is often observed. Simmons *et al.* (2005) suggest that contracts may vary with regard to the following terms: firstly, the contract provider may involve multinational companies, national companies and intermediaries; secondly, the type of crops being contracted may include traditional crops, non-traditional crops, broiler chickens, and horticultural crops; thirdly, the contract details may have different levels of technical support given to the farmers, different provision of credit, and different methods of price determination; fourthly, the level of formality may range from formally signed contracts to informal relationships; and lastly, the number of small farmers participating in the contract may vary. The intensity of contract arrangement also varies from firm to firm. Glover and Kusterer (1990) describe contract farming for the production of commodities such as broilers as being more intense, meaning that the company provide contractors with inputs and harvesting equipment or are closely involved in the farming operations. The range of contract details from one contractor company to another provides farmers with a wide selection of contracts and contractor companies to choose from.

2.2.3 Application of discrete choice models on contract farming participation

This section put forward a review on a number of studies conducted on contract farming participation. There are two main discrete choice models applied in these studies, namely the probit model and the logit model. Econometrics models that estimate choice behaviours are generally referred as discrete choice models, in which the dependent variable examined is a dummy variable (Greene, 2003). Methods applied and variables considered in the previous studies are used as guidelines for the present study.

Simmons *et al.* (2005) analysed the benefits of contract farming in three provinces in Indonesia. A contract was examined for each province, namely seed corn in East Java, seed rice in Bali and broilers in Lombok. A probit model was employed to identify the factors influencing smallholder participation in contract farming, comparing between independent and contract smallholders. Two-stage estimation was also used to estimate the effects of farm contracts on gross margin and labour use. Result from the review of the contracts indicates that there are a number of contract types operating in Indonesia. The different characteristics of contracts are influenced by the difference in technical requirements and related costs in production. The study show that farm size and farmer's age, education and participation in farm groups have significant influence in contract farming participation. Furthermore, managing the farm under a contract resulted in an increase in returns, particularly for the seed corn and broiler contracts.

Similar study has been conducted by Ramaswami *et al.* (2009). Where contract and independent poultry growers has been involved to evaluate the factors influencing contract farming participation. The gains from contract farming has been examined with independent growers considered as a benchmark in the study. A probit model was employed to determine the factors affecting contract participation. The study also used a treatment effects model to estimate the income gains. Significant variables of the study is summarised in Table 2.1. The table also presents the discrete choice models applied in the study.

Table 2.1 Discrete choice model application in contract farming research

Author	Model	Results (significant variables)
Simmons *et al.* (2005)	Probit	Farm size, age, education, and participation in farm groups
Jabbar *et al.* (2007)	Probit and multinomial logit	Age, education, family labour supply, landholdings, farm income
Ramaswami *et al.* (2009)	Probit and treatment effects model	Education, experience, the number of adults in the household, whether previous occupation was in agricultural activity, land ownership, distance to regional rural bank, distance from urban centre
Joseph *et al.* (2011)	Logit	Age, education, access to other income, duration of growing cotton
Arumugam *et al.* (2011)	Logit	Ownership, land size, education, perceived benefit, lack of opportunities, price risk

There are a number of studies on contract farming that employed a logit model approach to estimate the effects of independent variables on farmer participation in contract farming. These include research conducted by Jabbar *et al.* (2007), Joseph *et al.* (2011) and Arumugam *et al.* (2011). Jabbar *et al.* (2007) assessed the probability of rural household participation in independent and contract farming, with particular focus on poultry production. Both probit and multinomial logit were used to estimate the determinants influencing households participation in commercial and contract poultry farming.

Joseph *et al.* (2011) evaluated a number of factors influencing farmer participation contract cotton production in Patchway district, Zimbabwe. Employing the snowballing method, interviews on 100 farmers were carried out. Estimation of the binary logit model shown that age, education, access to other income, and the duration of growing cotton significantly affect farmer participation in contract farming.

Arumugan *et al.* (2011) identified a number od socio-economic characteristics that influence fresh fruit and vegetable farmers' participation in contract farming. Findings of the study was based on the estimation of logit model, which shown that ownership, land size, education,perceive benefits, opportunityand price risk influenced farmers' participation.

2.2.4 Contract farming in poultry production

Poultry production under contractual agreements adopts the same general concept of contract farming as other commodities. In this regard, contractor companies provide farmers with inputs and technical assistance, while farmers are responsible for managing the flock and providing production factors. The companies also take ownership of the chickens (Glover & Kusterer, 1990; Knoeber & Thurman, 1995; Patrick, 2004).

The difference between contract farming in the poultry production and contract farming in other commodities lies on the payment settlement. Payment settlement in contract poultry production does not only depend on the base payment (contract price), but also on the additional income that is determined by the performance of the flock. The flock is generally evaluated on the efficiency of feed consumption through the feed conversion ratio (FCR) and the mortality rate. In this regard, contractor companies often provide performance incentives to encourage better flock performance. These performance incentives are determined by a set of performance standards, which are based on the performance of farmers participating under the same contract. Those who obtain the best flock performance provide the standard that other farmers are compared to (Knoeber & Thurman, 1995).

2.3 Biosecurity on Poultry Farms

The outbreak of Highly Pathogenic Avian Influenza (HPAI) in 2003 caused economic loss not only to poultry farmers, but also other stakeholders such as marketers and farm contract providers. Today, avian influenza remains a widely discussed issue in Indonesia. Apart from causing economic loss due to high mortality rates in poultry and a decrease demand in for poultry (chicken) meat, the spread of avian influenza in the country has the ability to become a global pandemic.

In a global overview on HPAI, the FAO reported a number of HPAI cases between April and June 2012. Six countries, including Bangladesh, India, Egypt, Cambodia, China and Indonesia, reported a total of 98 domestic poultry outbreaks. The last four countries also confirmed a total of nine human cases, while China reported a number wild bird cases (FAO, 2012).

The type of marketing system influences the likelihood of chickens on poultry farms and the market becoming infected with HPAI. The four poultry production sectors in Indonesia defined by FAO (2004), Sector 1 includes companies that market products commercially and have an industrial integrated system with high biosecurity standards, Sector 2 involves moderate to high biosecurity production systems for commercial poultry products. This sector includes hatcheries and DOC suppliers, and Sector 3 involves low to minimal biosecurity systems for the production of commercial poultry that are commonly sold to live bird markets. This sector also consists of broiler farms that are contracted to companies in Sector 1 and non-contract layer farms. Finally, Sector 4 includes backyard and village poultry production with minimal biosecurity standards. Products from this sector are usually consumed locally.

With low to minimal biosecurity systems, Sectors 3 and 4 have a higher risk of HPAI infections compared with Sectors 1 and 2. However, with each sector in the production system being related to another, there are chances of infection between sectors. The infection of poultry in Sectors 1 and 2 would have a greater impact on Indonesia's poultry trade, due to the larger poultry population of these sectors. Nevertheless, there is a new realisation of the importance of biosecurity implementation in Sector 3 and 4. Live bird markets where poultry from Sector 3 is sold are considered to pose a potential threat of disease contagion.

The United Nation's Food and Agriculture Organisation – FAO (2003, p2) defines biosecurity as "a strategic and integrated approach that encompasses the policy and regulatory frameworks (including instruments and activities) that analyse and manage risk in the sectors of food safety, animal life and health, and plant life and health, including associated environmental risk".

The FAO (2003) further suggests that there are three main biosecurity measures in agriculture. Firstly, protecting the agricultural production system in which the livelihood of producers and other parties dependent on agriculture may be disrupted by the spread of disease. Secondly, protecting human health and consumer confidence from health risks, and thirdly protecting the environment and obtaining sustainable production through effective implementation of biosecurity.

With regard to poultry operation, Zander (1997) considers biosecurity to be measures that are implemented in order to prevent viruses, bacteria, fungi, protozoa, parasites, insects, rodents and wild birds from endangering the well-being of the poultry flock. Such preventative measures are key to good flock performance.

The adoption of biosecurity in poultry farms is highly dependent on the conditions of individual farms. It is recommended that poultry farms located near live poultry markets and densely populated areas tighten biosecurity measures. This is due to the higher risk of HPAI transmission in farms close to the live poultry trade. According to Sims (2007), there are a number of risks of HPAI spread in Indonesian poultry farms. These risks, which include unclean vehicles, containers, catching equipment, egg trays, production units and packaging materials, may have caused the HPAI epidemic in Indonesia between 2003 and 2006. Moreover, the import of hatching eggs and day old chicks (DOC) from other parts of Indonesia is another risk to be considered. There is the possibility that the vehicles used to transport these goods are contaminated.

Barcelo and Marco (1998) suggest three risks with regard to farm biosecurity, namely non-movable risks, movable risks and internal risks. Non-movable risks include loading bays, fencing and main entrances that are highly exposed to disease contamination. Movable risks include feed, waste management and water. Internal or on-farm risks cover actions regarding methods of pest control, handling of sick poultry and disposal of dead poultry.

The identification of risks on poultry farms assists farmers and other stakeholders in having a better understanding of biosecurity. This may result in a change of behaviour with regard to better farm management, which in turn can lead to a reduction of disease risk in the poultry marketing chain. In addition, education from extension officers can be a means of ensuring that farmers are aware of the importance of HPAI control for the country and the world. Apart from educating farmers about biosecurity through extension workers, contractual agreements between farmers and contract providers can be seen a way of improving the implementation of biosecurity on poultry farms by reinforcing the role of biosecurity measures in production.

Cunningham and Fairchild (2009) suggest a number of standard measures that poultry farmers may adopt. Firstly, one of the most serious threats to biosecurity is transportation of disease by humans. Keeping farm visitors to a minimum is one method of reducing disease risk. Farmers should also provide appropriate sanitised clothing and footwear for visitors. Secondly, poultry farmers and other staff working on the farm should limit their visits to other farms. If a visit to other farms is necessary, farmers should ensure to change clothes before and after entering the premises, and clean any vehicles used. Thirdly, keeping all animals out of poultry sheds is essential as animals may be carriers of poultry diseases. Moreover, it is important to keep poultry sheds or houses as secure as possible from wild birds, since wild birds feeding from poultry sheds may cause HPAI to spread. Fourthly, poultry farmers should avoid contact with non-commercial poultry such as backyard or village chickens. These types of poultry are usually not fully vaccinated and are therefore an extremely high risk. Fifthly, poultry should be checked daily. Sick and dead poultry should be handled appropriately, by separating sick birds from the flock and disposing of dead birds. Finally, keeping poultry sheds and houses clean from weeds and litter will reduce the number of pests, such as rodents, that may contaminate the farm.

HPAI control methods that one poultry farmer adopts may be different to those of another poultry farmer. The types of biosecurity measures implemented by farmers are influenced by a number of factors (Susilowati, 2011). These factors include possible loss of production and income, experience of farmers in poultry production, farm size, marketing and management systems, availability of capital and resources, importance of poultry as an income source, and type of farm (broiler or layer). Furthermore, the characteristics of farmers, such as experience in poultry production, age and education, influence a farmer's decision about controlling HPAI. The more experienced a farmer, the higher the chances of biosecurity adoption (Susilowati, 2011).

Aside from the aforementioned farmer characteristics, the availability of capital and support may also influence adoption. Poultry farmers in Indonesia, especially in Sector 3 and 4, are smallholders. This means that their production systems are less efficient compared to those in Sectors 1 and 2. Production costs in smallholder poultry farms are higher compared to larger poultry companies, due to the fewer number of sharing the production. This in turn influences the availability of capital to invest in biosecurity measures. A farmer therefore may have insufficient incentive to bear the full cost of the adoption of biosecurity measures, especially when they only receive part of the profit (Hennessy, 2008). In this case, it is necessary for the government and other related stakeholders, such as contract providers, to not only promote biosecurity, but also support farmers in the adoption process.

2.4 Summary

This section has discussed the general theory of contract farming, including definition of contract farming, types of contracts and benefits of participating in contract farming. A number of studies on discrete choice model application in contract farming participation has also been reviewed. Findings of previous studies has shown a number of common significant variables that can be considered in the present study. These variables include age, education, experience, farm size and farm income. The importance of biosecurity to reduce disease risks on poultry farms has been elaborated. This review on the literature provides guidelines for methods of analysis for this study.

CHAPTER 3: METHODOLOGY AND DATA

3.1 Introduction

The previous chapter has reviewed theoretical concepts of contract farming and empirical studies on discrete choice problems, both of which guide the analysis of the research questions in the present study. The chapter also presented a discussion on the impact of HPAI which leads to a realisation of the importance of biosecurity on smallholder poultry farms. This chapter discusses sample selection and methods of obtaining primary data. Models and approaches employed in the investigation are then developed and explained. Independent and dependent variables considered in this study are also defined. This chapter concludes with a summary of the characteristics of respondents.

3.2 Study Area and Sample Selection

The ACIAR project, *Cost-effective biosecurity for Non-industrial Commercial Poultry Sector (NICPS) operations in Indonesia*, has conducted pilot studies to test methods of encouraging biosecurity implementation in three provinces in Indonesia; Bali, West Java, and South Sulawesi. This project aims to define effective and efficient biosecurity measures for NICPS operations and raise the awareness of disease risk along the poultry market chain. The improvement in productivity from reduced disease risk is expected to increase farm income. Based on this ACIAR project the present study has been integrated into the Bali activities. Farmers from six *kabupaten* (regencies) in Bali were included in this study. These regencies were Tabanan, Badung, Gianyar, Klungkung, Bangli and Karangasem (Figure 3.1).

Bali is located between the islands of Java and Lombok. It is the 17th largest province among a total of 33 provinces across Indonesia. As shown in Figure 3.1, the island is divided into eight regencies, with Denpasar as the capital city. According to the census conducted in 2010, the population of Bali is 4.22 million people. Unique to the Muslim dominated country, Bali is home to the majority of Indonesia's Hindu population. With a total estimated land area of 5,632 km^2, the island is approximately 152 km wide from east to west, and spans approximately 112 km from north to south (BPS, 2012).

Figure 3.1 Map of Indonesia and Bali

Table 3.1 summarises the land use of each regency in Bali. The land is segregated into two categories; land used for agricultural purposes and land used for non-agricultural purposes. Denpasar has the smallest amount of land compared to other regencies. Being the capital city and the centre of business activities, the land used for non-agricultural operation is almost triple of that used for agricultural production. Buleleng covers the largest area in Bali, with approximately 81,000 ha of land used for agriculture and 55,000 ha utilised for buildings and state forests. Tabanan, known as the centre of rice production and broiler operations, has the second largest land use for agriculture.

Table 3.1 Land use by regency/municipality, 2011

Land use (ha)	Regency/municipality								
	Denpasar	**Jembrana**	**Tabanan**	**Badung**	**Gianyar**	**Klungkung**	**Bangli**	**Karangasem**	**Buleleng**
1. Agricultural land	**3,113**	**32,687**	**62,483**	**28,192**	**27,276**	**23,182**	**36,370**	**60,678**	**81,418**
a. Paddy irrigated land	2,597	6,836	22,435	10,243	14,732	3,845	2,910	7,154	10,992
• semi technical irrigation	2,597	6,714	18,003	10,208	14,410	3,845	2,776	4,555	9,436
• simple irrigation by Public Works Department	0	47	2,615	35	243	0	0	1,337	893
• traditional irrigation	0	0	1,817	0	79	0	134	1,131	562
• others	0	75	0	0	0	0	0	131	101
b. Non paddy irrigated land	516	25,851	40,048	17,949	12,544	19,337	33,460	53,524	70,426
• field (*tegal/kebun*)	396	9,458	15,604	8,211	11,248	7,313	20,663	17,676	37,422
• estate crops	35	15,162	22,593	6,430	7	6,025	8,841	29,533	31,834
• wood land	75	0	1,784	1,682	1,116	5,992	3,945	4,272	775
• sea fish pond	5	261	0	0	10	2	0	19	302
• fish pond	5	5	43	31	161	2	11	35	8
• grassland	0	0	0	0	2	0	0	0	0
• temporarily not used	0	0	24	231	0	0	0	716	85
• others	0	965	0	1364	0	3	0	1273	0
2. Non agricultural land	**9,665**	**51,493**	**21,450**	**13,660**	**9,524**	**8,318**	**15,711**	**23,276**	**55,170**
• house, building and land surroundings	7,950	6,224	6,062	8,139	5,250	1,332	3,326	2,295	5,566
• state forest	583	42,935	10,792	1,417	0	1,048	9,341	14,530	44,681
• swamp	0	121	0	0	0	1	0	0	30
• others	1,132	2,213	4,596	4,104	4,274	5,937	3,044	6,451	4,893
Total	**13,294**	**110,031**	**123,981**	**59,801**	**49,344**	**50,837**	**85,541**	**137,478**	**207,014**

Source: Bali in Figures, BPS 2011

A total of one hundred contract broiler farmers, participating in seven companies, were selected as part of the study. Farmers were not randomly selected, as the sample contractor companies provided the list of farmers to be interviewed. The selection of these farmers provided information on the factors that influence farmers' selection of contractor company. Six contracts were obtained to assist the analysis of bonus reward systems for the adoption of biosecurity. Each contract represented one contractor company involved in the study. Due to confidential considerations, one contractor company was reluctant to provide their contract.

A farmer was selected as a basis for determining assumptions on farm performance which include information on population of cohort, feed consumption, actual mortality rate, and actual feed conversion ratio. These assumptions are displayed in Appendix 1 and were used in the evaluation of bonus systems for biosecurity adoption.

3.3 Data Collection

To examine the previously discussed hypotheses of the study, a data set is required that would:

1. estimate the influence of independent variables on the selection of contractor companies;
2. evaluate the contract reward systems that encourage biosecurity adoption.

Data were collected through a survey conducted on contract broiler farmers in July 2012. The survey form was constructed to obtain both quantitative and qualitative data. The quantitative data were direct the variables used in the investigation of the research objectives, while the qualitative data supplemented the quantitative data by providing background information on the context of study. As seen in Appendix 2, the survey form had six sections as follows.

1. Basic information

   This section obtained general information on farmers. Information obtained included key variables of the farmers' characteristics (case-specific variables).
2. House and other assets

   Information on house tenure, ownership of land and livestock, access to credit and non-broiler income was obtained from this section.

3. On-farm decision making

   This part of the survey collects qualitative data on decisions made on-farm and who makes them. The role of both farmers and contractor companies is revealed in this section.

4. Infrastructure and investment

   This section elicits information on both biosecurity implementation on the farm and contractual agreements between farmers and contactor companies. In this regard, information on biosecurity implementation is related to the infrastructure of the farm, including distance of farm to potential source of disease risk. Data on contracts in this section is related to initial investments that farmers have to make before participating in a contract with a contractor company.

5. Poultry management

   This section was designed to provide data on the last completed cohort before the interview. Data obtained included the number of chickens sold, source of inputs and methods of managing sick birds.

6. Contract

   The last part of the survey was developed to obtain data on the contracts in which farmers are involved. This includes the number of contracts farmers have participated in, their current contractual agreements, types of bonuses provided by the contractor companies for better cohort performance, and farmers' perception of biosecurity adoption.

A number of preliminary preparations to eliminate biases were conducted prior to the survey. A pilot study was conducted in Selanbawak village, in Tabanan regency, to test the survey form. Five broiler farmers participating in two contracts were interviewed. Identified biases in the survey form were corrected accordingly. Furthermore, enumerators involved in the survey were trained by the researcher to ensure uniform understanding of questions in the survey form. In addition, broiler farmers were interviewed at home, instead of at the farm, to avoid enumerators potentially spreading disease from one farm to another. Each interview lasted approximately 45 to 60 minutes.

3.4 Model Specification

The two research objectives, discussed in Chapter One, have different approaches. Analysis of the factors affecting farmers' selection of contractor company employs an econometric approach, which includes the estimation of a multinomial logit model, a conditional logit model and a mixed model. A review of this econometric approach is presented first. After that, farmer gross margin analysis is developed for the evaluation of the contract bonus system that best reward farmers for biosecurity adoption. Definition of bonus types and methods of estimation are presented following a discussion on the econometric approach. A discussion on price conditions and scenarios considered in the gross margin estimation concludes this section.

3.4.1 Econometrics approach

Hill *et al.* (2008) assert that in the general theory of microeconomics, many of the choices made by companies and individuals cannot be measured by a continuous outcome variable. McFadden (1973) and Train (2003) suggests that maximum likelihood models such as logit and probit are generally used to explain discrete dependent variables that are closely associated with choice outcomes. Furthermore, logit and probit models are commonly employed for non-linear cases, where ordinary least square (OLS) regressions result in biased and inconsistent estimates.

The difference between logit and probit models lies in the distribution of the data set. The first method is based on the standard normal distribution, while the latter is centred on the logistic distribution (Doran, 1998). There are no theoretical grounds to justify the preference of choice between the two models. Most economists find that results do not vary between the two techniques. Logit models are popular because of their practicality and simplicity (Hoffman & Duncan, 1988; Gujarati, 1995; Doran, 1998; Greene, 2003; Hill *et al.*, 2008), and for this reason, logit models are employed in the present study.

In real life, individuals are not exposed to only ‘yes or no’ binary choices, but also face multiple choice situations. Examples of multiple choice situations include participation in the labour force (Boskin,1974; Long & Freese, 2006), consumer choice of soda drinks (Hill *et al.*, 2008), modes of commuting to work (Greene, 2003), and demographic analysis (Hoffman & Duncan, 1988). Logit model estimation, which was originally used to explain binary choice probability, has been further developed by econometricians to accommodate problems with multiple choice categories. These variations of the logit model include multinomial logit, conditional logit, mixed logit and nested logit (McFadden, 1973; Hoffman & Duncan, 1988; Greene 2003; Train, 2003; Hill *et al.*, 2008).

This section puts forward three logit models that were used in the examination of factors influencing the selection of contractor companies by broiler farmers. As multinomial and conditional logit models are both restricted by the independence of irrelevant alternatives (IIA) assumption, a review on methods of testing this limitation is also presented.

Multinomial logit model

Long and Freese (2006) consider multinomial logit to be simultaneous estimations of binary logit for comparisons of all choice categories. In addition, the model assumes that the data set is case-specific (Greene, 2003; Long & Freese, 2006), implying that the individual is considered as the unit of analysis, where individual characteristics are determined as independent variables (Hoffman & Duncan, 1988).

The constant nature of case-specific variables across alternatives results in the variables have a varied impact on each choice category. As such, the model estimates J-1 coefficients (β_i) for each independent variable, where J is the number of alternatives. The estimated coefficients demonstrate the effects on choice probability. The estimated coefficients show the choice probability of each alternative in relation to a choice set as a common benchmark (Hoffman & Duncan, 1988). Long and Freese (2006) refer to this alternative as the 'base category'. A number of methods can be utilised in the selection of the base category. The most popular and simplest technique is to select the alternative with the most number of observations. This method is employed in the present study, with the contractor company having the most selections being considered as the base.

The multinomial logit can be formally written as:

$$ln\Omega_{m|b}(X) = ln\frac{\Pr(y = m|X)}{\Pr(y = b|X)} = X\beta_{m|b}$$

(Hoffman & Duncan, 1988; Greene, 2003; Long & Freese, 2006) where:

b = base category

m = 1 to *j*, in which *j* = number of alternatives

x = case-specific independent variable

y = dependent variable

Pr = probability

Further, the predicted probability equation for the multinomial logit can be presented as

$$\Pr(Y = m|x) = \frac{\exp\,(x\beta_{m|b})}{\sum_{j=1}^{J} \exp\,(x\beta_{j|b})}$$

Similar to ordinary least square (OLS) regressions, hypothesis testing for coefficients can be conducted to describe the multinomial logit model estimates. The tests show whether the effects of all coefficients associated with a particular independent variable are simultaneously equal to zero. This assumption is generally referred as the null hypothesis (H_0) that imposes restriction on the model estimation. According to Long and Freese (2006) there are two techniques that can be employed in hypothesis testing. First, the likelihood ratio tests that involve: (1) fitting the full model, in which all independent variables are included; (2) fitting the restricted model that eliminates one or more independent variable, and (3) estimating the difference between the likelihood ratio of the full model and the restricted model. Second, the Wald test, which assumes that computed parameters fail to support the null hypothesis when there is a large difference between estimated coefficients and the expected value.

Due to the non-linear nature of the logit model, hypothesis testing of coefficients does not provide enough information on the magnitude of the effects of independent variables on the dependent variable. In fact, as previously discussed, hypothesis testing only demonstrates the simultaneous influence of the case-specific variables on the dependent variables. Long and Freese (2006) suggest that interpretations of the multinomial model should be based on predicted probabilities and functions of the probabilities, including the odds ratio and marginal effects.

From the previously discussed theory, the multinomial logit model in the present study can be applied as follows:

$$ln\Omega_{m|A}(X) = ln\frac{\Pr(y = m|X)}{\Pr(y = A|X)} = X\beta_{m|A} \qquad (1)$$

where:

A = base category (Contractor Company A)

m = 1 to *7*

x = case-specific independent variable

y = dependent variable

Similarly, the predicted probability for the influence of case-specific variables on the selection of contractor companies is defined as

$$\Pr(Y = m|x) = \frac{\exp(x\beta_{m|A})}{\sum_{j=1}^{J} \exp(x\beta_{j|A})} \qquad (2)$$

To obtain an understanding on the factors that affect farmers' selection of contractor companies, the dependent variable and a number of case-specific independent variables were considered and defined in Table 3.2.

Table 3.2 Definition of dependent and case-specific variables

Variable	Definition	Measurement	Expected sign
Dependent variable (Y):			
CHOICE	represents the selection made by farmers among 7 companies (contractor company A-G) involved in the broiler industry in Bali	dummy variable where: 0 = contractor company not selected 1 = contractor company selected	positive
Case-specific independent variable (X):			
AGE	age of broiler farmers	years	negative
EDUC	formal education received by the farmers	years	positive
EXPER	farmers' experience in chicken rearing	years	positive
OCC	farmers' main occupation, which is based on the amount of time spent or how the farmers perceive themselves.	dummy variable that comprise of: 1 = farmer 2 = poultry raiser 3 = government 4 = private sector 5 = trader 6 = service	negative
INC2	non-broiler income per annum	Rupiah (Rp.)	negative
FSIZE	farm size	number of chicken	positive

Conditional logit model

The conditional logit model, developed by McFadden (1973), has been utilised to describe choice behaviour cases, including the choice of mode of shopping, the choice of shopping destination, and thefrequency of shopping trip. Although conditional logit has many similarities with multinomial logit in terms of statistical properties, Hoffman and Duncan (1988) suggest that conditional logit is not merely an alternative for estimating the models that currently employ multinomial logit, but rather is designed to estimate a different class of models that focus on the characteristics of the alternatives.

In this model, the predicted probability of observing outcome *m* can be formally written as

$$\Pr(Y_i = m|z_i) = \frac{\exp\,(z_{im}\gamma)}{\sum_{j=1}^{J}\exp\,(z_{ij}\gamma)} \quad ; \text{ for } m \ = \ 1\ to\ j\,, j = number\ of\ alternatives$$

where z_{im} consists of the values of the independent variables for alternative *m* for case *i*; and γ is a parameter depicting the effect of z_{im} on the probability of choosing one alternative. Similarly to the multinomial logit model, estimates of the conditional logit model are generally interpreted based on predicted probabilities and odds ratios as functions of the probabilities.

Table 3.3 summarises and defines the alternative-specific variables considered in the present study. The dependent variable is still defined as *CHOICE*, which represents farmers' selection of contractor company. From the above theory, the predicted probability of selecting Company A, which represents the selection of Contractor company A, can be presented as follows:

$$\Pr(Y_i = A|z_i) = \frac{\exp\,(z_{iA}\gamma)}{\sum_{j=1}^{J}\exp\,(z_{ij}\gamma)} \qquad (3)$$

where z_i includes *SIZE, PRICE* and *BONUS*. Similar formulations can be made with Contractor companies B to G.

Table 3.3 Definition of alternative-specific variables

Variable	Definition	Measurement	Expected sign
Alternative-specific independent variable (Z):			
SIZE	size of contractor company	dummy variable, where: 0 = small (local contractor company) 1 = big (multinational or national contractor company)	positive
PRICE	average contract price provided by the contractor companies	Rupiah (Rp.)	positive
BONUS	type of bonus rewarded to farmers for better flock performance; which include price bonus and performance incentives	number of bonuses	positive

Mixed model

The mixed model is an approach that allows estimation of the combined effects of both case-specific and alternative-specific variables on the dependent variable. As previous models exclusively focus on either farmers' characteristics or contractor companies' characteristics, the mixed model serves as a function of both characteristics. Compared to both multinomial logit and conditional logit, this model relaxes the IIA assumption, which makes the model more applicable and realistic. The mixed model can be estimated in numerous ways. First, the model may be estimated under a simulation of log likelihood, utilising the Halton Draw (Train, 1999; Hensher & Greene, 2001). Despite technological advances in statistical analysis packages, the estimation for a mixed logit with this technique is often time consuming due to its complex nature. Second, Long and Freese (2006) suggest a simpler and arguably more preferable approach in developing the mixed model. Computation is conducted by fitting the multinomial logit model into the conditional logit model. Using the STATA software package, which allows this method of estimation, the present study adopts the second technique.

The predicted probability of the mixed model can be presented as follows.

$$P_{ij} = \sum_{k=1}^{J} \frac{\exp\left(X_i\beta_j + Z_{ij}\alpha\right)}{\exp(X_i\beta_k + Z_{ik}\alpha)} \qquad (4)$$

where X_i represents all the case-specific independent variables summarised in Table 3.2 and Z_i depicts all alternative-specific variables defined in Table 3.3.

Independent of Irrelevant Alternatives (IIA)

Multinomial logit and conditional logit are both restricted by the Independent of Irrelevant Alternatives (IIA) assumption. This assumption implies that the inclusion or exclusion of alternatives does not influence the odds of selecting other alternatives (Greene, 2003; Long & Freese, 2006). In relation to the present study, the removal of one contractor company from the broiler industry in Bali should not affect the probability of farmers selecting other companies.

In general, there are two methods of testing the IIA assumption, namely the Hausman-McFadden test (1984) and the Small-Hsiao test (1985). The IIA test compares coefficient estimates from the full model and the restricted model. The full model includes all alternatives, while the restricted model excludes one or more alternatives. A significant test statistic indicates the violation of the IIA assumption, which implies that the multinomial or conditional model is inappropriate for the case (Long and Freese, 2006). When multinomial and conditional logit are not applicable, models that relax the IIA assumption can be implemented, such as the mixed logit model and the nested logit model.

The satisfaction of the IIA assumption in this study implies that contract broiler farmers have a strong preference for one particular contractor company. This also shows that in the process of selecting contractor companies, farmers take into consideration all contractor companies available.

Heteroskedasticity

Heteroskedasticity is a condition where variance in the error term is observed. The basic assumption for OLS and logit models, including multinomial logit and conditional logit, is that the variance of error term is constant:

$$v(\varepsilon_j) = \sigma^2$$

Heteroskedasticity causes standard errors to be biased. OLS and logit models assume independent and identically distributed (iid) implying there is no variance in the error term. Heteroskedsticity can be treated in a number of ways including estimating the weighted least squares and robust standard error (Hill *et al.*, 2008).

3.4.2 Gross margin approach

This section presents the models used in exploring the contract bonus reward systems. In order to determine which contract best rewards farmers for biosecurity adoption, farmer gross margin models were developed. Gross margin can be defined as the difference between income generated by the enterprise and the variable costs associated with the production of the enterprise (Kay & Edwards, 1994; Malcom *et al.*, 2005).

Gross margin models of the contract reward systems comprise of a number of components, including:

1. Farmers' revenue, which is derived the sale of live birds (kilogram of live birds multiplied by the contract price).
2. Production expenditure, which includes the costs for day old chicks (DOC), feed, and vaccine and other chemicals.
3. Bonuses, which variy among contracts. These include the FCR bonus, market price bonus, European efficiency factor (EEF)/ indicator of flock performance (IP) bonus, mortality rate bonus, and production compensation (defined in the following section).
4. Extra biosecurity costs, which consist biosecurity investments required to attain biosecurity product ('Healthy Farm') certification. These costs are extra biosecurity costs that are required to reach a standard of biosecurity implementation. These costs are obtained from a biosecurity farm plan developed by the ACIAR project, which comprise of cohort costs, overhead costs, annual costs, training costs and certification costs.

In the wake of an interest in developing a niche market for poultry products from biosecure farms, the ACIAR project worked to establish a clean market chain for meat and eggs from certified biosecure farms in the study area. Products are sold under the 'Healthy Farm' logo at premium prices in the supermarket. Farm biosecurity plans were developed to set a standard of biosecurity measures for farms that become part of the clean market chain. Extra biosecurity costs applied in this study derived from this biosecurity farm plan. In this regard, extra biosecurity costs are defined as additional costs required by the farmers to achieve the standard biosecurity implementation for farm certification.

Bonus types

Bonus types investigated in this study can be categorised into two groups. First, the price related bonuses, which includes the existing market price bonus and the added bonus of price peremiums received for selling 'Healthy Farm' products in supermarkets. Second, the flock performance related bonuses which include FCR, EEF/IP, mortality rate, and production compensation bonus. Methods of estimation and definitions of these bonuses are as follows:

1. Market price bonus

   Market price bonus, later referred to as 'premium' after the investment of extra biosecurity measures, is a portion of the difference between market/retail price and the contract price offered by the contractor company. This bonus is rewarded to the farmers under two conditions: the market price must be higher than the pre-agreed contract price, and the performance of the flock satisfies the company's standards. Farmers with better flock performance receive a higher percentage of the difference between the two prices. Currently, contract companies do not provide a bonus for biosecurity adoption *per se*. In the present study, it is assumed that biosecurity premium is accommodated by the market price bonus.

2. Feed conversion ratio (FCR) bonus

   FCR measures the efficiency of the flock in converting feed into meat. FCR is generally estimated to determine the magnitude of other bonuses, including the market price bonus and the mortality rate bonus. FCR of the current flock is estimated using the following method.

$$FCR = \frac{total\ feed\ consumption(kg)}{total\ live\ bird\ weight\ at\ sale\ (kg)} \qquad (5)$$

3. European Efficiency Factor (EEF)/Index of Performance (IP) bonus

   EEF/IP is another production efficiency measurement, which is also utilised as the basis for determining other bonuses. Besides this, some contractor companies consider the EEF estimate as a bonus in itself. The present study employs the following method to calculate EEF/IP.

$$EEF(IP) = \frac{(livability\ (\%)\ \times average\ weight\ per\ bird\ (kg))}{actual\ FCR \times age\ at\ sale\ (days)} \times 100 \qquad (6)$$

4. Mortality rate bonus

   Mortality rate can be considered as a direct measurement of flock performance, as it estimates the number of deaths in a cohort. In general, contractor companies impose a standard allowable maximum flock mortality rate on contract farmers. Farmers who satisfy this requirement receive a bonus per kilogram of live bird sold. Those farmers who fail to maintain good flock performance and exceed the standard mortality rate, will not receive this bonus.

5. Production compensation

   Some contractor companies provide compensation to the farmers for managing the flock up to the sale date. This compensation is also paid to farmers when the sale schedule goes beyond the pre-agreed schedule due to a changes in market demand. Furthermore, production compensation is based on the age of chickens at sale. In general, contractor companies compensate farmers for every kilogram of chicken sold.

Pricing schemes

Contract models developed in this study considered two pricing conditions and four scenarios, defined as follows.

1. Generic price

   This pricing scheme imposes the same price conditions on all contracts. Input prices and contract prices are set as the average of all contracts. The purpose of this pricing scheme is to reveal the bonus structures of each contract in a way that is comparable.

2. Actual price

   To obtain the real bonus reward mechanisms of each contract, this pricing scheme was developed based on actual input and contract prices. As the general structure of reward systems is explored in the first pricing scheme, the actual price scheme serves to reflect the actual conditions of each contract. With input and contract pricing varying across contracts, this pricing condition serves to reveal the effects of different prices on gross margin.

Scenarios

1. Scenario 1 – No major disease outbreak
   This scenario depicts broiler production at a normal condition, where disease outbreak is not present and a difference between market price and contract price is observed, leading to the reward of a market price bonus.
2. Scenario 2 – Market price and contract price have the same value
   Market price bonus contributes a significant amount to farmers' additional income. The absence of a difference between market price and contract price may result in farmers depending entirely on the premium that is obtained when biosecurity is implemented. Under this circumstance, the magnitude of the effects of the market price bonus on farmers' gross margin is explored.
3. Scenario 3 – Loss of 50% of cohort
   This scenario demonstrates a condition where disease outbreak results in the loss of half of a cohort. The loss of a proportion of a cohort will reflect the importance of biosecurity adoption.
4. Scenario 4 – Lost of an entire cohort
   This scenario is similar to Scenario 3, but depicts a more severe outbreak case, where farmers lose an entire cohort due to the lack of biosecurity implementation.

3.5 Characteristics of Respondents

The contract broiler farmer survey was undertaken in July 2012. It included the six *kabupaten* (regencies) of Tabanan, Badung, Gianyar, Klungkung, Bangli and Karangasem. Figure 3.2 presents the frequency, or number, of respondents in each regency.

Figure 3.2 suggests that more than half of the broiler farmers interviewed live in the Tabanan regency. This regency is known to be the centre of rice production in Bali, which also accommodates poultry production. Badung and Gianyar have fewer agricultural activities compared to Tabanan. The smaller distribution of broiler farmers in this area is in line with this notion. Furthermore, Klungkung and Bangli have similar profile, accommodating 13 % and 14 % of respondents respectively.

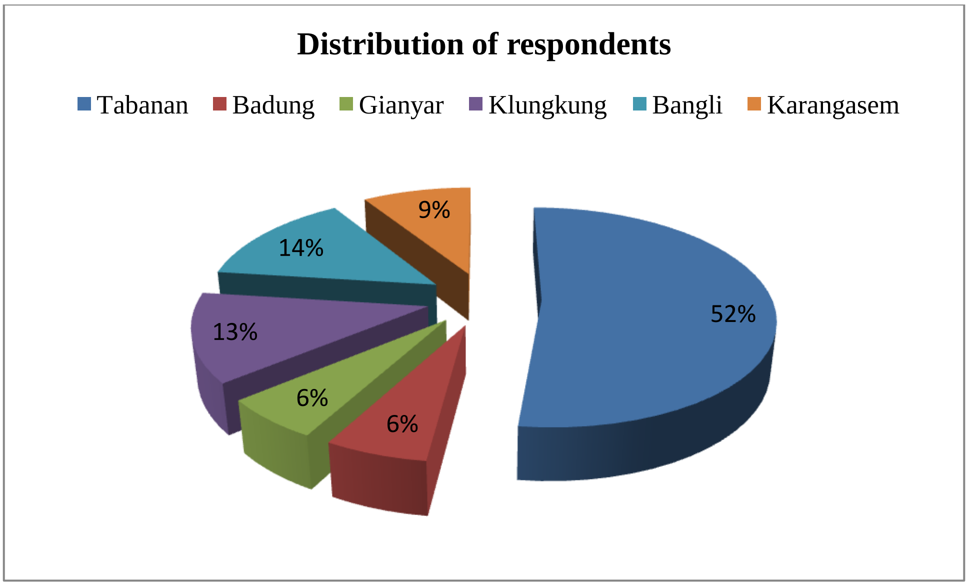

Figure 3.2 Geographical distributions of respondents

Table 3.4 summarises the characteristics of respondents. Farming experience is one of many independent variables considered to be important in poultry management. Experience in chicken rearing may influence farmers' selection of contractor company and their attitude towards biosecurity. Results from the survey show that farmers' experience varies from a minimum of 0.17 years to a maximum of 24 years, with a mean of 9.5 years.

The sample consisted predominantly of male broiler farmers, with 91 male and 9 female broiler farmers. The average age of farmers is 44 years, ranging between 26 and 66 years. Respondents were categorised into six main groups according to their main occupation. A total of 69 % of respondents participate in agricultural activities as farmers or poultry growers. The same number of farmers who work in the government also work in the private sector (11 %). In addition, respondents earn approximately Rp. 58.7 million (approximately 5,870 AUD) per annum from non-broiler income sources.

Broiler farmers selected have an average of eleven years of formal education. This implies that on average the farmers receive education up to senior high school. This further implies that respondents have satisfied the essential nine years of education promoted by the Indonesian Government. Furthermore, a number of farmers have also obtained a bachelor degree from a university.

The number of people living within the respondents' household varies from a minimum of two people to a maximum of ten people. A household comprising many families is common in Bali. Furthermore, an average of one person works in the broiler farm full or part-time. A similar profile is demonstrated by non-family members. The number of people working part-time on the farms usually increases at sale time.

Table 3.4 Characteristics of respondents

Variable	Observation	Mean	Standard deviation	Min	Max
Farming experience (year)	100	9.46	5.99	0.17	24
Gender (people):	100	1.09	0.29	0	1
Male	91				
Female	9				
Age (year)	100	43.98	9.19	26	66
Occupation (people):	100	2.51	1.30	1	6
Farmer	15				
Poultry raiser	54				
Government	11				
Private sector	11				
Trade	3				
Service	6				
Education (year)	100	11.42	3.02	1	16
Number of people living in the house (people)	100	7.24	5.23	2	10
Family member working full time in the farm (people)	100	1.34	0.62	0	4
Family member working part time in the farm (people)	100	0.76	1.05	0	7
Non-family member working full time in the farm (people)	100	0.46	0.88	0	4
Non-family member working part time in the farm (people)	100	0.87	1.51	0	10

Tables 3.5 and 3.6 provide information on house and asset ownership. The majority of respondents (76 %) have full ownership of their house, while 22 % have partial ownership. Furthermore, no respondents were renting a house, while only two respondents live in a relative's house with no payment.

Table 3.5 House tenure respondents

House tenure	Number of respondents
Partly owned	22
Fully owned	76
Rent	0
Borrow	2

At an average value of approximately Rp. 743 million, broiler farmers own a total average of 0.34 ha of dry land. The average area of irrigated land owned by the respondents is 0.28 ha. Furthermore, broiler farmers in the sample also raise cattle and pigs. The average value of cattle and pig is approximately Rp. 13 million and Rp. 10 million respectively. Many respondents own village chickens and ducks, despite the fact that back yard poultry may be a source of disease risk to the flocks raised in the farm.

Table 3.6 Other assets owned by the respondents

Assets	Total Average	Average value (Rp.)
Dry land (ha)	0.34	743,026,904
Irrigated land (ha)	0.28	555,222,222
Cattle (head)	1.13	13,375,000
Pig (head)	4.46	10,382,753
Village chicken (head)	11.26	5,803,035
Duck (head)	0.63	33,950

3.6 Summary

This section has described the study area and method of sample selection, where a total of 100 broiler farmers partnering seven contract companies were selected from various regencies in Bali. Data were collected from farmers using a formal survey questionnaire and interview. Furthermore, independent and dependent variables were defined. The econometric approach employed in this study has been explained though the application of three logit models. Dependent and independent variables have also been defined. The farmer gross margin approach has been presented with definitions of bonus types, pricing conditions, and scenarios to be evaluated.

CHAPTER 4: FARMERS' SELECTION OF CONTRACTOR COMPANY

4.1 Introduction

In this chapter, results from analysis of the factors affecting farmers' selection on contractor company will be presented. First, background information on broiler contract system is put forward. This includes a review on the type of contract observed in the study, role of farmers and firm in poultry management, and benefits and risks of contract participation. This is followed by discussions on factors that affect farmers' selection of contractor company, which is organised into three main investigations. The effects of case-specific variables on contractor company selection is first considered, followed by alternative-specific variables, and an integration of both case and alternative specific variables incorporated in a mixed model. The chapter is concluded with an independent of irrelevant alternatives (IIA) test and treatment for heteroskedasticity.

4.2 Contract Type and Initial Investment

A number of studies have discussed the nature of unwritten contracts between farmers and companies (Singh, 2005; Barret *et al.,* 2012). These informal contractual agreements are known to be more flexible than their written counterparts, in terms of the role of each stakeholder. However, this study has discovered that 96 % of respondents do actually sign a formally written contract. Furthermore, there is no uniformity with regards to the length of the contract. Broiler contracts may be written for a single sale, for all sales in a specified time period, or until a party chooses to terminate the contract.

In general, contracts investigated in the study fall under the category of production contracts. There are two distinct types of formal contracts observed in the sample. These contracts can be referred as 'initial' contract and 'cohort' contract. An initial contract specifies the agreement of business cooperation between the farmer and the contractor firm and is usually signed at the time of participation. General responsibilities of both parties are specified in this contract. Inputs including DOC, feed, and vaccine are provided by the firm, while labour, sheds, equipment, and other production factors are provided by the farmers. This specification of responsibilities is in line with the findings of Glover and

Kusterer (1990), Glover and Ghee (1992), Knoeber and Thurman (1995), Setboonsarng *et al.* (2006), and Barrett *et al.* (2012).

A cohort contract specifies the prices for each kilogram chicken (contract price) and inputs for each cohort. Although the majority of respondents claimed to have signed an initial contract, eleven farmers (11 %) did not actually sign a formal agreement. With regards to cohort contracts, 69 % of respondents signed a contract and receive a new contract for every new cohort. The majority of broiler farmers, who do not receive a new contract for each cohort, will receive one when changes in contract and input prices are observed. Furthermore, almost a quarter of respondents are provided with a new contract at request. When all input costs have been accounted for, farmers receive their payments, which take place between one to three weeks after sale. The majority of farmers in the sample receive payments within one week from sale period.

A deposit to the contractor company is given as an assurance of the farmer's loyalty to the contract provider. A majority of the respondents (80 %) were obliged by the firms to provide collateral. The provision of this collateral is usually in the form of vehicle certificates. Only four percent of the respondents stated that cash is required. However it has been observed that this deposit system does not prevent farmers moving from one company to another. Survey results show that within the last five years, 44 % of farmers have changed companies at least once. This termination of contract by the farmers is caused by a decrease in income and unsatisfactory provision of inputs.

Broiler contract companies impose penalties on those who do not meet the contractual agreements. Penalties vary from a simple warning to the termination of the contract. Companies may also decrease the provision of DOCs for a certain time period, if farmers fail to produce the required quality of product.

Table 4.1 summarises the investments required by the farmers, prior to joining the contractor firm. All respondents are required to invest in sheds before participating in a contract. Firms generally inspect these sheds for the size, capacity and materials, to ensure a good environment for the broilers. Equipment such as feeders, drinking containers and brooders are also purchased at the beginning of the contract.

Little attention is given to biosecurity related investments. Biosecurity implementation can be measured in the presence of several investments including secure boundary fence, entrance lock, designated parking, car wash area, high pressure pump, signage and footbath (Susilowati, 2011). The majority of farmers are not required to invest in a secure boundary fence, a designated parking area, a car wash area, a high pressure pump, or signage. Although many contract companies oblige farmers to build footbaths, there are no penalties imposed on those who disregard this advice. In cases where provision of footbath is satisfied, the facility is seldom used for reducing disease risk. Disinfectants in footbaths are not changed frequently and visitors or shed managers can easily enter the farm and shed without using the footbath. The lack of investment in biosecurity suggests that the adoption of biosecurity is not a prerequisite for joining the contract company. With regards to shed repairs and maintenance, respondents have spent on average approximately Rp. 7 million in the last 12 months. As farmers have the responsibility to provide labour and production facilities, the costs of repairs and maintenance are borne by the farmers.

Table 4.1 Initial investments by farmers prior to joining the contractor company

Investment	Yes	No
Shed	100	0
Equipment	93	7
Secure boundary fence	13	87
Entrance lock for farm and shed	53	48
Designated parking	17	83
Car wash area	0	100
High pressure pump	39	61
Signage	8	92
Footbath	62	38

4.3 The Roles of Farmers and Firms in Poultry Management

Production risks experienced by farmers may encourage participation in contract farming. However, managing poultry under a contract may result in farmers losing their independence in on-farm decision making. As mentioned in Chapter 2, farm management under a production contract is restricted to the standards imposed by the contractor company.

Table 4.2 presents the farmers' responses to questions concerning who makes on-farm decisions. The results show that financial reporting is generally made by the contractor company. In this regard, farmers receive income reports from companies after sale. This report includes input use and price, market price, contract price, and performance measurements including FCR and mortality rate. Contract providers also plan sale schedules and determine the contract price for live birds. In line with the contractual agreement, firms are responsible for the provision of input, animal health expertise, and vaccination program to ensure a good cohort performance.

Decisions regarding labour, such as hiring and allocating day-to-day tasks, are generally made by the owner of the farm. Permission for visitors and relatives to enter the farm is also commonly granted by the farmers. In line with the grower's responsibility to provide sheds, 95% of respondents make the decision for shed maintenance and investments.

Table 4.2 Distribution of respondents for on-farm decision making

Decision	Company	Owner	Manager	Company and owner
Hiring and firing labour	0	83	0	17
Financial reporting	63	34	0	3
When to sell chicken	89	4	6	1
Price of live bird	96	1	3	0
Allocating labour to day-to-day tasks	3	70	0	27
Purchasing poultry inputs	98	2	0	0
Permission for collector to enter farm	72	28	1	0
Permission for collector to enter shed	17	82	1	0
Permission for visitors (e.g. Department of animal husbandry, university, etc) to enter	11	89	0	0
Permission for relative of labourer or neighbour to enter farm	7	91	0	2
Investment in or maintenance of shed (e.g. spending money)	4	95	0	1
Vaccination program	99	1	0	0
Animal health expert provision	94	4	0	2

In general, on-farm management decisions are distributed between farmers and contractor companies. Although farm management practices are restricted by the company's standards, production advice becomes a trade-off that ensures better productivity. Production procedures and quality standards provide guidelines for contract farmers.

4.4 Benefits and Risks of Contract Participation in Broiler Production

Proponents of contract farming argue that managing enterprises under contractual agreements provides many advantages. This section puts forward the perceptions of 100 broiler farmers' on the benefits that can be obtained through contracting with a particular contract company. Factors such as access to credit, input, training, market, and size of the company are evaluated (Table 4.3).

Table 4.3 Benefits of contract participation

Benefit	Number of respondents
Access to credit	3
Access to high quality input	22
Access to training	1
Higher selling price	10
Guaranteed market	32
Increase income	1
Provision of input is on time	17
Friend/neighbour joining the company	16
It is a big company	31
Don't know	11
Others (management system, transparency and payment system)	26

Results from the interview show that a guaranteed market is the main driver of farmers signing up to a contract company. This corresponds with the general theory that contractor companies, with abundant information on the market, are able to provide broiler growers with better market access. Managing broilers under a contract means that not only do those farmers have a guaranteed market, but also the contract companies have a guaranteed quantity and quality of chickens.

The contract farming system allows the contract company to control the quality of the broilers to satisfy the market demand. Furthermore, with the assistance and advice from the contract company, farmers are able to access markets that farmers are unable to penetrate when managing their broilers independently. The contract guarantees a minimum price for each chicken produced. This implies that when the price of chicken in the market is lower than that of the contract, the contract company bears the loss. Culled or sick chicken will be purchased by the company at a lower price.

The size of the company is also an important factor that is considered by farmers when selecting a contract. The tendency to choose multinational and national companies over smaller local companies may be influenced by the reputation of the larger companies. Their experience in managing hundreds of broiler farmers across regions may attract farmers. The scale of the company may be the reflection of their success in the industry.

Access to high quality input also attracts farmers to join contract companies. In general, broiler companies obtain their inputs directly from feed mills, chicken breeders, and vaccine suppliers. The relationship between the contractor companies with input suppliers often means traceable inputs, which leads to consistent quality. Other factors has also been identified as potential benefits of joining a contractor company. These factors include the contract and management system of the company, transparency, on time payment and better service from the company's technical advisors.

Although there are numerous advantages in joining the contractor companies, there is evidence that there are also a number of risks. Problems experienced by the farmers during their contract may result in the change of contractor companies. Unsatisfied farmers are able to move from one contract company to another with ease. Table 4.4 presents risks of contract participation in the present study.

The table (Table 4.4) suggests that a majority of the respondents claim to have received poor quality DOCs and feed. Furthermore, 23% of respondents do not receive their inputs on time. Lack of training and transparency appears to be minor concerns for the farmers. However, with 11 % of farmers selecting the response, late payment is the third highest most important problem faced by farmers.

Table 4.4 Risks of contract participation

Risks	Number of respondents
No choice in accessing markets, technology, credit	3
Difficulty to meet the quality required by the contract	9
Difficulty to meet the quantity required by the contract	9
Difficulty in managing credit/capital that is provided	0
Access to training	1
Decrease in income	3
Lack of understanding/transparency in contract	1
Provision of input is not on time	23
Lack in quality of input (DOC, feed)	45
Depopulation of cohort	1
Late payment	11

4.5 Factors Affecting Farmers' Selection of Contractor Company

The main objective of this section is to identify the variables that affect farmers' selection of contract company. There are three approaches considered. First, the effects of case-specific independent variables are estimated by employing the multinomial logit model. Second, the influence of alternative-specific variables is estimated by utilising the conditional logit model. Finally, the combined effects of case-specific and alternative-specific variables are investigated by fitting the multinomial logit model into the conditional logit model, creating a mixed model.

4.5.1 The effects of case-specific variables on contractor company selection

The contractor companies considered in this study are assumed to be unordered, implying that there is no specific stratification for contract companies observed in the poultry industry. The dependent variable in this study is referred as *CHOICE* which represents the outcome of contract company selection made by the farmers. There is a choice between seven different contact companies. Furthermore, there are six case-specific independent variables considered. These are age (*AGE*), education (*EDUC*), farming experience (*EXPER*), occupation (*OCC*), non-broiler income (*INC2*), and farm size (*FSIZE*). Table 4.5 displays the multinomial logit estimations for the effects of case-specific variables on the dependent variable.

Table 4.5 Multinomial logit estimation

Choice	Coefficient	Original model		Treated model for heteroskedasticity	
		Standard error	p>│z│	Robust standard error	p>│z│
A	(base outcome)				
B					
AGE	-0.0520692	0.0437797	0.234	0.0460388	0.258
EXPER	0.2267777	0.0743106	0.002	0.0809044	0.005
EDUC	-0.1857221	0.1287488	0.149	0.1362984	0.173
OCC	0.9594042	0.3526661	0.007	0.3505132	0.006
INC2	0.0086672	-0.0138403	0.531	0.0121237	0.475
FSIZE	-0.0004517	0.0001912	0.018	0.0001929	0.019
constant	2.1705630	2.5971830	0.403	2.5679110	0.398
C					
AGE	-0.0611864	0.0501629	0.223	0.0407090	0.133
EXPER	0.1823476	0.0817692	0.026	0.0845311	0.031
EDUC	0.1459234	0.1718233	0.396	0.1918578	0.447
OCC	-0.0400073	0.4877936	0.935	0.4811374	0.934
INC2	0.0016753	0.0158575	0.916	0.0127454	0.895
FSIZE	-0.0001478	0.0001803	0.412	0.0001921	0.442
constant	-0.7277387	2.7436120	0.791	2.3983870	0.762
D					
AGE	-0.0475414	0.0574032	0.408	0.0513915	0.355
EXPER	-0.0510901	0.0955957	0.593	0.0912470	0.576
EDUC	-0.2399080	0.1857244	0.196	0.2120706	0.258
OCC	1.0346320	0.3907288	0.008	0.5256949	0.049
INC2	-0.0321783	0.0182060	0.077	0.0160594	0.045
FSIZE	-0.0006147	0.0002781	0.027	0.0003309	0.063
constant	5.2378880	3.6454860	0.151	3.4847240	0.133
E					
AGE	-0.0151071	0.0523539	0.773	0.0539495	0.779
EXPER	0.2754442	0.0907767	0.002	0.1088781	0.011
EDUC	0.0365300	0.1578437	0.817	0.1938952	0.851
OCC	0.6467003	0.4253791	0.128	0.5172961	0.211
INC2	-0.0060472	0.0184812	0.744	0.0199988	0.762
FSIZE	-0.0000783	0.0001815	0.666	0.0001806	0.665
constant	-4.5733170	3.0349300	0.132	3.1326990	0.144
F					
AGE	0.0051152	0.0508464	0.920	0.0464787	0.912
EXPER	0.0184020	0.0839422	0.826	0.0888205	0.836
EDUC	0.1078953	0.1744571	0.536	0.1553938	0.487
OCC	0.4361339	0.3956140	0.270	0.4068042	0.284
INC2	-0.0213283	0.0166395	0.200	0.0169355	0.208
FSIZE	-0.0004627	0.0002482	0.062	0.0002479	0.062
constant	-0.6876534	3.0463140	0.821	2.7927050	0.806
G					
AGE	-0.0504730	0.0467227	0.280	0.0586065	0.389
EXPER	0.0839568	0.0794984	0.291	0.0859526	0.329
EDUC	-0.1494521	0.1464048	0.307	0.1765850	0.397
OCC	0.0340186	0.4234791	0.936	0.2705041	0.900
INC2	-0.0016687	0.0155909	0.915	0.0167323	0.921
FSIZE	0.0001817	0.0001476	0.218	0.0001701	0.285
constant	1.3337060	2.6775740	0.618	3.6359890	0.714

LR $\chi 2(36)$=68.80 *Prob > χ^2=0.0008* *Log likelihood = -153.84102* *Pseudo R^2 =0.1828*

The output in this estimation (Table 4.5) has six panels, which represents the coefficients from the comparison with the base category. As the majority of farmers in the sample participate in a contract provided by Contract Company A, outcome A is specified as the base category of the model. Furthermore, Table 4.5 display results from the adjustment to the heteroskedasticity assumptions restricting the model. Heteroskedasticity is treated by estimating the logit models with robust standard error to improve the p-values of the estimates.

Estimated coefficients and signs of variables in Table 4.5 can be written as the following logit regression equations:

1. Comparison between Contractor Company B and base category

$$\begin{aligned} ln\,\widehat{\Omega_{B|A}}(x_\iota) = {} & 2.17056 - 0.05207AGE + 0.22678EXPER - 0.18572EDUC \\ & + 0.95940OCC - 0.00867INC2 - 0.00045FSIZE \end{aligned}$$

2. Comparison between Contractor Company C and base category

$$\begin{aligned} ln\,\widehat{\Omega_{C|A}}(x_\iota) = {} & -0.72774 - 0.06119AGE + 0.18235EXPER + 0.14592EDUC \\ & - 0.04001OCC + 0.00168INC2 - 0.00015FSIZE \end{aligned}$$

3. Comparison between Contractor Company D and base category

$$\begin{aligned} ln\,\widehat{\Omega_{D|A}}(x_\iota) = {} & 5.23789 - 0.04754AGE - 0.05109EXPER - 0.23991EDUC \\ & + 1.03463OCC - 0.03218INC2 - 0.00061FSIZE \end{aligned}$$

4. Comparison between Contractor Company E and base category

$$\begin{aligned} ln\,\widehat{\Omega_{E|A}}(x_\iota) = {} & -4.57332 - 0.01511AGE + 0.27544EXPER + 0.3653EDUC \\ & + 0.64670OCC - 0.00605INC2 - 0.00008FSIZE \end{aligned}$$

5. Comparison between Contractor Company F and base category

$$\begin{aligned} ln\,\widehat{\Omega_{F|A}}(x_\iota) = {} & -0.68765 + 0.00512AGE + 0.01840EXPER + 0.10790EDUC \\ & + 0.43613OCC - 0.02133INC2 - 0.00046FSIZE \end{aligned}$$

6. Comparison between Contractor Company G and base category

$$\ln \widehat{\Omega_{G|A}}(x_i) = 1.33371 - 0.05047AGE + 0.08396EXPER - 0.14945EDUC + 0.03402OCC - 0.00167INC2 + 0.00018FSIZE$$

Estimated parameters of the multinomial logit model are interpreted as the following.

a. Age

The estimates in Table 4.5 specify that most of the coefficient signs for *AGE* are negative, with the exception of the estimation between alternative F and the base category. This implies that *AGE* has a negative effect on *CHOICE*. This further implies that the older the broiler farmer is, the less likely the farmer will choose a given contract company. Regardless of the negative sign, none of the estimated coefficient for *AGE* is statistically significant. The tests have failed to reject the null hypothesis that β_{AGE} is equal to zero. This suggests that the selection of contractor company is not influenced by the farmer's age.

b. Experience

Experience in chicken rearing affects farmers' selection of contract company. The coefficient sign for all comparisons is positive, with the exception of the comparison between alternative D and the base category. In general, this demonstrates that an increase in farming experience will lead to an increase in the likelihood of selecting a particular contract company. However, this contradicts the nature of selection of Company D. A one year increase in experience results in a decrease of 0.05 in the selection of Contractor Company D.

c. Education

Although the estimation of coefficients for education does not show a significant influence, the overview of estimated coefficient signs varies across comparisons. Companies B, D and G have negative estimated coefficient signs. This suggests that the more formal education a farmer receives, the less likely an outcome of B, D and G is observed. Contrastingly, estimations for the comparisons of firms C, E and F with base category A results in positive coefficients. The insignificant effect of education implies that experience has a greater influence on *CHOICE* compared to formal education. This further implies that practical skills obtained from experience in broiler chicken rearing are more important in poultry production.

d. Occupation

Estimated coefficients related to main occupation all have positive signs, with the exception of the comparison between alternative C and alternative A. The positive effect of this variable implies that respondents with non-agricultural occupations are more likely to choose alternatives B, D, E, F and G. The opposite is true for alternative C.

e. Non-broiler Income

Excluding Contract Company D, non-broiler income does not significantly affect the dependent variable *CHOICE*. This implies that additional income earned from non-broiler sources does not affect contract company selection.

f. Farm Size

All estimated coefficients for farm size displayed in Table 4.5 are negative, except for the comparison between Company G and the base category. The negative influence indicates that the smaller the farm, the more likely the farmers are to select the given companies. This may be due to the ease of management with smaller number of chicken and farmers considering the distribution of risk related to participation in a contract.

Likelihood and Wald coefficient tests were conducted to test the hypothesis for the estimated coefficients. The tests indicate whether the effects of all coefficients associated with a particular independent variable are simultaneously equal to zero. Table 4.6 presents the results of hypothesis testing conducted with the likelihood test method, while Table 4.7 summarise the results using the Wald test method.

Table 4.6 Likelihood coefficient test

Variable	χ^2	df	$p> \chi^2$
AGE	3.531	6	0.740
EXPER	25.201	6	0.000
EDUC	8.996	6	0.174
OCC	15.804	6	0.015
INC2	4.814	6	0.568
FSIZE	17.838	6	0.007

The hypothesis that all the coefficients associated with experience are simultaneously equal to zero can be rejected at the 0.01 level (χ^2 = 25.201, *df* = 6, p<0.01). Similarly, the effect of main occupation is also statistically significant, but at the 0.05 level. In addition, the null hypothesis that states all coefficients associated with farm size are simultaneously equal to zero is rejected, in favour of the alternative hypothesis. Although the estimated value of chi-squared and p-value of the likelihood ratio test differs from the Wald test, the same conclusion can be drawn from both tests

Table 4.7 Wald coefficient test

Variable	χ^2	**df**	**p>** χ^2
AGE	3.337	6	0.766
EXPER	18.000	6	0.006
EDUC	7.893	6	0.246
OCC	12.327	6	0.055
INC2	4.436	6	0.618
FSIZE	13.529	6	0.035

Identifying the changes in the odds ratio can be utilised to interpret the effects of the logit model. The odds ratio is often referred to as the exponential coefficient of the independent variables. The magnitude of the effects of the case-specific independent variables on farmers' selection of contractor company is reflected in the odds ratio displayed in Table 4.8. A unit change of an independent variable results in the change of the odds in observing the selection of a particular contract company.

In line with the results in the coefficients tests, farmer experience, main occupation and farm size show significant effects on the dependent variable. However, there is an exception. When comparing the selection of Company D to base category A, *INC2* has a significant influence on *CHOICE* at 95 %.

With regard to the comparison between Contractor Company B and the base category, for a unit change in farming experience, the odds of farmers selecting Contractor Company B are 1.25 times greater, holding all other variables constant (Table 4.8). Comparing Contractor Company C with Contractor Company A, for a standard deviation increase in farming experience, the odds of selecting Company C increase by 1.2, *ceteris paribus.* Similarly, for each additional year of experience in chicken rearing, the odds of selecting

Contractor Company E increase by approximately 32 %, holding all other variables constant.

Table 4.8 Odds ratios for multinomial logit model

Odds	**b**	$p > \|z\|$	**Percentage**	**e^b**	**e^bStdX**
Exper *(sd=5.9947869)*					
B-A	0.22678	0.005	25.5	1.2546	3.8942
C-A	0.18235	0.031	20.0	1.2000	2.9836
E-A	0.27544	0.011	31.7	1.3171	5.2134
Occ *(sd=1.2987562)*					
B-A	0.95940	0.006	161.0	2.6101	3.4765
D-A	1.03463	0.049	181.4	2.8141	3.8333
Inc2 *(sd=24.26574)*					
D-A	-0.03218	0.045	-3.2	0.9683	0.4580
Fsize *(sd=2370.329)*					
B-A	-0.00045	0.019	-0.0	0.9995	0.3428
D-A	-0.00061	0.063	-0.1	0.9994	0.2329
F-A	-0.00046	0.062	-0.0	0.9995	0.3339

b = raw coefficient

sd= standard deviation

$p > |z|$= p-value for z-test

percentage = percentage change in odds

e^b = exp(b) = factor change in odds for unit increase in X

e^bStdX = standard deviation of factor change in odds for unit increase in X

Furthermore, for respondents whose main occupation is non-agriculture, the odds of managing their poultry under Company B are 2.6 times greater, *ceteris paribus*. Correspondingly, those whose main occupation does not fall under the category farmer or poultry raiser, the odds of selecting Contractor Company D increase by 181 %, holding other independent variables constant.

The comparison between Company D and the base category A has a significant estimate for the variable non-broiler income. The estimates of the exponential coefficient show that for a unit change in non-broiler income, the odds are expected to decrease by a factor of

0.97, holding all other variables constant. This implies that respondents with higher non-broiler income are less likely to participate in a contract with Contractor Company D.

Coefficient tests in earlier discussion show that the influence of *FSIZE* on *CHOICE* is statistically significant. With regards to the comparison between Company B and Company A, an increase in standard deviation leads to a decrease of the odds of selecting Company B by a factor of 0.99. Similarly, for a unit increase in farm size, the odds of participating in a contract under Company D decrease by 0.1%. Furthermore, for each additional chicken, the odds of cooperating with Contract Company F decrease by a factor of 0.99.

Table 4.9 displays the computed predicted probabilities of a positive outcome for each observation, given the values of the independent variables for that observation. The predicted probability of farmers selecting Contractor Company A range from 0.0025 to 0.6568, with a mean of 0.24. Similarly, the estimated probability of selecting Contractor Company B, with regards to the selection of contractor company B is between 0.0006 and 0.8108, with an average of 0.21. Companies E and F both have the lowest average predicted probability, at the value of 0.10.

Table 4.9 Predicted probability range for multinomial logit model

Choice	Observation	Mean	Standard deviation	Probability	
				Minimum	Maximum
A	100	0.24	0.1483367	0.0025078	0.6568350
B	100	0.21	0.1633833	0.0006244	0.8108395
C	100	0.12	0.0870755	0.0016029	0.3973946
D	100	0.11	0.1491639	0.0000109	0.8069433
E	100	0.10	0.1178251	0.0055374	0.5794951
F	100	0.10	0.0856012	0.0010464	0.4890750
G	100	0.12	0.1071499	0.0009348	0.5314171

Marginal effects estimates show the change in the outcome as one variable changes holding all other variables constant (Long & Freese, 2006). The computed marginal effects displayed in Table 4.10 are based on all variables at their mean. Pr $(y|x)$ show the probability of observing each dependent variables for specified explanatory variable values. The probability of selecting Contractor Company A for independent variables at their mean is 0.28. This probability is largest compared to other alternatives. This is followed by the probability of selecting Contractor Company B at the value of 0.22. Farmers' selection of Contractor Company D has the smallest probability, at the value of 0.05.

Moreover, the average absolute change in probability (Avg|Chg|) of various contract companies for a farmer who is average in age is approximately 0.004, holding all variables constant. A similar interpretation can be made for farmers that are average in farming experience and education. The average absolute change in probability for experience and education is 0.014 and 0.016 respectively.

Table 4.10 also suggests that an increase in experience results in a 2,7 % increase in probability of selecting Contractor Company B. Contrastingly, a unit change in experience leads to a decrease in the probability in selecting Contractor Company D by a factor of 0.009.

Table 4.10 Marginal effects of multinomial logit model

AGE	**Avg|Chg|**	**A**	**B**	**C**	**D**	**E**	**F**	**G**
-+1/2	0.003691	0.008192	-0.005206	-0.004102	-0.001021	0.001185	0.003542	-0.002589
-+sd/2	0.033772	0.074947	-0.047618	-0.037571	-0.009335	0.010816	0.032441	-0.023679
MargEfct	0.003692	0.008193	-0.005207	-0.004102	-0.001021	0.001185	0.003542	-0.002590
EXPER								
-+1/2	0.014554	-0.030352	0.026834	0.009551	-0.008620	0.014555	-0.009225	-0.002743
-+sd/2	0.084705	-0.176285	0.155643	0.054626	-0.051008	0.086199	-0.053333	-0.015842
MargEfct	0.014567	-0.030379	0.026860	0.009564	-0.008624	0.014559	-0.009235	-0.002746
EDUC								
-+1/2	0.016208	0.011256	-0.032685	0.023515	-0.010925	0.006572	0.015383	-0.013116
-+sd/2	0.048456	0.033446	-0.097671	0.070606	-0.032856	0.019549	0.045996	-0.039069
MargEfct	0.016225	0.011277	-0.032722	0.023528	-0.010929	0.006584	0.015399	-0.0131361
OCC								
-+1/2	0.055927	-0.104296	0.130231	-0.051575	0.035937	0.023163	0.006415	-0.039875
-+sd/2	0.072002	-0.134262	0.167889	-0.066437	0.046459	0.029580	0.008079	-0.051309
MargEfct	0.056655	-0.105666	0.131656	-0.052204	0.036179	0.023746	0.006712	-0.040423
INC2								
-+1/2	0.000989	0.001828	-0.000500	0.001028	-0.001405	0.000033	-0.001554	0.000570
-+sd/2	0.023985	0.044329	-0.011922	0.024915	-0.034406	0.000863	-0.037618	0.013839
MargEfct	0.000989	0.001828	-0.000500	0.001028	-0.001405	0.000033	-0.001554	0.000570
FSIZE								
-+1/2	0.000032	0.000053	-0.000059	4.947e-06	-0.000023	9.380e-06	-0.000029	0.000044
-+sd/2	0.073848	0.121984	-0.136757	0.011420	-0.055283	0.021476	-0.066429	0.103588
MargEfct	0.000032	0.000053	-0.000059	4.948e-06	-0.000023	9.375e-06	-0.000029	0.000044
Pr(yx)		0.284188	0.224061	0.126762	0.054584	0.086386	0.104350	0.119668

	AGE	***EXPER***	***EDUC***	***OCC***	***INC2***	***FSIZE***
x=	43.98	9.4562	11.42	2.51	34.39	4985
sd_x=	9.19154	5.99479	3.01572	1.29876	24.2657	2370.33

-+1/2 = changes of one unit centered on the base values, -+sd/2 = changes of one standard deviation centered on the base values, MargEfct = maginal effect

4.5.2 The effect of alternative-specific variables on contractor company selection

Long and Freese (2006) assert that the conditional logit model is the equivalent to the multinomial logit. Greene (2012) further asserts that the conditional logit model is regarded as the best model to estimate the effects of alternative-specific variables on the dependent variable. The conditional logit model also provides a flexible means of combining case-specific and alternative-specific variables.

This study considers three alternative-specific variables: contract company size (*SIZE*), contract price (*PRICE*), and number of bonuses offered to the farmers for better cohort performance (*BONUS*). Table 4.11 displays the conditional logit estimates for the effects of alternative-specific variables on a farmers' selection of contract company.

Table 4.11 Conditional logit estimation

Variable	Coefficient	Original model		Treated model for heteroskedasticity	
		Standard error	p>|z|	Robust standard error	p>|z|
SIZE	0.7143827	0.311630	0.022	0.3105483	0.021
PRICE	0.0005918	0.000531	0.265	0.0005370	0.270
BONUS	0.2008694	0.174953	0.251	0.1775299	0.258

LR $\chi(3) = 10.51$ Prob > $\chi^2 = 0.0147$ Pseudo $R^2 = 0.0270$ Log likelihood = -189.33578

The conditional logit model considered in this study does not have an intercept. Furthermore, similar to the multinomial logit model, the regression equation based on estimates in Table 4.11 can be written as follows.

$$ln\,\widehat{\Omega\,(x_i)} = 0.714SIZE + 0.001PRICE + 0.201BONUS$$

All variable coefficients have a positive sign, suggesting a positive influence on the dependent variable *CHOICE*. The size of the company is the only variable that is statistically significant at the 95 % level of significance. This implies that the null hypothesis, which assumes the coefficient of *SIZE* is equal to zero, is rejected in favour of the alternative hypothesis. Furthermore, estimates suggest that the bigger the size of the contract company, the more likely the farmers are to choose that particular company.

PRICE and *BONUS* do not show significant influence on the choice of contractor company.

Contract and bonus reward systems, discussed in later sections, will reveal that each contract company offers a different set of contract prices. Furthermore, some contract companies offer higher contract prices. It imples that the variation in price offered does not have impact on the selection of contractor company. The insignificant p-value suggests that the influence of *PRICE* on *CHOICE* can be disregarded. Similarly, bonus rewards that provide additional income to farmers with better cohort performance do not affect the farmers' selection of contractor companies.

Similar to the multinomial logit model, estimates of the effect of explanatory variables on the dependent variable can be interpreted in terms of the odds ratios. Table 4.12 summarises the factor changes in odds for each unit increase in the alternative-specific independent variables.

Table 4.12 Odds ratio for conditional logit model

Variable	b	$p > \|z\|$	e^b
SIZE	0.71438	0.021	2.0429
PRICE	0.00059	0.270	1.0006
BONUS	0.20087	0.258	1.2225

b = raw coefficient

$P > |z|$ = p-value for z-test

e^b = exp(b) = factor change in odds for unit increase in X

For a unit increase in the size of the company, the odds of selecting a particular contract company are 2.04 times greater. Similarly, for a standard deviation increase in contract price offered by the firm, the odds of participating in a contract with a particular firm are 1.0006 times greater. In addition, for each additional bonuses rewarded to the farmer, the odds of selecting one of the seven contractor companies is increased by approximately 1.23.

Table 4.13 displays the computed probabilities for all the alternatives at a specified value of the independent variable. When alternative-specific variables are at their mean, the probability of choosing one contract company is the same as another, taking the value of approximately 0.14. When characteristics of companies, such as size of company, contract price offered, and the number of bonuses provided, are indifferent, farmers have no specific preference of contractor companies.

Table 4.13 Predicted probability for conditional logit model

Alternative	**Base category**	**B**	**C**	**D**	**E**	**F**	**G**
Probability	0.14	0.14	0.14	0.14	0.14	0.14	0.14
Value of alternative specific variables:							
SIZE	0.57	0.57	0.57	0.57	0.57	0.57	0.57
PRICE	13,676	13,676	13,676	13,676	13,676	13,676	13,676
BONUS	2.57	2.57	2.57	2.57	2.57	2.57	2.57

4.5.3 The combine effects of independent variables on contractor company selection

The previous section has explored the individual effects of case-specific and alternative-specific variables on farmers' selection of contractor company. This section puts forward analysis on the combine effects of both kinds of variables. To test the combined effect of case-specific and alternative-specific variables on farmers' selection of a contract company, a mixed model was developed by fitting the multinomial logit model into the conditional logit model. Table 4.14 summarises the estimated parameters of the mixed model. Furthermore, estimates can be presented in the following regression equations.

1. Contractor Company B

$$\widehat{ln\Omega_B} = -0.03227AGE_B + 0.22433EXPER_B - 0.13828EDUC_B + 0.891165OCC_B - 0.00745INC2_B - 0.00042FSIZE_B - 2.8545SIZE + 0.007478PRICE - 2.68379BONUS$$

2. Contractor Company C

$$\widehat{ln\Omega_C} = -0.07219AGE_C + 0.18820EXPER_C + 0.11721EDUC_C - 0.06123OCC_C + 0.00082INC2_C - 0.00017FSIZE_C - 2.8545SIZE + 0.007478PRICE - 2.68379BONUS$$

3. Contractor Company D

$$\widehat{ln\Omega_D} = -0.00683AGE_D - 0.04770EXPER_D - 0.09562EDUC_D + 0.87705OCC_D - 0.02667INC2_D - 0.00051FSIZE_D - 2.8545SIZE + 0.007478PRICE - 2.68379BONUS$$

4. Contractor Company E

$$\widehat{ln\Omega_E} = -0.00990AGE_E + 0.27782EXPER_E + 0.04986EDUC_E + 0.62172OCC_E - 0.00606INC2_E - 0.00007FSIZE_E - 2.8545SIZE + 0.007478PRICE - 2.68379BONUS$$

5. Contractor Company F

$$\widehat{ln\Omega_F} = -0.01909AGE_F + 0.02074EXPER_F + 0.02401EDUC_F - 0.46295OCC_F - 0.023462INC2_F - 0.00052FSIZE_F - 2.8545SIZE + 0.007478PRICE - 2.68379BONUS$$

6. Contractor Company G

$$\widehat{ln\Omega_G} = -0.04855AGE_G + 0.08426EXPER_G - 0.13751EDUC_G - 0.06727OCC_G - 0.00217INC2_G - 0.00018FSIZE_G - 2.8545SIZE + 0.007478PRICE - 2.68379BONUS$$

Table 4.15 displays the odds ratios of case-specific variables. The results show a similar profiles to the multinomial model estimation, where coefficients related to *EXPER*, *OCC*, and *FSIZE* are statistically significant. The exception is the coefficient between alternative C and *AGE* is significant at the 90 % level of significance. The negative sign of this coefficient indicates that an increase of one year in the farmer's age leads to a decrease in selecting Contractor Company C by 7 %.

For farming experience, there are three coefficients that have rejected the null hypothesis. All coefficients have a positive sign, indicating a positive influence on the dependent variable. The odds of selecting Contractor Company E are 1.32 times greater with a year increase in *EXPER*. This figure is the largest compared to other companies. Likewise, for each additional year in *EXPER*, the odds of selecting Contractor Company B are approximately 1.25 greater, *ceteris paribus*. Furthermore, for a standard deviation increase, the odds of selecting Company C are approximately 1.21 greater, holding all other variables constant.

Table 4.14 Mixed model estimation

Choice	Coefficient	Original model		Treated model for heteroskedasticity	
		Standard error	p>|z|	Standard error	p>|z|
B					
AGE	-0.0322713	0.0316252	0.308	0.0339919	0.342
EXPER	0.2243282	0.0742597	0.003	0.0827961	0.007
EDUC	-0.1382813	0.1046784	0.186	0.1150567	0.229
OCC	0.8916512	0.3313086	0.007	0.3227286	0.006
INC2	-0.0074538	0.0138835	0.591	0.0130765	0.569
FSIZE	-0.0004205	0.0001828	0.021	0.0001998	0.035
C					
AGE	-0.0721975	0.0410189	0.078	0.0424004	0.089
EXPER	0.1882042	0.0812560	0.021	0.0843505	0.026
EDUC	0.1172126	0.1444065	0.417	0.1691818	0.488
OCC	-0.0612262	0.4777985	0.898	0.4726469	0.897
INC2	0.0008171	0.0157839	0.959	0.0125228	0.948
FSIZE	-0.0001655	0.0001801	0.358	0.0001922	0.389
D					
AGE	-0.0068273	0.0482138	0.887	0.0390259	0.861
EXPER	-0.0477008	0.0939942	0.612	0.0949707	0.615
EDUC	-0.0956233	0.1512475	0.527	0.1725180	0.579
OCC	0.8770482	0.3534263	0.013	0.4548136	0.054
INC2	-0.0266743	0.0175777	0.129	0.0160367	0.096
FSIZE	-0.0005129	0.0002537	0.043	0.0002865	0.073
E					
AGE	-0.0099049	0.0513391	0.847	0.0530450	0.852
EXPER	0.2778239	0.0910453	0.002	0.1096079	0.011
EDUC	0.0498593	0.1537104	0.746	0.1867844	0.790
OCC	0.6217166	0.4123121	0.132	0.5072709	0.220
INC2	-0.006061	0.0185418	0.744	0.0201899	0.764
FSIZE	-0.0000742	0.0001806	0.681	0.0001829	0.685
F					
AGE	-0.0190863	0.0470987	0.685	0.0440013	0.664
EXPER	0.0207394	0.0843821	0.806	0.0897716	0.817
EDUC	0.0240116	0.1554121	0.877	0.1366801	0.861
OCC	0.4629542	0.3744045	0.216	0.3634394	0.203
INC2	-0.0234635	0.0162255	0.148	0.0162902	0.150
FSIZE	-0.0005200	0.0002508	0.038	0.0002499	0.037
G					
AGE	-0.0485545	0.0449376	0.280	0.0538613	0.367
EXPER	0.0842682	0.0794700	0.289	0.0860150	0.327
EDUC	-0.1375056	0.1397778	0.325	0.1634654	0.400
OCC	-0.0672784	0.2825677	0.812	0.1147038	0.558
INC2	-0.0021685	0.0155663	0.889	0.0164540	0.895
FSIZE	0.0001832	0.0001471	0.213	0.0001681	0.276
SIZE	-2.8545170	2.8844460	0.322	2.6388590	0.279
PRICE	0.0074795	0.0046715	0.109	0.0047229	0.113
BONUS	-2.6837910	1.4167970	0.058	1.4408630	0.063

LR $\chi 2(36)=78.76$ Prob > $\chi^2=0.0002$ Log likelihood = -155.2091 Pseudo R^2 =0.2024

Table 4.15 Odds ratios for case-specific variables

Choice	b	$p > \|z\|$	e^b
AGE			
C	-0.07220	0.089	0.9303
EXPER			
B	0.22433	0.007	1.2515
C	0.18820	0.026	1.2071
E	0.27782	0.011	1.3203
OCC			
B	0.89165	0.006	2.4392
D	0.87705	0.054	2.4038
FSIZE			
B	-0.00042	0.035	0.9996
D	-0.00051	0.073	0.9995
F	-0.00052	0.037	0.9995

b = raw coefficient

$p > |z|$ = p-value for z-test

e^b = exp(b) = factor change in odds for unit increase in X

The coefficients for occupation, particularly for alternatives B and D, are significant at the 0.01 level. The odds of selecting either Company B or D are both approximately 2.4 times greater for farmers with a non-agricultural main occupation. Furthermore, the odds of selecting alternatives B, D, and F also have similar profiles with regard to farm size. An increase in the standard deviation for farm size, leads to a decrease of odds by a factor of 0.99.

Table 4.16 displays the estimates of exponential coefficients for alternative-specific independent variables. In contrast with the results from the conditional logit model, coefficients for both *SIZE* and *BONUS* have a negative signs. Meanwhile, the coefficient for *PRICE* indicates a significant positive effect on *CHOICE* at the 90 % confidence level. When the multinomial logit model is fitted into the conditional logit model to create a mixed model that considers both case-specific and alternative-specific variables, estimates for *BONUS* and *PRICE* are significant at 90 % level of significance. This contradicts earlier tests with the conditional logit model, where only alternative-specific variables are included.

The negative sign of the coefficient for *BONUS* indicates that the more bonuses a contract company provide to the farmers, the less likely the farmers will select the particular company. Furthermore, for each additional number of bonuses provided by the company, the odds of selecting that particular company decrease by a factor of 7 %, holding all other variables constant. In addition, for a standard deviation increase in price, the odds of choosing a particular contractor company are 1.01 times greater, *ceteris paribus*. The positive sign on the coefficient for price demonstrates that the higher the contract price, the more likely the farmers will select the company.

Table 4.16 Odds ratio for alternative-specific variables

Choice	b	z	$p > \|z\|$	e^b
SIZE	-2.85452	-0.990	0.322	0.0576
PRICE	0.00748	1.601	0.109	1.0075
BONUS	-2.68379	-1.894	0.058	0.0683

b = raw coefficient

z = z-score for test of b=0

p > |z| = p-value for z-test

e^b = exp(b) = factor change in odds for unit increase in X

The estimations displayed in Table 4.17 show predicted probabilities of selecting each contractor company when all independent variables have the same value for every alternative. The values assigned for each explanatory variable are their mean. If company size, contract price, and number of bonuses took the same value for all alternatives, Contractor Company E has the highest predicted probability. This implies that at average value for independent variables, farmers tend to select Company E.

Contractor Company A, which was determined as the base category in the model, has the second highest predicted probability at the value of 0.02. Moreover, Contractor Company B and C have similar profile, with an estimated probability of 0.08. Furthermore, the least likely company to be selected is Company D.

Similar interpretations can be made with the case-specific independent variables. Using the average of all case-specific variables, the computed probability of selecting Company

E is 955 times greater than the selection of Contractor Company D. The inclusion of case-specific variables into the model resulted in the variation of prediction probabilities. This contradicts the results shown in the conditional logit analysis, where estimates show uniformity.

Table 4.17 Predicted probabilities for mixed model

Alternative	A	B	C	D	E	F	G
Probability	0.023	0.008	0.008	0.001	0.956	0.002	0.002
Value of case-specific alternatives:							
	AGE	***EXPER***	***EDUC***	***OCC***	***INC2***	***FSIZE***	
x =	43.98	9.4562	11.42	2.51	34.39	4985	
Value of alternative-specific alternatives:							
SIZE	0.571	0.571	0.571	0.571	0.571	0.571	0.571
PRICE	13,676	13,676	13,676	13,676	13,676	13,676	13,676
BONUS	2.571	2.571	2.571	2.571	2.571	2.571	2.571

In summary, with regards to broiler farmers' characteristics, significant influence on the selection of contractor companies were found in farming experience, main occupation, and farm size. Experience and occupation both have a positive effect on the contractor company selection, while on the contrary, farm size demonstrates a negative influence. Poultry management skills obtained by the farmers throughout the years of raising broilers have enabled farmers to evaluate contract providers involved in the poultry industry. In general, the more experienced the farmers, the more likely the sample contractor companies are selected. This is with an exception of one contractor company, Company D, where less farming experience resulted in greater probability of selection. This negative effect may be influenced by other unobserved characteristics of the farmers.

Many of the respondents involved in the present study do not only work as broiler farmers. Occasionally, chicken rearing is a side line to the respondent's main occupation. As defined in Chapter 3, the expected sign of occupation is negative. It is anticipated that respondents with agricultural related occupation (farmers and broiler growers) are more likely to select the sample companies. This is with the assumption that these respondents require greater assurance for their livelihood by seeking a contract. Contract participation would mean the reduction of production risks. However, estimated parameters show that respondents with non-agricultural occupation have greater probabilities in selecting the given companies. This may be due to less time being spent on-farm, where contract participation may result in better productivity due to the production advice given by the contractor companies.

The coefficient of farm size also contradicts the expected sign. The smaller the farm capacity, the more likely farmers select a particular company. This may be a result of the greater risks involved in raising smaller flocks. When flocks are not managed well, resulting in poor cohort performance, farmer's relatively small income is reduced. This greater probability of company selection by farmers with smaller farms may also be driven by the reduction of production risks due to management standards and advice given by the companies.

In terms of the contractor companies' characteristics, company selection is positively influenced by the size of contract companies. Broiler production in Bali involves both multinational and national companies, alongside with small local companies. It is known that larger companies have better experience and facilities in broiler operation. With this in place, larger companies attract more farmers, as there is a sense of security for the farmers from their well-known reputation for experience in broiler production. Although smaller local integrators offer a closer personal relationship with contract farmers, implying there is less bureaucracy in company management, it is not enough to attract more farmers to participate in the company.

The combined effects of both farmer and firm characteristics coincide with previous estimates. It can be concluded that farmer experience, main occupation, and farm size significantly influence the selection contractor company. A difference in estimation is observed in the influence of characteristics of companies when combined with the influence of farmer characteristics. Result show that the number of bonus provided by contractor companies has a negative effect on company selection. This result contradicts the anticipated sign. It is expected that farmers are more attracted to companies that greater number of bonuses. However in reality, farmers seek for companies with smaller number of bonuses. Large companies tend to provide smaller number of bonuses, ranging from two to three types. On the contrary, smaller companies provide more of bonus, generally up to four types. This implies that farmers are more attracted to the size of the contract company compared to the number of bonuses provided.

The overall findings to a large extent answered the first hypothesis presented in Chapter 1. Farm experience in chicken rearing, main occupation, farm size, size of company, contract price and the number of bonus provided by the company significantly influence farmers' selection of contractor company. While age, education and non-broiler farmers does not influence farmers' choice.

4.5.4 Independence of irrelevant alternatives (IIA)

Multinomial logit and conditional logit are both restricted by the IIA assumption. This assumption implies removal of one contractor company from the broiler industry in Bali should not affect the probability of farmers selecting other contract providers. Table 4.18 summarise the estimates of IIA test for the multinomial logit model, while Table 4.19 provide information on IIA test for the conditional logit model.

The results from the Hausman test for IIA assumption conclude that the odds are independent of other alternatives. This implies that the removal of one or more contractor companies from the poultry industry does not change the probability of selecting other companies. As the assumption of IIA has not been violated, multinomial logit model can be utilised to estimate the effects of case-specific variables on company selection.

Table 4.18 IIA test for multinomial logit model

Omitted alternative	χ^2	df	p> χ^2	Evidence
B	-5.122	30	-	-
C	0.180	30	1.000	for Ho
D	0.006	30	1.000	for Ho
E	-1.202	30	-	-
F	3.785	30	1.000	for Ho
G	-0.229	30	-	-
A	2.488	30	1.000	for Ho

Note: If χ^2<0, the estimated model does not meet asymptotic assumptions of the test

The insignificant probability (prob> χ^2) in Table 4.19 demonstrate that the dataset has not violated the IIA assumption. This implies that difference in coefficient is not systematic and conditional logit model can be utilised to estimate the influence of alternative-specific variables on farmers' selection of contract company.

Table 4.19 IIA test for conditional logit model

Variable	(b) Partial	(B) Full	(b-B) Difference	Standard error
Size	0.7443012	0.7143827	0.299185	0.2703365
Price	0.0005599	0.0005918	-0.000318	0.0028730
Bonus	0.2095121	0.2008694	0.0086428	0.0780832

b=consistent under Ho and Ha; obtained from clogit

B=inconsistent under Ha, efficient under Ho; obtained from clogit

Test: Ho: difference in coefficients not systematic

χ^2 *(3) =(b-B)'[(V_b-V_B)^(-1)](b-B)*

=0.01

Prob> χ^2 *= 0.9996*

As previously discussed in Chapter 3, multinomial and conditional logit is restricted with the heteroskedasticity assumption. Tests conducted reveal that heteroskedasticity is present in the dataset. This implies that there is a variance in the error terms of estimated models. This variance may be cause by a number of independent variables considered in the model. The heteroskedasticity problem is treated by estimating the models using robust error terms.

4.6 Summary

This section has observed the effects of selected independent variables on contractor company selection in poultry production. It can be seen that farmer experience, main occupation, farm size, size of contractor company, contract price and the number of bonuses provided by the company significantly influence farmers' selection of contract company. These results will be used in the interpretation of gross margin calculation in the next chapter, especially with regard to company size, contract price and the number of bonuses provided.

CHAPTER 5: BONUS REWARD SYSTEM FOR BIOSECURITY ADOPTION

5.1 Introduction

This chapter put forward a discussion on bonus reward system for biosecurity adoption. A review on the bonus reward system for each contract is presented first. This is followed by a simulation of bonus systems, utilising a gross margin approach. In this simulation, two price conditions and four scenarios are considered. The chapter is concluded with the identification of the contract that best reward farmers for biosecurity implementation.

5.2 Bonus Reward System in Contract Broiler Production

Knoeber and Thurman (1995) and Glover and Kusterer (1990) assert that payments in contract broiler production systems is based on the performance of the cohort. Payment settlements are generally grouped into two. First, the basic payment which is the contract price that farmer receives for selling live birds to the firm and second, performance incentives in the form bonuses for a good cohort performance. In this study, bonuses rewarded by the contract companies can be categorised into two groups, namely price bonuses and performance bonus. Price bonuses include the market price reward. Performance bonuses are calculated through a combination of feed conversion ratio (FCR) bonus, European Efficiency bonus (EEF) or performance index (IP) bonus, mortality rate bonus, and production compensation bonus. Bonus reward systems in contract broiler production can be viewed not only as a source of additional income to the farmers, but also as an economic incentive that will encourage better cohort performance. Particular bonuses are described below.

A market price bonus is rewarded to farmers when there is a difference between the market price and the pre-agreed contract price, implying that the former is higher than the latter. All contract companies in the study pass on a portion of the difference in prices to the farmers. This bonus is stated as a percentage of the difference between the market price and contract price that the farmer receives. Although considered as a price-related bonus, the value of this bonus is highly dependent on the performance of the cohort. Better flock performance leads to a greater percentage of the market price bonus being passed on to farmers.

The FCR is a measure of the efficiency in the cohort's performance. Estimates of the FCR reflect the ability of the broiler chicken to convert feed into meat. In contract broiler production, the estimated FCR, which is later referred to as the actual FCR, is compared to the company's standard FCR. The difference between actual FCR and standard FCR is not only a bonus in itself, but also acts as a basis of determining the quantity of other bonuses. In theory, a lower FCR means higher production efficiency (Pattison *et al.*, 2008), farmers receive a greater reward when actual FCR is smaller than the company's standard FCR.

The EEF or the IP is another measurement used by the companies to determine the cohort's performance. This index is based on a number of factors, including liveability of the flock, average weight, FCR, and age at harvest. As FCR is considered in this measurement, it can be said that a better FCR leads to better performance index. For most contracts, IP is not an actual bonus that is rewarded to the farmers, but rather a basis for determining the amount of market price and mortality rate bonuses given to the farmers.

A number of companies in this study reward their farmers with mortality rate bonuses. This bonus is usually rewarded per kilogram of birds harvested. As more live birds are harvested, more income is earned by both farmers and firms. Each contract has a maximum mortality rate allowed. When the mortality rate is within the standard range, this bonus is awarded to the farmers.

There is another bonus referred to as production compensation. Only one contract includes this, which is awarded to the farmers when broiler chickens pass a certain age. When harvests are delayed due to the market mechanisms, the farmers have to manage the flock for longer. Under the production compensation, farmers are rewarded a certain amount per chicken to compensate for the extra labour they are asked to contribute.

There are six contracts evaluated in this study. Each contract represents one company. There are four national companies that provide contracts to the majority of broiler farmers in Bali and two local contractor companies. The number and type of bonuses included in the contracts differ between companies.

a. Contract 1

Two types of bonuses are provided in Contract 1. They are the FCR and market price bonuses. The FCR bonus for this company is based on the difference between the actual FCR observed in one cohort and the standard FCR determined by the company. Standard FCR can also be considered as the expected FCR for a certain age of harvest. When the difference between FCRs is equal to or larger than zero, farmers will not receive any bonus. Farmers receive a maximum of Rp. 80 per kg when the difference between FCRs is less than -0.2. Based on cohort performance measured by FCR, a maximum of 30 % market price bonus is rewarded to the growers.

b. Contract 2

Farmers participating Contract 2 are potentially rewarded with four types of bonuses. Similar to the previous contract, the company estimates the FCR bonus based on the difference between the actual FCR and the standard FCR imposed by the company. This efficiency bonus ranges between Rp. 60 per kg and Rp. 100 per kg. The market price bonus is awarded based on the estimates of the FCR. When a difference between market price and contract price is observed, farmers will receive a minimum of 15 % of the difference in price. Furthermore, this contractor company provides another bonus that reflects efficiency, the EEF bonus. Cohorts that obtain an EEF between 100 and 300, receive Rp. 60 per kg whereas those with estimates EEF higher than 300, receive more than double that amount; Rp. 150 per kg. This second contract also provides farmers with a mortality bonus. A cohort with less than 3 per cent mortality is rewarded with Rp. 50 per kg.

c. Contract 3

Contract 3 has a similar provisions to Contract 1, providing two types of bonus; the FCR and market price bonuses. This company, however, provides higher bonuses than the first contractor company. The lowest FCR bonus provided is Rp. 75 per kg, whereas the highest is Rp. 150 per kg. The estimation of the market price bonus for this contract company slightly differs from the first. The percentage of market price bonus that farmers receive is based on the production index of the cohort. The higher the IP, the higher the bonus received. The lowest market price bonus provided is 20 %, while the highest is 35 %.

d. Contract 4

The fourth contract company provides three types of bonuses. When the cohort FCR is within the maximum range of the standard FCR, the company provides Rp. 100 per kg. Furthermore, if the actual FCR of the cohort is less than the company's standard, the company provides an additional Rp. 100 per kg. In addition, a bonus of Rp. 50 per kg is given if the mortality rate of the cohort satisfies the standard range determined by the company. When a difference in market price and contract price is observed, 25 % of the difference in price is passed on to the farmers.

e. Contract 5

Contract 5 provides the four types of bonuses. Similar to the previous contracts, this contractor company provides FCR bonus. However, the FCR bonus is given when the actual FCR is greater than the standard FCR. The reason for this approach is unclear. Ideally, the less feed consumed by the broiler and the more the birds weigh, the more efficient the performance of the cohort. It may be possible that this contract company receives a greater profit from selling feed to the contract farmers, thus the more feed consumed, the greater the bonus given by the contract company. The smallest FCR bonus provided is Rp. 50 per kg, whereas the largest is Rp. 100 per kg. Similar to the previous company, this company provides a mortality rate bonus that is based on the percentage of live birds at harvest. The minimum tolerance range of live bird is 94 % in which a bonus of Rp. 10 per bird is given. The highest mortality rate bonus given is Rp. 50 per bird. A market price bonus of 30 % is also provided if the cohort's FCR is within the standard range. This contract company also provides a production compensation bonus that is based on the age of the chicken at harvest. The smallest amount of compensation provided is Rp. 10 per head, while the highest is Rp. 20 per head.

f. Contract 6

The last contract company provides three bonus types. Similar to the third contract company, IP is included in this bonus system. The estimation of IP is to determine the amount of market price and mortality rate bonus given to the farmer. The minimum range of IP tolerance for the bonus reward is 230. This company provides a market price bonus that ranges between 20 and 35 %, and a mortality rate bonus that is between Rp. 25 per kg and Rp. 45 per kg. A FCR bonus is included in this contract system; however, the estimation of this bonus differs from the other contract companies. The FCR bonus is based on the difference between the average weight of birds and actual FCR. This bonus ranges between Rp. 30 per kg and Rp. 100 per kg.

Table 5.1 summarises the types of bonus offered by each contract company. From the above discussion, it can be concluded that the smaller companies (Contract 4 and 5) tend to provide more bonus to their farmers, compared to the bigger contract companies. All contract company investigated in this study provide FCR and premium bonuses.

Table 5.1 Bonus provision of each contract

Contract	FCR	Market price	EEF	Mortality	Production compensation
Contract 1	✓	✓			
Contract 2	✓	✓	✓	✓	
Contract 3	✓	✓			
Contract 4	✓	✓		✓	
Contract 5	✓	✓		✓	✓
Contract 6	✓	✓		✓	

Furthermore, only three out of five contractor companies consider mortality rate in their bonus system and one provides production compensation. Estimates from the mixed model presented in Chapter 4 demonstrate that the number of bonus had a negative effect on contract company selection. While the conditional logit model concluded that the size of contractor company had a significant positive effect on farmers' selection of contract company. This suggests that smallholder farmers are more concerned about the size of the contract company, rather than the number of bonuses offered. Bonus simulations, presented later in the chapter will reveal the effects of the number and proportion of bonuses on farmer gross margin. This chapter does not only consider the types of bonus provided, but also the amount offered.

5.3 Simulation of Bonus Reward System

This section aims to investigate the role that bonus systems can play in encouraging biosecurity adoption. The market system in Indonesia does not provide incentives for farmers to adopt biosecurity. Similarly, the current contract system observed in the poultry industry does not provide financial incentives for biosecurity adoption. It is known that farmers require a form of reward to attract biosecurity adoption. In this regard, as most broiler farmers participate in contract, the contract bonus system is considered as a potential means to promote biosecurity adoption. Contractor company funding models are developed to closely resemble the contracting scheme of each contact company. In order to better understand the bonus reward system of each contract, two pricing schemes are considered. First, a scheme under which a set of uniform input and contract prices are determined for each contract. This scheme is later referred as the generic price scheme. Second, models are developed with input and contract prices that vary according to each contract. The second pricing scheme is referred as the actual price scheme.

The generic price scheme is used in order to obtain a general overview of the bonus system for each contract under the same set of conditions. The second pricing scheme is to replicate the actual conditions of contract participation with each contract company. Furthermore, there are four scenarios defined that will assist to evaluate the bonus systems in order to determine which contract better encourages the implementation of biosecurity activities. The first scenario represents the condition where there is no major disease outbreak. A difference between the market price and contact price is observed; therefore a market price bonus is rewarded to the farmers. The second scenario represents a condition where there is no difference in prices, thus the farmers depend entirely on the premium that is obtained when biosecurity is implemented. Under this circumstance, the magnitude of the effects of market price bonus on farmer's gross margin is explored. The third and fourth scenario both evaluate the contract conditions at a time of major disease outbreak. The loss of a proportion of a cohort in a cohort is considered in the third scenario, whereas the fourth scenario analyses a situation where the entire cohort is lost due to disease outbreak. These scenarios demonstrate the importance of biosecurity with regard to the farmers' income. Table 5.2 presents the definition of each scenario.

Table 5.2 Definition of scenarios

Scenario	Definition
Scenario 1	No major disease outbreak
Scenario 2	No major disease outbreak, no difference in market price and contract price (no market price bonus rewarded)
Scenario 3	Loss of half a cohort due to outbreak
Scenario 4	Loss of an entire cohort due to outbreak

The adoption of biosecurity has important implications with regards to the welfare of people and poultry. After the initial HPAI outbreak in Indonesia in 2003, poultry farm biosecurity has become an important issue in the poultry industry. The devastating effects of HPAI have affected not only the health regulations of the nation, but also the production and marketing of poultry goods. There are no uniform set of biosecurity measures applicable to all farms, all farms are different. It is most important that the farmers define the sources of disease in their farm and make an effort to reduce the disease risk.

In general, there are costs associated with biosecurity implementation. If there are no pull factors from the market, there is little probability that the farmers will be interested in adopting biosecurity. There is a need for economic incentives in order to encourage farmers to improve their poultry management and reduce the disease risk through biosecurity.

This section will first discuss the scenarios under the generic price scheme, followed by the actual price scheme results. Differences in gross margins are used to compare when farmers bourne all extra costs of biosecurity and when contractor companies support farmers with the extra costs of biosecurity. A set of biosecurity measures is set as prerequisite to establish farms as biosecure farms. Extra biosecurity costs include farmer training and certification by *Pusat Biosekuriti Unggas Indonesia* – Indonesian Centre for Poultry Biosecurity. A certified biosecure farm will be able to market their product with the "Healthy Farm" logo in the supermarket. Marketing a traceable broiler product means that farmers will be able to enjoy a premium price for their products. This premium will act as an economic incentive to reward farmers for adopting biosecurity.

The 'Healthy Farm' logo was developed under the ACIAR project – Cost effective biosecurity for NICPS operations in Indonesia as part of the establishment of clean market chain for poultry products from biosecure farms. Apart from defining cost effective biosecurity for the non-industrial commercial poultry sector in Indonesia, the project seeks to market 'Healthy Farm' products to create an incentive for the farmers to improve poultry management and reduce disease risk through biosecurity adoption. The project's goal is encourage farmers to adopt biosecurity through the development of niche market for these products and a premium price. The investigation of bonus systems in each contract will reveal the amount of reward farmers receive if biosecurity is adopted and in turn products from biosecure farms are marketed as premium products.

Farmers' gross margin is estimated under two conditions, namely prior to investment in biosecurity (pre-biosecurity) and after farmers invest in extra biosecurity measures (post-biosecurity). This study assumes that when biosecurity measures, reflected in the extra biosecurity costs, are implemented in the farm, products from the farm are marketed under the "Healthy Farm" logo. This implies that farmers will receive a premium for the certified products. The estimation of gross margins under the two conditions will measure the changes in profitability as a result of biosecurity implementation.

5.3.1 Generic price scheme

Table 5.3 provides estimates under the assumptions of the first scenario, while Table 5.4 summarises estimates for the second scenario. Results from Scenario 1 under the generic price scheme show that Contracts 4 and 6 reward farmers with better FCR bonus compared to other contracts. While Contracts 3, 5 and 6 reward farmers with the highest market price bonus. In general, under the same market conditions, Contract 6 has the best bonus system for the farmers. This is reflected in the estimation of total bonus received by the farmers. Farmers participating in Contract 6 receive bonuses approximately five times greater than that of Contract 1.

Scenario 1 also demonstrates that under the generic price scheme, the provision of more types of bonuses does not necessarily lead to greater gross margin. Farmers under

Contract 6, with only 3 types of bonuses, receive approximately 51 % more than farmers participating in Contract 2 with the provision of 4 types of bonuses. Furthermore, contracts with similar conditions, such as Contract 1 and 3, differ significantly with regards to gross margin after biosecurity adoption.

The variation in total amount of bonus rewarded, regardless of the type, is highly dependent on the proportion of the bonus given. For instance, with regards to market price bonus, one contract reward farmers with only six percent of the difference between market price and contract price, while other contracts reward farmers up to 30 % of the difference in prices. The proportion of the bonus provided play a greater role than the number of types of bonuses rewarded. A greater proportion leads to greater additional income for a cohort performance that is within the company's standard range. The proportionof bonuses for each contract is presented in Appendix 3.

Bonus values for FCR, EEF, mortality, and production compensation are the same as Scenario 1 for Scenario 2. However, variation is made under the market price bonus. In this Scenario 2 there is no difference between market price and contract price, which leads to the absence of market price bonus in this scenario. Differing from the first scenario, Table 5.4 reveals that Contract 4 rewards farmers with the highest amount of bonus.

The estimation of pre-biosecurity gross margin in Scenario 2 demonstrates that market price bonus is a major contributor to additional income for the broiler farmers. The absence of market price bonus results in approximately 31 % decrease in pre-biosecurity gross margin for Contract 6. A similar decrease in gross margin is observed in other contracts. This implies that the assumed Rp 500 premium for 'Healthy Farm' products is not enough to cover the extra biosecurity costs for these contracts, with the absence of market price bonus.

In summary, under a normal condition, where disease contagion is not present (Scenario 1), Contract 6 provide the best incentives for biosecurity adoption. Contrastingly, Contract 1 provide the least amount of bonus compared to other contracts. When market price and contract price are the same (Scenario 2), it seems that Contract 6 remains to reward biosecurity better than other contracts. This is reflected in the high gross margin and total amount of bonus received after the implementation of biosecurity.

Table 5.3 Generic price scheme bonus simulation, Scenario 1

	Contract 1	Contract 2	Contract 3	Contract 4	Contract 5	Contract 6
Total Revenue (Rp)	1,101,466,100	1,101,466,100	1,101,466,100	1,101,466,100	1,101,466,100	1,101,466,100
Total Expenditure (Rp)	**1,094,238,250**	**1,094,238,250**	**1,094,238,250**	**1,094,238,250**	**1,094,238,250**	**1,094,238,250**
Bonuses (Rp) – Pre Biosecurity						
FCR	2,070,425	4,969,020	6,211,275	8,281,700	4,140,850	8,281,700
Market Price	8,308,201	20,770,504	41,541,007	34,617,506	41,541,007	41,541,007
EEF		4,969,020				
Mortality		4,140,850		4,140,850	2,058,000	2,898,595
Production compensation					0	
Total Bonus (Rp)	**10,378,626**	**34,849,394**	**47,752,282**	**47,040,056**	**47,739,857**	**52,721,302**
GM pre biosecurity (Rp)	**17,606,476**	**42,077,244**	**54,980,132**	**54,267,906**	**54,967,707**	**59,949,152**
Extra biosecurity costs (Rp)						
Overhead	593,000	593,000	593,000	593,000	593,000	593,000
Annual	461,000	461,000	461,000	461,000	461,000	461,000
Cohort	1,757,000	1,757,000	1,757,000	1,757,000	1,757,000	1,757,000
PBUI Initial	3,500,000	3,500,000	3,500,000	3,500,000	3,500,000	3,500,000
PBUI Annual	550,000	550,000	550,000	550,000	550,000	550,000
Total Biosecurity costs (Rp)	**6,861,000**	**6,861,000**	**6,861,000**	**6,861,000**	**6,861,000**	**6,861,000**
Bonuses (Rp) – Post Biosecurity						
FCR	2,070,425	4,969,020	6,211,275	8,281,700	4,140,850	8,281,700
Premium	10,437,781	26,094,454	52,188,907	43,490,756	52,188,907	52,188,907
EEF		4,969,020				
Mortality		4,140,850		4,140,850	2,058,000	2,898,595
Production compensation					0	
Total Bonus (Rp)	**12,508,206**	**40,173,344**	**58,400,182**	**55,913,306**	**58,387,757**	**63,369,202**
GM post biosecurity (Rp)	**12,875,056**	**40,540,194**	**58,767,032**	**56,280,156**	**58,754,607**	**63,736,052**

Table 5.4 Generic price scheme bonus simulation, Scenario 2

	Contract 1	Contract 2	Contract 3	Contract 4	Contract 5	Contract 6
Total Revenue (Rp)	**1,101,466,100**	**1,101,466,100**	**1,101,466,100**	**1,101,466,100**	**1,101,466,100**	**1,101,466,100**
Total Expenditure (Rp)	**1,094,238,250**	**1,094,238,250**	**1,094,238,250**	**1,094,238,250**	**1,094,238,250**	**1,094,238,250**
Bonuses (Rp) – Pre Biosecurity						
FCR	2,070,425	4,969,020	6,211,275	8,281,700	4,140,850	8,281,700
Market Price	0	0	0	0	0	0
EEF		4,969,020				
Mortality		4,140,850		4,140,850	2,058,000	2,898,595
Production compensation					0	
Total Bonus (Rp)	**2,070,425**	**14,078,890**	**6,211,275**	**12,422,550**	**6,198,850**	**11,180,295**
GM pre biosecurity (Rp)	**9,298,275**	**21,306,740**	**13,439,125**	**19,650,400**	**13,426,700**	**18,408,145**
Extra biosecurity costs (Rp)						
Overhead	593,000	593,000	593,000	593,000	593,000	593,000
Annual	461,000	461,000	461,000	461,000	461,000	461,000
Cohort	1,757,000	1,757,000	1,757,000	1,757,000	1,757,000	1,757,000
PBUI Initial	3,500,000	3,500,000	3,500,000	3,500,000	3,500,000	3,500,000
PBUI Annual	550,000	550,000	550,000	550,000	550,000	550,000
Total Biosecurity costs (Rp)	**6,861,000**	**6,861,000**	**6,861,000**	**6,861,000**	**6,861,000**	**6,861,000**
Bonuses (Rp) – Post Biosecurity						
FCR	2,070,425	4,969,020	6,211,275	8,281,700	4,140,850	8,281,700
Premium	2,129,580	5,323,950	10,647,900	8,873,250	10,647,900	10,647,900
EEF		4,969,020				
Mortality		4,140,850		4,140,850	2,058,000	2,898,595
Production compensation					0	
Total Bonus (Rp)	**4,200,005**	**19,402,840**	**16,859,175**	**21,295,800**	**16,846,750**	**21,828,195**
GM post biosecurity (Rp)	**4,566,855**	**19,769,690**	**17,226,025**	**21,662,650**	**17,213,600**	**22,195,045**

The loss of half a cohort is assumed in Scenario 3 (Table 5.5). This scenario reveals the variation of gross margins before and after biosecurity. This scenario also demonstrates the importance of biosecurity implementation, when all other bonuses are present accordingly. As discussed in Scenario 1, Contract 4 rewards farmers with the highest amount of FCR bonus. Similarly, Contract 5 provides the highest market price bonus. As a consequence of the loss of a portion of the flock, a 14 % decrease in mortality rate bonus is observed in Contracts 2 and 5. In the same way, a seven per cent decrease in the bonus is also shown in Contract 4. Post-biosecurity estimates show increase in gross margin for all contracts. The lowest percentage increase in gross margin is observed in Contract 6. This implies that Contract 6 farms benefit the least from biosecurity adoption. While Contract 2 farmers, with the second smallest gross margin compared to other contracts, benefit the most. These large percentage differences between gross margins show the possible amount that farmers will lose in the case of a disease outbreak.

Scenario 4 demonstrates a hypothetical scenario where an entire cohort is lost as a consequence of disease. Presented in Table 5.6 under this condition, Contract 1 farmers have the smallest pre-biosecurity gross margin. The absence of biosecurity has resulted a negative gross margin for contract 1 and 2. The implementation of biosecurity improves the gross margin of all contracts. Gross margins for Contracts 1 and 2 became positive, while the greatest increase is observed in Contract 6.

To sum up, generic price scheme bonus simulation of four scenarios has shown that Contract 6 with three types of bonuses (FCR, market price and mortality rate) remains to provide the best incentive for biosecurity adoption. This shows that under the same price conditions, Contract 6 better reward farmers for disease risk reduction. This is followed by Contracts 3 and 6. Farmers participating in Contract 1 remains to receive the least amount of gross margin.

Table 5.5 Generic price scheme bonus simulation, Scenario 3

	Contract 1	Contract 2	Contract 3	Contract 4	Contract 5	Contract 6
Total Revenue (Rp)	**1,024,395,586**	**1,024,395,586**	**1,024,395,586**	**1,024,395,586**	**1,024,395,586**	**1,024,395,586**
Total Expenditure (Rp)	**1,036,474,781**	**1,036,474,781**	**1,036,474,781**	**1,036,474,781**	**1,036,474,781**	**1,036,474,781**
Bonuses (Rp) – Pre Biosecurity						
FCR	1,925,556	4,621,333	5,776,667	7,702,222	3,851,111	7,702,222
Market Price	7,726,870	19,317,174	38,634,348	32,195,290	38,634,348	38,634,348
EEF		4,621,333				
Mortality		3,549,300		3,851,111	1,764,000	2,695,778
Production compensation					0	
Total Bonus (Rp)	**9,502,171**	**32,109,140**	**44,411,015**	**43,748,624**	**44,249,459**	**49,032,348**
GM pre biosecurity (Rp)	**-2,577,023**	**20,029,945**	**32,331,820**	**31,669,429**	**32,170,264**	**36,953,153**
Extra biosecurity costs (Rp)						
Overhead	593,000	593,000	593,000	593,000	593,000	593,000
Annual	461,000	461,000	461,000	461,000	461,000	461,000
Cohort	1,757,000	1,757,000	1,757,000	1,757,000	1,757,000	1,757,000
PBUI Initial	3,500,000	3,500,000	3,500,000	3,500,000	3,500,000	3,500,000
PBUI Annual	550,000	550,000	550,000	550,000	550,000	550,000
Total Biosecurity costs (Rp)	**6,861,000**	**6,861,000**	**6,861,000**	**6,861,000**	**6,861,000**	**6,861,000**
Bonuses (Rp) – Post Biosecurity						
FCR	2,070,425	4,969,020	6,211,275	8,281,700	4,140,850	8,281,700
Premium	10,437,781	26,094,454	52,188,907	43,490,756	52,188,907	52,188,907
EEF		4,969,020				
Mortality		4,140,850		4,140,850	2,058,000	2,898,595
Production compensation					0	
Total Bonus (Rp)	**12,508,206**	**40,173,344**	**58,400,182**	**55,913,306**	**58,387,757**	**63,369,202**
GM post biosecurity (Rp)	**12,875,056**	**21,233,149**	**58,767,032**	**56,280,156**	**58,754,607**	**63,736,052**

Table 5.6 Generic price scheme bonus simulation, Scenario 4

	Contract 1	Contract 2	Contract 3	Contract 4	Contract 5	Contract 6
Total Revenue (Rp)	**944,113,800**	**944,113,800**	**944,113,800**	**944,113,800**	**944,113,800**	**944,113,800**
Total Expenditure (Rp)	**976,304,500**	**976,304,500**	**976,304,500**	**976,304,500**	**976,304,500**	**976,304,500**
Bonuses (Rp) – Pre Biosecurity						
FCR	1,774,650	4,259,160	5,323,950	7,098,600	3,549,300	7,098,600
Market Price	7,121,316	17,803,289	35,606,578	29,672,148	35,606,578	35,606,578
EEF		4,259,160				
Mortality		3,549,300		3,549,300	1,764,000	2,484,510
Production compensation					0	
Total Bonus (Rp)	**8,895,966**	**29,870,909**	**40,930,528**	**40,320,048**	**40,919,878**	**45,189,688**
GM pre biosecurity (Rp)	**-23,294,734**	**-2,319,791**	**8,739,828**	**8,129,348**	**8,729,178**	**12,998,988**
Extra biosecurity costs (Rp)						
Overhead	593,000	593,000	593,000	593,000	593,000	593,000
Annual	461,000	461,000	461,000	461,000	461,000	461,000
Cohort	1,757,000	1,757,000	1,757,000	1,757,000	1,757,000	1,757,000
PBUI Initial	3,500,000	3,500,000	3,500,000	3,500,000	3,500,000	3,500,000
PBUI Annual	550,000	550,000	550,000	550,000	550,000	550,000
Total Biosecurity costs (Rp)	**6,861,000**	**6,861,000**	**6,861,000**	**6,861,000**	**6,861,000**	**6,861,000**
Bonuses (Rp) – Post Biosecurity						
FCR	2,070,425	4,969,020	6,211,275	8,281,700	4,140,850	8,281,700
Premium	10,437,781	26,094,454	52,188,907	43,490,756	52,188,907	52,188,907
EEF		4,969,020				
Mortality		4,140,850		4,140,850	2,058,000	2,898,595
Production compensation					0	
Total Bonus (Rp)	**12,508,206**	**40,173,344**	**58,400,182**	**55,913,306**	**58,387,757**	**63,369,202**
GM post biosecurity (Rp)	**12,875,056**	**21,233,149**	**58,767,032**	**56,280,156**	**58,754,607**	**63,736,052**

5.3.2 Actual price scheme

This section discusses gross margin changes for each scenario under the actual price scheme. Contract and input prices are considered according to the nature of the contract. In general the actual price assumption does not alter the nature of the bonus system of each contract observed in the uniform price scheme. However, the specific price scheme reveals the variation in revenues and expenditures under the influence of each contract. Some contracts have higher input price, while others offer better contract prices.

Table 5.7 provides model estimates under the assumptions of the Scenario 1, where there is no disease contagion. Under the first scenario, Contract 5 rewards farmers with the highest bonus and results in the highest returns compared to other contract companies. Contrastingly, Contract 2 with the total bonus value of Rp. 14.9 million compensates farmers with the smallest bonus. After the implementation of biosecurity, an increase in gross margin is observed under Contracts 3, 4, 5 and 6. A decrease in post-biosecurity gross margin is found in Contracts 1 and 2. This implies that the assumed Rp. 500 premium from marketing 'Healthy Farm' broiler chicken is not sufficient to cover the extra biosecurity costs for these contracts. This result is in line with estimates under the uniform price scheme.

Table 5.8 summarise estimates for the Scenario 2, assuming the absence of market price bonus. Scenario 1 results show that farmers participating in Contract 2 receive the highest total revenue, Contract 6 is the second best. Farmers participating in Contract 6 pay the most with regard to the provision of inputs including day old chicks (DOC), feed, and medicine. Under the actual price scheme, farmers participating in Contract 1 is at a loss, yielding a negative gross margin even after the implementation of biosecurity.

There are a number of reasons that may trigger the loss in Contract 1 when implementing biosecurity. First, extra biosecurity costs include costs that are paid for only once, for example farm certification. As this gross margin analysis is set up for only one production year (7 cohorts), an improvement in gross margin may be possible in the next production year. Second, the estimates show that there is still a risk of loss in broiler production even though farmers participate in contract farming.

Table 5.7 Actual price scheme bonus simulation, Scenario 1

	Contract 1	Contract 2	Contract 3	Contract 4	Contract 5	Contract 6
Total Revenue (Rp)	**1,002,913,870**	**1,173,516,890**	**1,086,973,125**	**1,109,747,800**	**1,072,148,882**	**1,166,891,530**
Total Expenditure (Rp)	**1,034,134,500**	**1,144,472,000**	**1,085,112,000**	**1,108,422,000**	**1,023,267,000**	**1,157,667,000**
Bonuses (Rp) – Pre Biosecurity						
FCR	2,070,425	4,969,020	6,211,275	8,281,700	4,140,850	8,281,700
Market Price	14,221,335	9,962,885	45,888,900	32,547,081	50,336,173	21,913,378
EEF		4,969,020				
Mortality		4,140,850		4,140,850	2,058,000	2,898,595
Production compensation					0	
Total Bonus (Rp)	**16,291,760**	**14,931,905**	**52,100,175**	**44,969,631**	**56,535,023**	**33,093,673**
GM pre biosecurity (Rp)	**-14,928,870**	**43,976,795**	**53,961,300**	**46,295,431**	**105,416,905**	**42,318,203**
Extra biosecurity costs (Rp)						
Overhead	593,000	593,000	593,000	593,000	593,000	593,000
Annual	461,000	461,000	461,000	461,000	461,000	461,000
Cohort	1,757,000	1,757,000	1,757,000	1,757,000	1,757,000	1,757,000
PBUI Initial	3,500,000	3,500,000	3,500,000	3,500,000	3,500,000	3,500,000
PBUI Annual	550,000	550,000	550,000	550,000	550,000	550,000
Total Biosecurity costs (Rp)	**6,861,000**	**6,861,000**	**6,861,000**	**6,861,000**	**6,861,000**	**6,861,000**
Bonuses (Rp) – Post Biosecurity						
FCR	2,070,425	4,969,020	6,211,275	8,281,700	4,140,850	8,281,700
Premium	16,350,915	15,286,835	56,536,800	41,420,331	60,984,073	32,561,278
EEF		4,969,020				
Mortality		4,140,850		4,140,850	2,058,000	2,898,595
Production compensation					0	
Total Bonus (Rp)	**18,421,340**	**20,255,855**	**62,748,075**	**53,842,881**	**67,182,923**	**43,741,573**
GM post biosecurity (Rp)	**-19,660,290**	**42,439,745**	**57,748,200**	**48,307,681**	**109,203,805**	**46,105,103**

Table 5.8 Actual price scheme bonus simulation, Scenario 2

	Contract 1	Contract 2	Contract 3	Contract 4	Contract 5	Contract 6
Total Revenue (Rp)	**1,002,913,870**	**1,173,516,890**	**1,086,973,125**	**1,109,747,800**	**1,072,148,882**	**1,166,891,530**
Total Expenditure (Rp)	**1,034,134,500**	**1,144,472,000**	**1,085,112,000**	**1,108,422,000**	**1,023,267,000**	**1,157,667,000**
Bonuses (Rp) – Pre Biosecurity						
FCR	2,070,425	4,969,020	6,211,275	8,281,700	4,140,850	8,281,700
Market Price	0	0	0	0	0	0
EEF		4,969,020				
Mortality		4,140,850		4,140,850	2,058,000	2,898,595
Production compensation					0	
Total Bonus (Rp)	**2,070,425**	**4,969,020**	**6,211,275**	**12,422,550**	**6,198,850**	**11,180,295**
GM pre biosecurity (Rp)	**-29,150,205**	**34,013,910**	**8,072,400**	**13,748,350**	**55,080,732**	**20,404,825**
Extra biosecurity costs (Rp)						
Overhead	593,000	593,000	593,000	593,000	593,000	593,000
Annual	461,000	461,000	461,000	461,000	461,000	461,000
Cohort	1,757,000	1,757,000	1,757,000	1,757,000	1,757,000	1,757,000
PBUI Initial	3,500,000	3,500,000	3,500,000	3,500,000	3,500,000	3,500,000
PBUI Annual	550,000	550,000	550,000	550,000	550,000	550,000
Total Biosecurity costs (Rp)	**6,861,000**	**6,861,000**	**6,861,000**	**6,861,000**	**6,861,000**	**6,861,000**
Bonuses (Rp) – Post Biosecurity						
FCR	2,070,425	4,969,020	6,211,275	8,281,700	4,140,850	8,281,700
Premium	2,129,580	5,323,950	10,647,900	8,873,250	10,647,900	10,647,900
EEF		4,969,020				
Mortality		4,140,850		4,140,850	2,058,000	2,898,595
Production compensation					0	
Total Bonus (Rp)	**4,200,005**	**10,292,970**	**16,859,175**	**21,295,800**	**16,846,750**	**21,828,195**
GM post biosecurity (Rp)	**-33,881,625**	**32,476,860**	**11,859,300**	**15,760,600**	**58,867,632**	**24,191,725**

In the absence of a market price bonus, the contract mechanism in Scenario 2 reveals that Contract 1 farmers loose Rp. 29 million prior to biosecurity implementation. Farmers participating in this contract loose a further Rp. 4 million from the sale of ‘Healthy Farm’ product. This implies farmers under Contract 1 require a premium more than Rp. 500 per kg to cover their costs. Gross margins received by farmers under Contract 1 is significantly lower than other contracts.

In summary, under the actual price condition, Contract 5 provide the best bonus system for the promotion of biosecurity adoption. On the contrary, farmers participating in Contract 1 benefit the least from biosecurity implementation in Scenario 1 and 2. The negative gross margin may be influenced by the nature of the premium from ’Healthy Farm’ product sale and the extra biosecurity costs.

Tables 5.9 and 5.10 present contract simulation results for Scenario 3 and 4 respectively. Under the Scenario 3 assumptions, the implementation of biosecurity increase gross margins from Rp. 82.6 million to Rp. 109.2 million for farmers participating in Contract 5. Farmers participating in Contract 1 remains to be at loss, even after the implementation of biosecurity. The loss of an entire cohort in Scenario 4 (Table 5.10) sets farmers participating in Contract 1 behind by Rp. -48.8 million before the adoption of biosecurity. Under the same contract, with the implementation of biosecurity, still receive a negative return of Rp. -19.6 million.

Under all scenarios, Contract 5 provide the best reward for biosecurity adoption. This is followed by Contracts 3 and 6. Similar to the results in the generic price scheme, Contract 1 reward the least for biosecurity implementation. The negative gross margin in Contract 1 implies that farmers require financial support from contract companies to improve farm biosecurity. Alternatively, a better share of premium is required to cover the extra biosecurity costs imposed on the farm. Findings from both generic and actual price conditions supports the second hypothesis, presented in Chapter 1, that the greater proportion of bonus provided by the company leads to a better reward system for biosecurity implementation.

Table 5.9 Actual price scheme bonus simulation, Scenario 3

	Contract 1	Contract 2	Contract 3	Contract 4	Contract 5	Contract 6
Total Revenue (Rp)	**932,739,139**	**1,091,404,921**	**1,010,916,696**	**1,032,097,808**	**1,085,243,143**	**1,085,243,143**
Total Expenditure (Rp)	**979,254,092**	**1,079,667,102**	**1,030,338,122**	**1,050,547,714**	**1,099,579,653**	**1,099,579,653**
Bonuses (Rp) – Pre Biosecurity						
FCR	1,925,556	4,621,333	5,776,667	7,702,222	3,851,111	7,702,222
Market Price	13,226,256	9,265,774	42,678,015	30,269,734	46,814,108	20,380,081
EEF		4,621,333				
Mortality		3,549,300		3,851,111	1,764,000	2,695,778
Production compensation					0	
Total Bonus (Rp)	**14,156,825**	**13,086,385**	**48,454,681**	**41,823,068**	**52,429,219**	**30,778,081**
GM pre biosecurity (Rp)	**-32,358,128**	**24,824,204**	**29,033,255**	**23,373,162**	**82,616,019**	**16,441,571**
Extra biosecurity costs (Rp)						
Overhead	593,000	593,000	593,000	593,000	593,000	593,000
Annual	461,000	461,000	461,000	461,000	461,000	461,000
Cohort	1,757,000	1,757,000	1,757,000	1,757,000	1,757,000	1,757,000
PBUI Initial	3,500,000	3,500,000	3,500,000	3,500,000	3,500,000	3,500,000
PBUI Annual	550,000	550,000	550,000	550,000	550,000	550,000
Total Biosecurity costs (Rp)	**6,861,000**	**6,861,000**	**6,861,000**	**6,861,000**	**6,861,000**	**6,861,000**
Bonuses (Rp) – Post Biosecurity						
FCR	2,070,425	4,969,020	6,211,275	8,281,700	4,140,850	8,281,700
Premium	16,350,915	15,286,835	56,536,800	41,420,331	60,984,073	32,561,278
EEF		4,969,020				
Mortality		4,140,850		4,140,850	2,058,000	2,898,595
Production compensation					0	
Total Bonus (Rp)	**18,421,340**	**20,255,855**	**62,748,075**	**53,842,881**	**67,182,923**	**43,741,573**
GM post biosecurity (Rp)	**-19,660,290**	**42,439,745**	**57,748,200**	**48,307,681**	**109,203,805**	**46,105,103**

Table 5.10 Actual price scheme bonus simulation, Scenario 4

	Contract 1	Contract 2	Contract 3	Contract 4	Contract 5	Contract 6
Total Revenue (Rp)	**859,640,460**	**1,005,871,620**	**931,691,250**	**951,212,400**	**918,984,756**	**1,000,192,740**
Total Expenditure (Rp)	**922,087,000**	**1,012,162,000**	**973,282,000**	**990,262,000**	**908,272,000**	**1,039,072,000**
Bonuses (Rp) – Pre Biosecurity						
FCR	1,774,650	4,259,160	5,323,950	7,098,600	3,549,300	7,098,600
Market Price	12,189,716	8,539,616	39,333,343	27,897,498	43,145,291	18,782,896
EEF		4,259,160				
Mortality		3,549,300		3,549,300	1,764,000	2,484,510
Production compensation					0	
Total Bonus (Rp)	**13,964,366**	**12,798,776**	**44,657,293**	**38,545,398**	**48,458,591**	**28,366,006**
GM pre biosecurity (Rp)	**-48,482,174**	**6,508,396**	**3,066,543**	**-504,202**	**59,171,347**	**-10,513,254**
Extra biosecurity costs (Rp)						
Overhead	593,000	593,000	593,000	593,000	593,000	593,000
Annual	461,000	461,000	461,000	461,000	461,000	461,000
Cohort	1,757,000	1,757,000	1,757,000	1,757,000	1,757,000	1,757,000
PBUI Initial	3,500,000	3,500,000	3,500,000	3,500,000	3,500,000	3,500,000
PBUI Annual	550,000	550,000	550,000	550,000	550,000	550,000
Total Biosecurity costs (Rp)	**6,861,000**	**6,861,000**	**6,861,000**	**6,861,000**	**6,861,000**	**6,861,000**
Bonuses (Rp) – Post Biosecurity						
FCR	2,070,425	4,969,020	6,211,275	8,281,700	4,140,850	8,281,700
Premium	16,350,915	15,286,835	56,536,800	41,420,331	60,984,073	32,561,278
EEF		4,969,020				
Mortality		4,140,850		4,140,850	2,058,000	2,898,595
Production compensation					0	
Total Bonus (Rp)	**18,421,340**	**20,255,855**	**62,748,075**	**53,842,881**	**67,182,923**	**43,741,573**
GM post biosecurity (Rp)	**-19,660,290**	**42,439,745**	**57,748,200**	**48,307,681**	**109,203,805**	**46,105,103**

Results in the contract model demonstrated that under Scenario 1 and 2, many contracts resulted in a decreasing gross margin after the implementation of biosecurity. This implies that under the specific input and contract price of the corresponding contracts, the assumed Rp. 500 per kg premium for 'Healthy Farm' products does not sufficiently cover the cost of biosecurity. Estimations are made to reveal the minimum value of premium for each contract, in order to obtain breakeven point between pre-biosecurity gross margin and post-biosecurity gross margin. Table 5.11 presents the premium to cover the biosecurity costs.

Farmers participating in Contract 2 offers the greatest contract price among other contracts. This is followed by Contract 6. Despite having the highest contract price, Contract 2 has the highest feed price, which can be reflected as higher input cost for farmer and may render their gross margin. Despite having the lowest contract price, Contract 1 also has the lowest input price with regards to chicken feed. Contract 2 and 5 have similar profile with regards to DOC price, at the value of Rp. 4,000 per chick. In addition, farmers participating in Contract 6 have to pay the highest price for DOC, at Rp. 6,600 per chick.

Table 5.11 Contract price and input price

Contract	**1**	**2**	**3**	**4**	**5**	**6**
Contract Price (Rp./kg)	12,110	14,170	13,125	13,400	12,946	14,090
DOC (Rp./chick)	4,750	4,000	6,000	5,500	4,000	6,600
Finisher feed (Rp./kg)	5,300	6,250	5,300	5,600	5,450	5,600
Starter feed (Rp./kg)	5,350	6,350	5,300	5,600	5,450	5,700
Premium to cover biosecurity costs (Rp./kg)	2,170	870	435	525	435	435

Table 5.11 also show that farmers participating in Contract 1 require a premium of at least Rp. 2,170 per kg to obtain breakeven. On the contrary, farmers from Contract 3, 5 and 6 require at least Rp. 435 to cover the biosecurity expenses. In addition, when given the responsibility to pay for the extra biosecurity costs, farmers participating in contract 2 and 4 require a premium of at least Rp. 870 and Rp.525 respectively to obtain breakeven.

5.4 Summary

This chapter has discussed the types of bonus provided by contractor companies and gross margin received by farmers under the condition of absence and presence of outbreak. It was revealed that the number of bonus provide varies from a minimum of two types of bonus, to a maximum of four. The most common types of bonuses offered include FCR, market price, and mortality rate. The results from bonus price simulation shows that Contract 6, with three types of bonuses including the FCR bonus, market price bonus and mortality rate bonus, provide the best reward system for biosecurity adoption under the generic price scheme. On the other hand, under the actual price conditions, Contract 5 with four bonuses (FCR, market price, mortality rate and production compensation) best promote biosecurity adoption, while Contract 1 with two bonuses (FCR and market price) provide the least. It can also be concluded that beside the number of bonuses provided, the amount of bonus rewarded to farmers should also be considered in biosecurity adoption.

CHAPTER 6: SUMMARY, CONCLUSION AND IMPLICATION

The major findings from this research are summarised in the first section of this chapter. Conclusion and implications of the study are drawn based on the findings. Research contribution in relation to farmer's selection to contract company and biosecurity implementation will be highlighted. Limitations of the study and suggestion for further research are outlined.

6.1 Summary

The identification of HPAI outbreak in 2003 has resulted in devastating economic loss, not only to producers and other stakeholders involved in the poultry operation, but also the consumers and wider community. The reoccurrence of HPAI in 2005 and 2011 has demonstrated that there is an urgency to improve farm biosecurity implementation in Indonesia. With the increasing realisation of the importance of improving biosecurity particularly in Sectors 3 (smallholder farms managing poultry between 500 and 20,000 birds), the Australian Centre for International Agricultural Research (ACIAR) has established a project in Indonesia *Cost-effective biosecurity for Non Industrial Commercial Poultry Sector (NICPS) operations in Indonesia*. This project aims to identify efficient and effective biosecurity measures for NICPS farms.

The project encourages contractor companies to improve biosecurity implementation through training and advice as the majority of Sector 3 farmers manage poultry through a contract. Nowadays there are no market incentives to encourage biosecurity adoption by the farmers. However, performance incentives (bonuses) that is originally utilised to ensure better cohort performance, may serve as motivation for farmers to adopt biosecurity. Moreover, the vast number of contractor companies providing contracts to smallholders and variations observed in contract may lead to an understanding of the behaviour of farmers in selecting a contract provider. The research question was what factors affecting farmers to select contract company. In regards to biosecurity implementation, which contractor company has best reward system regarding biosecurity adoption. The present study aims to first to investigate the factors influencing farmers' selection of contract companies and second to identify a bonus system that best reward farmers for biosecurity adoption.

The study was conducted in Bali, Indonesia. A total of one hundred contract broiler farmers, participating in seven companies, were selected as part of the study. Farmers were not randomly selected, as the sample contractor companies provided the list of farmers to be interviewed. The selection of these farmers provided information on the factors that influence farmers' selection of contractor company. Six contracts were obtained to assist the analysis of bonus reward systems for the adoption of biosecurity. Each contract represented one contractor company involved in the study.

The present study employed two approaches in the analysis of the research questions. First, an econometrics approach was developed to examine the factors influencing famers' selection of contract company. This involves the estimation of three logit models, including multinomial logit, conditional logit, and a mixed model by fitting the multinomial logit model into the conditional logit model. Second, the gross margin approach that considered two main price conditions, namely generic price and actual price schemes. Both price conditions evaluated the contract bonus system from four different scenarios covering the conditions of the absence and presence of disease outbreak.

Findings from the research show that a variation in contracts exists with regards to bonus provision. Differences are observed to some extent in the method of calculation and the amount of bonus provided by the contract companies. Result of the study from the multinomial logit approach shows that with regards to farmers' characteristics, farmer's year of experience in chicken rearing is the most significant determinant of contract company selection. This followed by farm size, and main occupation. Other demographic characteristics of farmers such as age, education, and non-broiler income were insignificantly influencing farmers on the choice of contract company. On the other hand, using the conditional logit model, it is found that the size contract company is the only variable affecting farmers' selection of contract company. Other variables such as contract price and the number type of bonuses offered by the contract company did not show significant impact on the choice of farmers' selection.

The combined effects of both farm and company characteristics on the selection of contractor company are better explained in the mixed model. The results show that farmer experience in chicken rearing, main occupation, farm size, contract price and number of bonuses offered by the company significantly affect the choice of farmers' selection.

Further insights on the results of the mixed model, it can the seen farmer experience, main occupation, and farm size are consistent variables in affecting the choice of contractor company selection. Meanwhile, contract price and the number type of bonus reward significantly affect the choice of contract company selection, omitting the size of the company variable as indicated in the conditional logit model.

In terms of gross margin analysis, it is found that Contract 6 with three types of bonuses provides the best reward for biosecurity implementation under the generic price condition, either in the absence or presence of disease outbreak. The second and the third best are shown by Contract 3 with two types of bonuses and Contract 5 with four types of bonuses rewards. However, Contract 5 has the best performance when applied the actual price scheme into the gross margin analysis. This is followed by Contract 3 and Contract 6 as the second and the third best performance. In this study, three contracts often come up to the key insights of gross margin received by the farmers that is Contracts 3, 5, and 6. In addition, types of bonuses offered by companies are FCR, market price, mortality and production compensation.

6.2 Conclusion and Policy Implications

The results in this study shown that factors affecting farmers' decision in selecting contract company coming from both sides, that is from farmers' characteristics and company's profile. The study also covered the issues of the absence and presence of disease outbreak. The econometrics model developed in this study can provide insight on farmers' decision to select contractor company in poultry production. The gross margin analysis in this research complements the econometrics model in terms of evaluating the bonus system for biosecurity adoption. As such, national and local companies can be involved in promoting biosecurity.

Findings from this research are informative to both government and contractor companies in considering biosecurity supports, given that biosecurity implementation is not just responsibility of the farmers and poultry producers. Farmers' characteristics such as experience in chicken rearing, main occupation and farm size are main variables to be included in the government's program to support biosecurity. As farmers perceived contract price, size of the company, and the type of bonus rewards to the choice of company selected, it is important for contractor companies to work together with farmers to evaluate their bonus system. Inclusion of biosecurity bonus in the reward system will lead to cost-sharing procedure to achieve administrative and allocative efficiency between farmers and contractor companies.

This research reveals that it not necessarily big companies provide better support than smaller companies to biosecurity implementation. It is more notable to concern on the amount of bonus reward in the system together with the type of bonuses. This is owing to the gross margin analysis that the number of bonuses provided by the contract guarantees a greater gross margin. Greater proportion of each bonus provided by the companies leads to greater gross margin for farmers. This larger share of the premium will act as incentives for farmers to reduce disease risk through biosecurity.

Results from this study can act as a benchmark for contractor companies with regard to the implementation of bonus systems. It can be recommended that contractor companies consider bonus systems similar to that of Contract 5, 3 and 6 to better reward farmers for biosecurity adoption. The negative gross margin observed in Contract 1 after the implementation of biosecurity, shows that farmers require a greater support from the companies to cover the biosecurity costs. This can be in the form of sharing the biosecurity costs between farmers and companies or increasing the amount of premium pass on to the farmers. These findings can also be shared among the members of the Indonesian Poultry Association.

The econometrics and gross margin models developed in the present study can be applied for examining farmer decision making and simulate contract bonus systems in other areas prone to poultry diseases, where biosecurity implementation remains priority.

6.3 Limitation of the study and further research

Considerable efforts have been put into the development models employed in the present study. However, these models are not without limitations. As contract companies provide the names of farmers to be interviewed, the sample is not selected randomly. Consequently, there may be selection bias present in the dataset. The logit models applied in the present study does not treat for selection bias. Furthermore, heteroskedasticity is present in the multinomial and conditional logit model. Although this has been treated by estimating the models with robust standard error, improving the p-value, the estimated coefficients may not be efficient. This research suggests considering sample selection to avoid selection bias in the model.

In terms of bonus system simulation, this study was conducted to estimate only one production year with seven cohorts. Consequently, the continuous benefits of biosecurity implementation are not yet revealed. This limitation opens to further research by taking longer time span of production years into consideration to observe the benefits of biosecurity implementation in the long run.

This study does not cover the willingness to pay for 'Healthy Farm'. It will be interesting to compare the bonus system in this study with the willingness to pay to ensure that greater proportion of the premium is passed on to the farmers.

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APPENDICES

Appendix 1 Assumptions on farm performance

Parameter	Assumption
Number of DOC (N)	6,000
Live birds (%)	98
Number of live birds (N)	5880
Total weight livebirds harvested (kg)	11,831
Average weight per bird (kg/bird)	2.01
Age (day)	38
Finisher feed consuption (kg)	16,750
Starter feed consumption (kg)	4,350
Total feed consumption (kg)	21,100
Average feed consumption per bird (kg/bird)	3.52
Actual FCR	1.78
Standard FCR	1.75
Number of cohorts in a production year (N)	7

Appendix 2 Questionnaire

Questionnaire Number | | | |

FARM CONTRACTS AND BIOSECURITY: THE CASE OF BROILER FARMERS IN BALI, INDONESIA

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SCHOOL OF BUSINESS, ECONOMICS, AND PUBLIC POLICY

FACULTY OF THE PROFESSIONS

UNIVERSITY OF NEW ENGLAND

2012

Name of numerator	**Date of interview**	**Place of interview**
	______ /______ /______	

A. BASIC INFORMATION

A1. Poultry management. *1 = Contract 2 = Independent* ☐

(If 1 go to A2, otherwise stop the interview)

A2. Do you make the decision on contract selection? *1 = Yes 2 = No* ☐

(If 1 go to A3, otherwise stop the interview)

Farmer Name	**Farmer code**
A3:	**A4.**

A5. What is your telephone/mobile number? ☐

A6. How many years have you been raising broiler chicken? ☐

A7. What is your gender? *1 = Male* *2 = Female* ☐

A8. What is your age? *(year)*

A9. What is your main occupation?

1 = Farmer *2 = Poultry raiser* *3 = Government* *4 = Private sector*

5 = Trade *6 = Service* *7 = Other, mention!* ________________

A10. How many years of formal education have you completed?

A11. How many people are currently living with you?

(Family and non-family members, including the interviewee)

A12. How many family members are working full-time on your farm?

(Family members include husband, wife, children, parents, including the interviewee)

A13. How many family members are working part-time on your farm?

(For example those helping with vaccination, harvest, etc)

A14. How many non-family members are working full-time on your farm?

A15. How many non-family members are working full-time on your farm?

B. HOUSE AND OTHER ASSETS

This Table requires number, type, and use of any houses that you own and/or the houses that you rent

B1. House number	**B2. What is the tenure for this house?** *1 = Partly own (to B3)* *2 = Fully own (to B4)* *3 = Rent (to B5)* *4 = Borrow (to B5)*	**B3. What equity do you have in this/ these house/s?** *(%)*	**B4. What is the approximate value of the house (including land)?** *(Rp. million)*
01			
02			

This set of questions relates to the type, number and value of your household assets. Complete B5 and B6 for all assets do not leave blank. If money has been borrowed (e.g. from bank or other family) include that as household assets

B5. How much land and livestock do you have?

Code No.	**Asset**	**Total**	**Value** *(Rp)*
1	Dry land	Ha	
2	Irrigated land	Ha	
3	Cattle	head	
4	Pig	head	
5	Village chicken	head	
6	Duck	head	

B6. Have you borrowed money or received credit from any of these sources in the last 3 years? *1 = Yes* *2 = No* [ ]

(If 1, complete the following table, otherwise go to B12)

B7 Code No.	**B8. When did borrow these funds?** *(month/year)*	**B9. How much did you borrow?** *(Rp. 000)*	**B10. Where did you borrow from?** *(use the codes below)*	**B11. For what purpose did you receive this credit?** *(use the codes below)*		
1				1.	2.	3.
2				1.	2.	3.
3				1.	2.	3.

Codes for use above:

B10.	*B11.*
1 = Commercial bank, agricultural bank, farmer/village cooperative *2 = Shop, money lender, neighbour, family, friend* *3 = Contract company* *4 = Government program* *5 = Other, mention!*	*1 = Agriculture: Buy/improve land, buy livestock, buy/repair farm equipments/building* *2 = Biosecurity: buy/build fence, footbath, etc* *3 = Household: education fees, health costs, basic household needs, buy/improve house, family/community ceremony, buy household assets, repay debt*

NON-BROILER INCOME

This Table requires information concerning all non-broiler income,that is any income earned in activities other than broilers by members of the household.

B12. What type of non-broiler income -earning activities have been undertaken during the last 12 months? *(use code below)*	**B13. How much non-broiler income was earned in the last 12 months?** *(Rp 000)*

Codes for use above

1 = Seasonal Crops	**2 = Livestock**	**3 = Off-farm**	**4 = Perennial Crops**	**5 = Fishery**	**6 = Non-farm**
e.g. *paddy, secondary crops, horticulture crops, etc.*	*e.g. cattle, goats, swine, native chickens, ducks, quails, breeder or layer, commercial enterprise, etc*	e.g. *farm laborer, agriculture processing, rented out land, collector trader, owner/employee poultry shop, slaughter house, transportation, chicken trader, etc*	e.g. *coconut, coffee, clove,cocoa etc*	e.g. *aquatic, marine, etc*	*e.g. home industry, transport, construction, trading, scholarship, payment in kind, pension, direct cash support from govt/NGO, remittance, renting out land, renting out assets, etc*

C. ON-FARM DECISION MAKING

I am going to read out a decision that may need to be made on a poultry farm, Please tell me if the decision needs to be made and who has the major responsibility for making it.

	Type of decision	**Code No.**
C1	Hiring and firing labour	
C2	Financial reporting	
C3	when to sell chicken	
C4	Price of livebird	
C5	Allocating labour to day-to-day tasks	
C6	Purchasing poultry inputs (feed, DOC, medicine)	
C7	Permission for collector to enter farm	
C8	Permission for collector to enter shed	
C9	Permission for visitors (i.e Dinas, university, etc) to enter	
C10	Permission for relative of labourer or neighbor to enter farm	
C11	Investment in or maintenance of shed (e.g. spending money)	
C12	Vaccination program	
C13	Looking for Expert (special) for animal health	

1 = Contractor company *2 = Owner* *3 = Contract company + owner* *4 = Manager* *5 = Owner + Manager*
6 = Manager propose advise and owner decide *7 = Collector* *8 = Poultry shop* *9 = Dinas*
10 = Technical support (TS) *11 = No decision made* *12 = Other, mention!* ________________________

D. INFRASTRUCTURE AND INVESTMENT

Can you please provide information on one poultry farm that you have some link or responsibility for?

D1. Which regency is the farm locaed? *1 = Jembrana* *2 = Tabanan* *3 = Badung* *4 = Gianyar* *5 = Klungkung* *6 = Bangli* *7 = Karangasem* *8 = Buleleng* *9 = Denpasar*	**D2. Number of shed in the farm?**	**D3. What is the total land area of each farm?** *(sq meter)*	**D4. What is the total capacity of broilers if all sheds are full?** (head)	**D5. Distance from the house to farm? (km)** *If house in the farm write 0*	**D6. How many commercial poultry farms are there within a 1 km radius of the farm?**

Please provide information on a shed that is in that farm.

How far is the nearest shed in that farm to the following? Write 0 if there is none.

D7. Road that vehicles can pass through *(meter)*	**D8. Market that sell livebirds** *(km)*	**D9. Shed to neighbouring farm** *(meter)*

The following are questions regarding your current contract.

Are you required to have any of the following initial investments in joining the contract company?

Investment	**A. Discription** *1 = Yes 2 = No* *3 = Don't know* *(If 2 or 3 go to the next row, otherwise go to the next column)*	**B. Did you have it before participating in the contract?** *1 = Yes 2 = No* *(If 2 go to the next column, otherwise go to the next row)*	**C. Percentage of investment**		
			You *(%)*	**Contract company** *(%)*	**Other, Mention!** *(%)*
D10. Shed *(certain standard of sheds)*					
D11. Equipments *(e.g feeder, brooder, plastic cover for shed, etc)*					
D12. Secure boundary fence					
D13. Entrance lock for farm and shed					
D14. Designated parking *(i.e. for visitors, collectors, etc)*					
D15. Car wash area					
D16. High pressure pump					
D17. Signage *(i.e. for visitors)*					
D18. Footbath					
D19 Other, mention!					

D20. Approximately how much money has been spent on repairs and maintenance of this sheds in the past 12 months? (Rp)

D21. Who pays for the repairs and maintenance of this shed?

1 = Owner *2 = Contract company* *3 = Owner + contract company* *4 = Other, mention!* ________________________

E. POLTRY MANAGEMENT

We now want to ask you questions about your broiler. Could you please answer the questions for the <u>last completed cohort</u> that have been on this one farm.

E1. Number of DOC's in cohort	**E2. From where were these DOCs sourced?** *1 = Contract company* *2 = Poultry shop* *3 = Direct from breeder* *4 = Neighbour, friend* *5 = Other, mention!*	**E3. How do you know these DOC's are clean or safe?** *1 = Government certificate* *2 = Supplier provides certificate* *3 = Trust supplier* *4 = Own knowledge* *5 = don't know*	**E4. Were all the chickens sold at one day?** *1 = Yes* *2 = No* *(If 1, go to E 6, otherwise go to E5)*	**E5.How many days was the cohort sold?** *(day)*	**E6.How many chickens were sold?** *(head)*	**E7. What was the weight when they were sold?** *(kg/head)*

E8. Why were they sold at this weight? *1 = Don't know* *2 = In the contract* *3 = Contract company decide to sell* *4 = I decided to sell* *5 = Had sick birds* *6 = Other, mention!*	**E9. What is the contract price per kg?** *(Rp./kg)*	**E10. What is the actual price that you received?** *(Rp./kg)*	**E11. Where do you purchase litter?** *1 = Rice mill* *2 = Collector* *3 = Don't purchase* *4= Other, mention!*	**E12. Did any birds get sick in this cohort?** *1 = Yes* *2 = No* *3 = Don't know* *(If 2 or 3 go to E15, otherwise go to E13)*	**E13. Was there a diagnosis undertaken for these sick birds?** *1 = Yes* *2 = No* *3 = Don't know* *(If 1 go to E14, otherwise go to E15)*
		.			

E14. Who undertook the diagnosis *1 = Contract company* *2 = Government vet laboratory* *3 = Poultry shop* *4 = NGO* *5 = Private veterinarian* *6 = Drug company* *7 = Hatchery* *8 = Other, mention!*	**E15. What is the most common method of bird disposal?** *1 = burial* *2 = burning* *3 = fed to pets* *4 = thrown in river* *5 = thrown in hole* *6 = sell at market/collector*	**E16. Did you vaccinate your chickens** *1 = Yes* *2 = No* *(If 2 go to E19, otherwise go to E17)*	**E17. What did you vaccinate your chickens for?** *(mention all that apply)* *01 = HPAI* *02 = ND* *03 = Gumboro* *04 = Other, mention!*	**E18. What was the major reason you vaccinated?** *1 = requirement of contract company* *2 = was told to* *3 = habit* *4 = have suffered loss from the disease before* *5 = other, mention!*

F. CONTRACT

We now want to ask you about your contract.

F1. How many contract companies have you worked with in the last 5 years? *(starting with the latest contract company)*

No.	**A. Name of contract company** *(use code below)*	**B. Number of cohort under the contract** *(in the last 5 years)*	**C. Time with this contract company**		**D. What ware the main reasons of terminating the contract?** *(use code below, leave blank if still under the same contract company)*	
			Start	**Finish** *(leave blank if still under the same contract company)*		
01					1.	2.
02					1.	2.
03					1.	2.
04					1.	2.

Code for above use:

A			***D***
1 = Ciomas Adisatwa (Ciomas)	*8= Unggas Jaya Abadi (Ujadi)*	*15= Sierad*	*1 = Difficulty to meet quality/quantity required in the contract*
2 = Mitra Sinar Jaya (MSJ)	*9 = Prima Unggas Dewata (PUD)*	*16= Dobel K*	*2 = Difficulty in following the poultry management 3 = Contract company's decision to terminate the contract*
3 = Mitratama Bumi Abadi (MBA)	*10 = Permata Karya Persada (PKP)*	*17= Denpasar Sumber Makmur (DSM)*	*4 = Contract agreement*
4 = MItra Wijaya Mulia (MWM)	*11= Januputro (Janu)*	*18= Agri Satya Mandiri (ASM)*	*5 = Decreasing income*
5 = M23	*12 = Mitra Ayam Sejati (MAS)*	*19 = Malindo*	*6 = Credit/capital management*
6 = Surya Inti Pratama (SIP)	*13 = Kartika Argo (Kartika)*		*7 = Lack in the service given by the contract company 8 = Provision of input (feed and DOC)*
7 = Panca Patriot Prima (Patriot)	*14 = Sentral Unggas Bali (SUB)*		*9 = I decided myself*

Please provide information on your current contract.

F2. Why have you signed up with you current contract provider?
(give up to 3 main reasons)

1	2	3

1 = Access to credit *2 = Access to high quality input* *3= Access to training* *4 = Higher selling price*
5= Guaranteed market *6= Access to improved technology* *7= Increased income* *8= Punctual provision of input*
9 = Friend/neighbour joined the company *10 = It is a big company* *11 = Don't know*
*12 = Other, mention!*_________________________

F3. What are the main problems with contracting to the current contract provider?
(give up to 3 main reasons)

1	2	3

1 = No choice in accessing markets, technology, credit
2 = Difficulty to meet the quality required of the contract
3 = Difficulty to meet the quantity required of the contract
4= Difficulty managing credit/capital that is provided
5= Access to training
6= Decreased income
7 = Lack of understanding/transparency in contact
8= Provision of input that is not punctual
9 = Lack in quality of input (DOC, feed)
10= Depopulation of cohort
11 = Other, mention! ____________________________________

F4. What is the form of the contract?

1 = Formal (written) *2 = Informal (verbal)*

The following are questions regarding your initial contract with the company. Initial contract is a contract which you signed when first joining the contract company.

F5. Did you sign an initial contract when first joining the contract company?

1 = Yes *2 = No* *3 = Don't know*

F6. Are you required to pay a deposit for joining the contract?

1 = Yes *2 = No* *3 = Don't know*

(If 1 go to F7, otherwise go to F8)

F7. What is the form of the deposit?

1 = Cash *2 = House/land certificate* *3 = Vehicle certificate* *4 = Other, mention!* ________________________

F8. Are there any penalties imposed to those who cannot meet the contract requirements. E.g. selling chicken to a third party, FCR below the standard FCR, continuous loss, etc.

1 = Yes *2 = No* *3 = Don't know*

(If 1 go to F9, otherwise go to F10)

F9. What are the penalties imposed?

1 = Termination of contract
2 = Decrease in bonus
3 = Decrease in provision of DOC
4 = No provision of DOC
5 = Other, mention! ___________________________________

The following are questions regarding cohort contract. Cohort contract is a contract that you sign at the beginning of a new production cycle (new cohort).

F10. Did you sign a cohort contract?

1 = Yes *2 = No* *3 = Don't Know*

F11. Do you receive a new contract for every new cohort?

1 = Yes *2 = No* *3 = Don't Know*

(If 2 go to F12, otherwise go to F13)

F12. When do you have to sign a cohort contract?

1 = Every time there is a change in price	*2 = Whenever the company gives a new contract*
3 = When I ask for a new contract	*4 = Don't know*
5 = Never	*6 = Other, mention!*____________________________

F13. What is the payment system in the contract?

1= *At the time of harvest*	*2 = 1 week after harvest*	*3 = 2 weeks after harvest*
4 = >2 weeks after harvest	*5 = After the next cohort (DOC)*	*6= Other, mention!*____________________________________

F14. Has the contract changed since you joined the company?

1= Yes *2 = No* *3 = Don't know*

(If 1 go to F15, otherwise go to F16)

F15. How did the contract changed?

1= Type of bonus	*2 = Payment system*	*3 = Harvest schedule*
4 = Marketing procedure	*5= Other, mention!*____________________________________	

The following table requires information on the role of farmers in poultry management.

In the last 12 months, has your role in poultry management improved in regards to the following?

Management	**Description** *1 = Yes* *2 = No* *(If 1 go to the next column, otherwise go to the next row)*	**Explain the reasons behind the improvement of your role in poultry management.** *(e.g. change contract company, participation in training, motivated to be better, negotiation, loyalty to the current company, complaint, etc)*
F16. Chick-in schedule		
F17. Harvest schedule		
F18. Rest period schedule		
F19. Reduction of disease risks		
F20. Choice of disinfectant		
F21. Choice of vaccine		
F22. DOC quality		
F23. Contract price		
F24. Bonuses		
F25. Number of visitors that enter the farm		
F26. Number of vehicles that enter the farm		
F27. Services from Technical Support (TS) officers		

The following are questions regarding the bonuses that you receive in your current contract.

Do you receive the following bonuses?

Type of bonus	**A. Description** *1 = Yes* *2 = No*	**B. Do you know how to get this bonus?** *1 = Yes* *2 = No* *(If 1 go to the next column, otherwise go to the next row)*	**C. Explain what you know about the calculation of this bonus/how to get this bonus?**
F28. FCR			
F29. IP			
F30. EEF			
F31. Market price			
F32. Mortality			
F33. Other, mention!			

The word 'benefit' used in the following questions refers to the reduction of disease risk and financial benefits.

Who will receive the most benefit if:

(Use code to answer)

1 = Only me	*2 = Only the contract company*	*3 = Me + contract company equally receive benefit*
4 = I receive more	*5 = Contract company receive more*	*6= Consumer*
7 = Slaughter house	*8 = Collector*	
9 = No one	*10 = Don't know*	

F34. Your were able to reduce the mortality rate from 3% to 2%

F35. Consumers in the supermarket are willing to pay more for your chicken

F36. The market price increased

F37. Improve your actual FCR to meet the standard FCR of the company

F38. You invested on the maintenance of shed

F39. You invested on biosecurity, e.g. secure boundary fence, footbath, farm/shed entrance lock, etc.

F40. In your opinion, as the current contract give you enough motivation to reduce risk of disease for your chicken?
e.g. motivation in the form of bonuses, support from the contract company including training, service from TS, etc.

1 = Yes *2 = No*

Why?

Notes: Thank you for your participation

Appendix 3 Proportion of bonuses rewarded to farmers

Contract	FCR (Rp./kg)	Market price (%)	EEF (Rp./kg)	Mortality (Rp./kg)	Production compensation (Rp./kg)
Contract 1	25	6			
Contract 2	60	15	60	50	
Contract 3	75	30			
Contract 4	100	25		50	
Contract 5	50	30		50	0
Contract 6	100	30		35	

The proportion of bonuses rewarded, based on the assumptions presented in Appendix 1, is used in the calculation of gross margin.