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Food safety research in Indonesia: a scoping study and ACIAR's response

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SECTION 1: THE APPROACH TO FOOD SAFETY RESEARCH IN ACIAR

1 The approach to food safety research in ACIAR

In 2006, ACIAR commissioned a report (Morris, 2007, see Part 2 of this volume) on opportunities for ACIAR in food safety research. As ACIAR's largest partner country, and one in which animal and plant health, agribusiness and fisheries programs were active, Indonesia was chosen as the case study. In preparing the report, and number of field visits were conducted and a national workshop was held.

The purpose of this paper is to reflect on the Morris (2007) report and define a framework for investment in food safety research in Indonesia, the target country at this time, and that may also be applicable to other ACIAR partner countries.

2 General principles and definitions

Risks to food safety, for the purposes of this paper, can be derived from contamination of food stuffs with microbiological agents, (bacteria, viruses, fungi, protozoa, prions), chemicals used to enhance and protect productivity (antimicrobials, pesticides, anthelmintics, and growth promotants), naturally-occurring toxins (mycotoxins, plant and aquatic toxins) and naturally occurring and environmental contaminants (metals). Some companies and governments include detection of genetically modified food components in the arena of food safety

Contamination can occur at any stage along the food chain from the point of production, transport, storage, wholesaling, processing to retailing. Food safety risks range from those causing illness and death as a result of ingestion or contact with food to those that impact on trade of commodities domestically or internationally through regulatory or commercial barriers. The risks then can be overt, causing ill health in a person or groups of people exposed to the risk, or perceived to be a risk, particularly by accumulation, and therefore excluded or minimised in food products. Many of these threats can be attributed to the intensification of production systems and maximisation of outputs (chemical, some microbial agents) and the extended supply chain between the producer and the end user associated with storage (microbial, chemical, toxins). A major change in the last decade in both developed and developing countries is the greater distance and processing that occurs between the point of production and the point of consumption.

As an issue, food safety cuts across many other areas of science and policy including human health, terrestrial and aquatic animal health, welfare and production, plant health and production, environmental health and domestic and international trade, regulation and agreements. This complexity is managed internationally by agreements, notably Codex guidelines (FAO/WHO) and the World Trade Organisation (Application of Sanitary and Phytosanitary measures). These are largely driven by developed countries through consumer and producer demand.

3 Food safety in developing countries - Indonesia as a case study

The role and importance of food safety in developing countries varies greatly. In the traditional "wet" market situation the daily routine of purchase of food for consumption on the same day limits the extent of some problems, especially for the most common microbiological contaminants. Some issues remain important such as the ongoing occurrence of human cases of avian influenza acquired from birds from wet markets in Indonesia and Vietnam and microbial and pesticide contamination of leaf crops. There is also likely to be an underlying level of intestinal disease in the village or urban situation

from wet market purchases that is considered normal. At the other extreme, more affluent individuals are increasingly shopping at supermarkets in developing countries (the so-called "supermarket revolution") partly in response to the perception that food is cleaner and safer, the shopping is more convenient and refrigeration is available. Between these extremes, more food products are being marketed following manufacturing and handling procedures that can create food safety problems as well opportunities to remove others.

Agricultural practices can directly contribute chemical and microbiological agents into the food chain. Examples include pesticide and microbial contamination of vegetable and horticultural crops and antibiotics in meat and crustaceans. Use of these chemicals is usually in response to an overwhelming disease threat and they are applied to support intensive management systems that may be difficult to sustain without chemical use.

Generally food safety "events" are not regularly reported publicly and only sometimes formally recorded in developing countries. Some countries are making more serious efforts to monitor food safety events by survey. The International Food Safety Authorities Network (INFOSAN) was established to report food safety and food contamination incidents. The International Health Regulations, implemented in June 2008, mandates the reporting of public health incidents to the World Health organization. However not all countries are signatories to this regulation. Government systems for monitoring compliance are often weak they lack resources for testing and auditing, there are overlapping or conflicting jurisdictional issues and either inadequate legislation (or the legislation is not enforced). There is thus little production or overt domestic demand for food products that are *assured* to be safe. However there is demand for products that are *perceived* to be safe, with the perception reinforced either by knowing the source (imported) or available in a "cleaner" environment such as supermarkets. The growth in this demand reflects the growing affluence of the middle class and development of tourism.

Many of the comments above are relevant to Indonesia. The Indonesian study was commissioned to identify gaps in knowledge and relevant research issues specifically relating to meat, vegetable crops and shrimp (Morris, 2007). Its main findings were:

Indonesia currently has limited measures in place to protect safety of food consumed by its population. Some food surveillance is occurring across a number of commodities, however that effort is dissipated by irregular enforcement and duplication of efforts.

The scale of food safety problems is largely unknown, as are the critical points in the supply chain for the three food types (poultry, shrimp and vegetables) studied. Over half of the Indonesian population now lives in urban areas and this trend will continue. Urban populations rely on much longer food chains, and this provides greater opportunity for microbial and chemical risks to be increased and affect large numbers of people.

The highest priority for research should be to obtain a better understanding of the risks within the supply chains for the three selected commodities.

Two forms of chemical contamination of products (use of inappropriate preservatives in meat products and contamination of shrimp by antimicrobials) are known and will need research to minimise those hazards in the Indonesian context.

- Demand drivers for food safety in Indonesia currently originate from either government regulation or from market forces operating through market chain participants such as food processors and major retail organizations such as supermarket chains. A comprehensive set of government regulations to enforce food safety standards exists in Indonesia. However, enforcement is inconsistent and there appears to be many overlapping authorities. It is unlikely that stricter enforcement of current regulations would on its own meet the need. Consumer awareness of food safety risks is not very well developed amongst the majority of the Indonesian population. Market forces operate to enhance food safety only in a few sectors of the food supply market, such as supermarkets, fast food chains, hotels and major restaurants. At present, market drivers for food safety are more clearly apparent in the export market than they are in the domestic market. Of the commodities studied, only shrimp has a significant export market, and hence there are more clearly apparent demand drivers to ensure that shrimp products meet the required standard. Stringent, well enforced regulations in importing countries such as Europe and Japan have created strong economic drivers for high food safety standards (especially control of antimicrobial residues) in shrimp destined for export.
- There are considerable resources for conducting research into food safety in Indonesia, with a number of trained scientists in relevant disciplines. However, the institutional framework for governance is limited by overlapping and competing responsibilities and poor compliance regimes but is improving and advanced in some sectors.
- There have been a number of donor-funded activities that aim to improve the institutional frameworks for food safety and including those working in specific commodity sectors. Success of these initiatives has mainly been limited by institutional constraints or poor policy.

4 ACIAR Management response to the report

A wide variety of food safety risks exist in Indonesia in the vegetable, shrimp and meat products under study, particularly microbial and chemical contaminants. Risk assessments for food safety should be a part of wider activity in the three commodity sectors. It would appear this is already been done for vegetables and to some extent for shrimp. While none has been conducted for poultry, at this point in the development of that industry it is difficult to contemplate how research will assist smallholder producers that mainly supply wet markets. There may be future opportunities associated with the reorganization of that industry as a result of the avian influenza epidemic.

The current activity in shrimp production supported by ACIAR is a good example of an integrated project where food safety is an incentive to conduct the research and adoption of the outcomes. Consideration should be given to other interventions to address food safety issues, especially microbial contamination, along the supply chain apart from the better farm management systems (to reduce antimicrobial contamination).

Prolongation of shelf life of meat products is clearly an issue in the absence of a cold chain. However, it is not considered appropriate to conduct research in these areas without a clear adoption pathway. The sector concerned is very large, lacks a coherent structure that may facilitate adoption and the wet market arguably will be displaced as the general community development occurs.

Domestically there is at present little demand for safe food products. While supermarkets are perceived as a place to purchase safe food there is little underlying substance to that perception. Supermarkets do not appear willing to pay a premium for a safe product as defined by independent audits. It will be important to obtain a better understanding of the

perceptions of food safety related issues by consumers, supermarkets, wholesalers and fast food chains in order to identify what (if any), benefits can be derived from improving food safety, and who captures the benefits.

Institutional constraints such as overlapping or unclear regulatory control, disconnection between stakeholders in the supply chain must be addressed for research to be effective.

5 Approaches to Food Safety Research

The development of a research strategy involves prioritisation of research needs based on an analysis of the gaps in knowledge to improve the safety of food and an assessment of the likelihood of uptake of the results of the proposed research. A good example of an industry-led approach is that of the red meat sector in Australia. Here the incentives to develop and implement an approach to food safety have arisen from domestic and international (regulatory and commercial) market demand for food safety. The Australian Government and industry have established "SAFEMEAT", a representative body to ensure that all beef products achieve safety and hygiene standards that are independently audited. Underpinning this approach is a commitment to research in areas identified by a systematic risk assessment, relying on an exhaustive and rigorous risk management review of the red meat supply chain (Pointon et al, 2005). Under new food regulatory arrangements and the new *Food Standards Australia New Zealand Act 1991,* FSANZ has responsibility for the development of Primary Production and Processing Standards for food produced by the primary industry sector within Australia. As part of the FSANZ standard development framework, risk assessments examining the public health and safety issues relating to all sectors will be progressively undertaken to inform the development of risk management measures.

A similar approach has been used in Indonesia to improve food safety and product quality in Indonesian vegetable production (Asandi et al, 2006). That study described the food chain, identified the key stakeholders and conducted a risk assessment and then developed and tested good agricultural practices (GAP) that specifically targeted the issues that were identified. However, most stakeholders did not consider food safety to be a significant issue (based on lack of complaints received), and so there were very little demand present to encourage adoption of new practices. Notably supermarkets were not providing any price incentive for "safe" food, despite a government auditing system for GAP. The conclusion was that the policy (auditing and certification systems) and commercial settings were not currently present, although there was an expectation that they would develop in the future. In this context, technical research will have limited application although a case for policy research could be made to develop an industry and government coalition to manage the process.

6 ACIAR involvement in food safety research – general considerations

ACIAR has conducted a number of projects related to food safety. These are summarised in Appendix 1. The common theme is that an issue of food safety has been identified in the wider context of the research needs for a particular commodity or smallholder group. For example, FIS 2005/169 aims to improve the productivity and profitability of small holder shrimp aquaculture which feeds into commercial supply chains. It will develop and test enterprise level interventions, partly driven by the concern over antibiotic residues in product destined for export markets. High-value export markets require strict certification and testing of products before entry. The project is building on previous activity in the same ACIAR program as well as other donors (Shrimp product safeguarding - Indonesia, Malaysia and the Netherlands; WWF and Indonesia) as well as more general assistance notably by Australia to the National Agency for Drug and Food Control to develop risk assessment, risk management and communication capabilities.

This example provides a useful model for future investment in that smallholders are a key stakeholder, the supply chain is active and responsive and there is a clear driver for practice change. However, smallholders are not the sole agent for change, and other points of intervention need to be considered. For example for microbial contamination of vegetable crops, post-farm cleaning or washing is a valid intervention currently used in high value markets in Indonesia.

The drivers for adoption of practices to minimise food safety risks are not clear or present in many of the partner countries in which ACIAR operates. These drivers can include regulatory or commercial demand for minimum food safety standards (domestic or export demand), adequate legislation and enforcement, connections through and within the food supply chains, adequate capacity to identify risks and manage risks, and adequate reporting of human health events. However, within some countries and commodity groups there is increasing awareness and need for compliance to meet particular domestic demand or to fill export markets. This will increase over time as markets respond to the demands of higher net worth individuals and as export markets develop. There is evidence from many countries that such a transition is occurring already.

Other ACIAR processes will also identify research priorities. For example, the assessment of importance of zoonotic disease (Perkins et al 2007) has prioritised and identified research issues for those diseases transmissible from vertebrates to humans including rabies, cysticercosis, trichinosis and avian influenza. Some of these can be considered food safety issues.

Within the above context, food safety research could be supported by ACIAR where:

- an issue is identified as part of the wider research needs for a specific commodity
- the demand for food safety standards is present or is likely to emerge and as part of an overall strategy to gain greater value for a commodity
- the connections between smallholders, industry and government are present or can be developed in order to facilitate the uptake and adoption of new practices
- smallholders can or are likely to derive a benefit from research
- Australian research capacity exists, is appropriate and is available.

The research should:

- include a thorough assessment of the hazards and where they may occur along the food chain
- include identification of the most cost-effective points of interventions and not just those that can be implemented by the grower or producer
- be part of larger activity that seeks to improve overall the benefit from a commodity either as stand alone projects or integrated
- include specialist skill sets to conduct the research especially hazard analysis and quantification
- address policy or institutional issues, particularly the relationship between commodity supply chains, customers and government and notably audit and compliance regimes
- facilitate development of communication and education material on food safety relevant to the identified activities in the food supply chain.

7 References

Asandi, A., Schoorlemmer, H., Adiyoga, W., Dibyantoro, L., van der Voort, M., Sulastrini, N., Sulastrini, I., 2006. Development of good agricultural practice to improve food safety and product quality in Indonesian vegetable production. HORTIN - Horticultural research collaboration between Indonesia and The Netherlands, Wageningen, p. 90.

Morris, RJ, 2007. Research opportunities to minimise food safety risk in Indonesia, Australian Centre for International Agricultural Research, Final Report Series

Perkins, N. 2007, Zoonotic diseases in Indonesia, Australian Centre for International Agricultural Research, in press.

Pointon A, Jenson I., Jordan D., Vanderlinde P., Slade J. & Sumner J. (2006). A risk profile of the Australian red meat industry: approach and management. Food Control. 17(9): 712-718

SECTION 2: FOOD SAFETY IN INDONESIA: A SCOPING STUDY

8 Acknowledgments

We thank Prof. Winarno for the invaluable background documents on shrimp production in Indonesia. We also acknowledge advice from Dr Richard Callinan on sources of information about food safety in shrimp production.

9 Executive summary

Indonesia currently has limited measures in place to protect safety of food consumed by its population. The scale of food safety problems is largely unknown, as are the critical points in the supply chain for the three food types studied in this report. To some extent people have been protected from major food borne disease (FBD) outbreaks in the past by the fact that a very high proportion of the population lived in rural villages as subsistence farmers. In this situation, the supply chain was very short, and traditional protective measures (such as cooking foods shortly after harvesting with few intermediate handlers, and the use of spices in cooking) have mitigated the risk. However the rapid pace of urbanization over recent decades means that over half of the Indonesian population now lives in urban areas, and this trend will continue and intensify. Urban populations rely on much longer food chains arising from fewer but larger scale producers, with far greater opportunity for microbial and chemical hazards to be expressed and affect large numbers of people.

This study examined the nature and scale of food safety risks for vegetables, shrimp and both red and white meat. It found that objective evidence of the true hazards and where they occurred in the chain were sparse for all three product categories, therefore gaining a better understanding of this underpinning information was an important step if other elements of the national research program were to be correctly focused on major problems. However some immediate problems could also be identified. Two forms of chemical contamination of products (use of inappropriate preservatives in meat products and contamination of shrimp by antimicrobials) are known to require investigation with a view to minimizing the hazards. An opportunity also exists for shrimp and meat to begin to explore the practical application by farmers of improved practices, using knowledge gained both within and outside Indonesia.

10 Introduction

Food safety may be defined as the practices (including monitoring) that protect food from the risk of containing microbial, chemical and physical hazards. These hazards may occur at any stage of production and post-harvest handling (including growing, harvesting, processing, transporting, preparing, distributing and storage). Food safety is important in Indonesia because FBD causes human suffering, as well as direct and indirect economic burdens (e.g. health care costs; loss of earnings; cost of investigation; lost production; and loss of confidence in the food supply). For commodities which are exported (e.g. shrimp), food safety practices must meet international food safety standards if trade is to be reliably maintained continuously.

The official statistics do not reflect the true level of FBD. In 2005 only 43 FBD outbreaks were recorded by the Department of Health, affecting 3084 people (1.3 cases per 100,000 people) and causing 5 deaths. By contrast approximately 26,000 cases of FBD per 100,000 people are recorded annually in the US. Microbial contamination during food production, processing, transport or preparation is the major cause of diarrhoeal disease worldwide. Contamination of food by chemicals such as pesticides, heavy metals or aflatoxins has the potential to lead to chronic health problems in the community if there is ongoing exposure to such agents. Whilst it is widely accepted that FBD are widespread and common in Indonesia, most outbreaks are not investigated or the investigation does not include any laboratory confirmation. Therefore accurate information on the most important causative agents and products incriminated in incidents is not available. Comparisons with countries which do undertake investigations is therefore not possible.

10.1 Identification of the major risks

There is little data on which to assess the importance of microbial contamination of the food products of interest. Quite low numbers of samples of chicken and beef are tested by the National Laboratory for Animal Product Quality Control. E. coli and Salmonella spp. are cultured from a proportion of samples.

The National Centre of Development and Control of Fish Products tests shrimp and the following are considered the main hazards: Salmonella spp; Clostridium botulinum; pathogenic Escherichia coli; Listeria monocytogenes; Campylobacter jejuni; Shigella spp; pathogenic Staphylococcus aureus; vii) Vibrio cholerae; viii) Vibrio parahaemolyticus; iix) Vibrio vulnificus; and ix) Yersinia enterocolitica. No data on the microbial contamination of vegetables is available.

The use of the following hazardous chemical in food preparation in Indonesia have been identified by a Food Watch report (WHO, 2004):

- Borax (sodium borate), used by street vendors as a preservative and to improve the texture of some foods especially *bakso* – a boiled meatball made from red or white meat
- Formalin, used to enhance the shelf-life of some products (e.g. chicken)
- Rhodamine B, a red colouring used in some drinks.

Meeting international antimicrobial residue standards presents a major problem for shrimp production. In particular, traces of banned products such as chloramphenicol and nitrofurans have been detected on various occasions and resulted in loss of export trade. Following the detection of chloramphenicol residues in shrimp exported from Indonesia to the European Union (EU), exports to the EU fell by 64% (Greehalgh, 2004). Although there is no conclusive scientific evidence that trace levels of these antimicrobials have

deleterious health effects, strict requirements imposed by importing countries make antimicrobial residues a serious issue for the shrimp industry in Indonesia.

10.2 The food safety system in Indonesia

The Government organisations involved in food safety are identified in Table 1. The roles of some of these organisations are described in more detail in the following sections.

Table 1. Food safety activities by leading Ministry / Agency

Food safety activity	Leading Ministry/Agency
Agricultural production and harvest	Ministry of Agriculture National Agency of Drug and Food Control
Fisheries production	Ocean and Fisheries National Agency of Drug and Food Control
Slaughter facilities and meat	Ministry of Agriculture
Food Processing and Marketing	National Agency of Drug and Food Control Ministry of Industry and Trade
Licensing of processing plants	Ministry of Industry and Trade
Coordination standards	National Standardization Board
Pre-market food products evaluation	National Agency of Drug and Food Control
Food labelling and advertising control	National Agency of Drug and Food Control Ministry of Industry and Trade
Food safety and quality monitoring	National Agency of Drug and Food Control Ministry of Agriculture Ministry of Industry and Trade
Food production and distribution inspection	National Agency of Drug and Food Control Ministry of Industry and Trade
Food investigation and surveillance/food poisoning cases	National Agency of Drug and Food Control Ministry of Health
Public warning and public awareness	National Agency of Drug and Food Control Ministry of Agriculture
Exports and Imports	Ministry of Agriculture Ministry of Industry and Trade National Agency of Drug and Food Control Director General of Customs
Retail and Food Services	National Agency of Drug and Food Control Ministry of Health Local Government
Codes of Practice	Ministry of Agriculture National Agency of Drug and Food Control
Complaints	National Agency of Drug and Food Control
Education in food safety	All Ministries/Agencies
Coordination	Home Affairs Local Government

Food research	All Ministries/Agencies Local Government Universities

Source An Integrated Food Safety System- a model for Indonesia, a report prepared by Consultants for the Indonesian National Agency of Drug and Food Control and the Australian Government Analytical Laboratories through an AusAid funded Government Sector Linkages Programme , September 2001, (updated April 2002)

10.3 Points of intervention

Hazards may occur at any point in the food chain between the farm and the consumer. Similarly, control measures may be implemented at all stages of: production, processing; transport; retail; and during preparation in the home. The Hazard Analysis and Critical Control Point (HACCP) system is firmly established as the foremost system for assuring food safety. HACCP is a systematic approach that prevents and/or reduces physical, chemical and biological food-borne hazards to acceptable levels to ensure protection of the public's health. It allows Critical Control Points (CCPs) to be identified, where action can be taken to mitigate the identified hazards, thus forming the basis for risk management programmes. The system is used at all stages of food production, processing and preparation. Application of good hygienic practice and GAP are prerequisites to the success of a HACCP programme.

Whilst it is clear that some hazards, such as antimicrobial residues, occur mainly during production, microbial contamination may take place at any stage during the food chain. The available data is too limited to allow adequate identification of the critical stages of the food chain for the specific circumstances found in Indonesia, either nationally, or within sub-populations who follow different food preparation practices.

10.4 Conclusion

There are two main justifications for improving food safety in Indonesia: Firstly, to improve the health of the Indonesian consumer and secondly, to support the export of food products (notably shrimp). The second component both protects overseas consumers and ensures continuing access to export markets. Food safety research could be directed at addressing the major gaps in knowledge about FBD in Indonesia, or resolving specific food safety issues that can be currently identified, or both.

11 An overview of meat production and marketing in Indonesia

11.1 Production and consumption of meat types

Meat production and consumption have both grown substantially over recent decades, with a dip at the time of the Asian financial crisis in the late 1990s.

Table 2: Populations of major livestock species (1,000s).

Species	Year				Annual Growth Rate (%)	
	1980	1990	2000	2002	1980-1990	1990-2000
Cattle and buffaloes	8,897	13,745	13,413	13,701	4.4	- 0.2
Sheep and goats	11,815	17,304	19,993	20,210	3.9	1.5
Pigs	3,155	7,136	5,357	5,927	8.5	-2.8
Poultry	170,328	596,716	887,573	1,264,410	13.4	4.1

Table 3: Annual Consumption of Major Meat Types (1,000 metric tonnes).

Species	Year				Annual Growth Rate (%)	
	1980	1990	2000	2002	1980-1990	1990-2000
Beef and buffalo	261.4	306.4	421.8	383.9	1.6	3.2
Sheep and goat	54.0	90.3	81.1	88.6	5.3	-1.1
Pig	176.4	547.5	414.5	473.2	12.0	-2.7
Poultry	177.8	508.9	845.4	841.5	11.1	5.2

Table 3 shows trends in production since 1980, with substantial growth in all meat types particularly in the 1980s. Poultry stands out as the fastest growing population.

Trends in consumption (measured as domestic disappearance), show that poultry has sustained growth, largely due to the emergence of large scale commercial poultry production. Poultry meat consumption in 2002 was nearly five times that in 1980. Pig meat is the second fastest growing product.

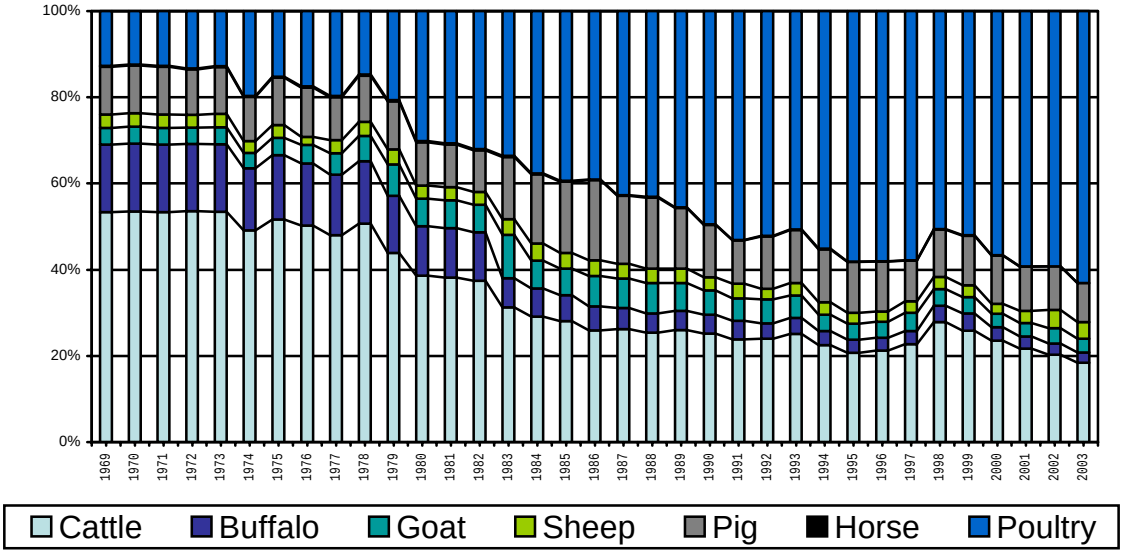

Figure 1: Proportion of total meat consumption by species.

11.2 Poultry production and marketing

There are 4 general types of poultry enterprises in Indonesia, which FAO has labelled Sectors 1 to 4 (Rushton et al., 2005). Sector 1 is large scale industrial production. Sector 2 is mid-scale commercial production. Sector 3 is small scale semi-commercial farms which typically buy their young stock from the industrial sectors 1 and 2, and sector 4 is small holder village flocks, principally composed of chickens and ducks.

Figure 3 shows the growth in the populations of the four major poultry types used for meat production over recent decades, and demonstrates the extremely rapid growth of broiler production since 1980, and the steady but much slower growth in native chicken production.

Production is mainly for national consumption but some export of processed product and day-old chicks exists and can be regionally important, such as exports from Sumatra. Breeders produce about 1.8-2 million layer and 18-20 million broiler day-old-chicks (DOC) per week. It is estimated that there are 2,289 commercial poultry companies employing about 25,000 persons in Indonesia.

Figure 2 shows the trend since 1969 in the proportions of total meat consumption represented by various species, and shows clearly how poultry has emerged since 1980 as the new leading terrestrial source of animal protein for the Indonesian population. Consumption per person of poultry for 2001 was 4.04 kg of carcass weight equivalent. For beef it was 1.99. For sheep and goat meat it was 0.42 and for pigmeat it was 0.77. All of these are substantially less than fish, which was 12.09.

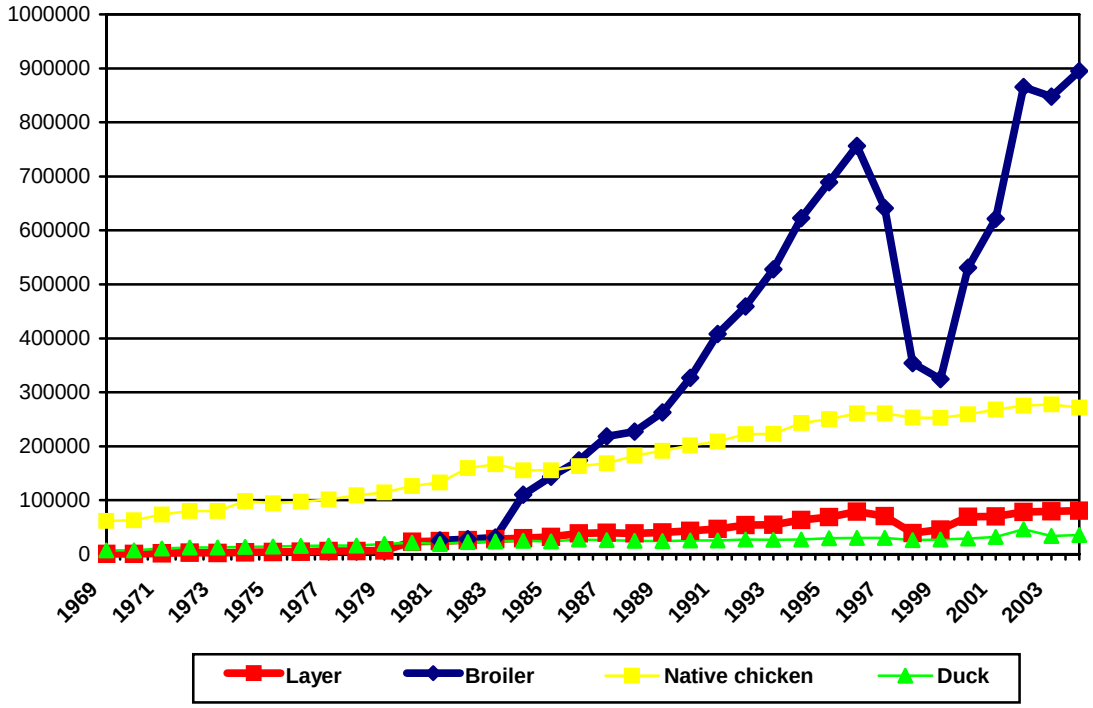

Figure 2: Trend in population of poultry types 1969-2004

The industrial sector is dominated by 5 large companies and CP Indonesia, Japhva and Anwar Sierad Produce jointly account for about 80% of the industrial poultry production. About 10% of the industrial sector's production is exported. The mid-scale commercial farms are franchise type operations with dependence on the large industrial companies. The semi-commercials are slightly smaller operations. Chickens for the large and small commercial sectors of the industry are mainly obtained from large international breeding companies such as Cobb, Hubbard, and ISA, but some privately owned local hatcheries also supply smaller commercial operators.

Most small-holders in rural villages have a small backyard flock of around 10-30 birds. Village chickens are usually indigenous strains, (ayam kampong), with natural breeding and chicks hatched under the hens in the village. Some small-holders run up to 10,000 birds, which are purchased as DOC, and marketed in the vicinity.

The industry profile for West Java gives some insight into the nature of the poultry industry. There are about 117 million poultry of all species in West Java. Of these, about 70 million birds are kept in small farm flocks of up to 15,000 layers or 10,000 broilers. The average small farm flock size is about 2,000 birds. Provincial government services are only concerned with small farm operations and the larger commercial operations provide their own veterinary care, including vaccinations, at their own expense. It was estimated in the early 1990s that 174 million birds were kept in backyard systems (Johnston et al., 1991).

Kampung chickens are raised using traditional low-cost farming techniques by almost every village household as a sideline activity and are an important source of meat and eggs, despite suffering from low productivity. They are important players in disease occurrence because of their widespread distribution and lack of biosecurity. In many cases, farmers integrate their native chicken operations with freshwater fish farming by housing the chickens in cages above fish ponds, which enables the fish to use chicken feed and manure for food.

Kampung chickens are popular with city dwellers and fetch higher prices than broilers. The government actively encouraged larger scale kampung chicken production in the 1980s but the scheme was only partially successful, mainly due to the inability to obtain regular and sufficient supplies of hatching eggs to meet market demands. Cross-breeds between native and improved chickens are farmed alongside kampung chickens, and represent an important source of traditional "kampung-type" chicken meat.

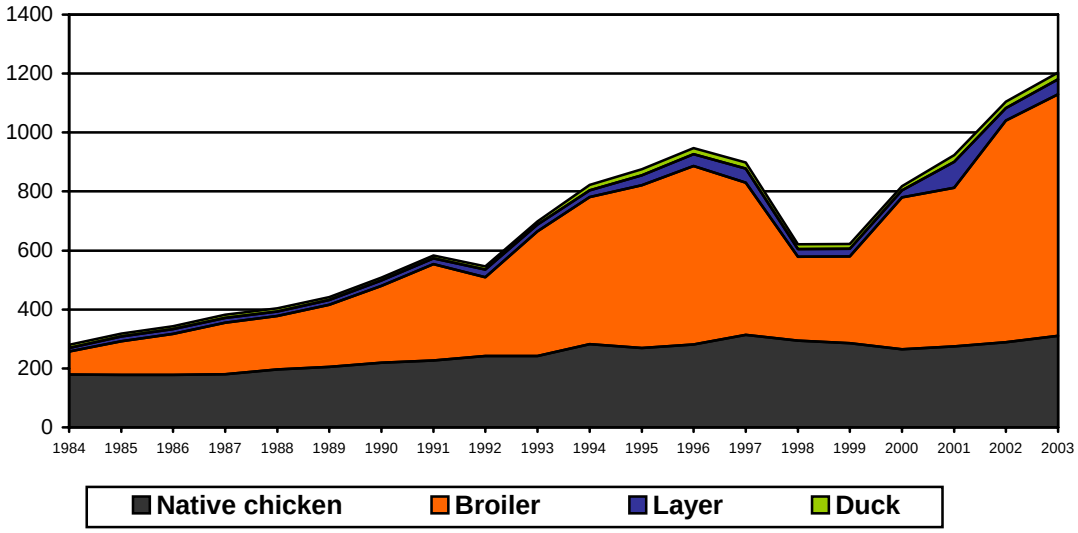

Figure 2: Consumption of major poultry meats 1984-2003.

Figure 3 shows the growth in consumption of poultry meat in total since 1984, and the contribution of the various poultry types. Native chicken has grown slowly, but broiler consumption has grown at a very fast rate, with a dip during the Asian financial crisis.

11.3 Pig production and marketing

Production of pigs has also shown substantial growth over recent decades, as shown in Figure 4.

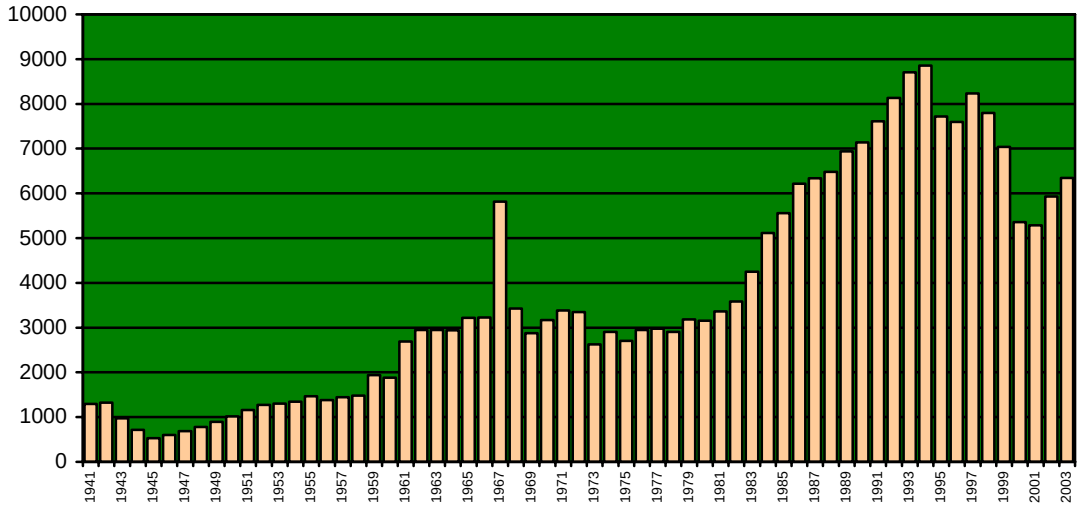

Figure 3: Pig production 1941-2003.

Although pig meat is not consumed by the majority of the Indonesian population, in some parts of the country it is a popular meat, and there is also a substantial export business providing pigmeat, particularly to Singapore.

Production is split between small scale village herds based on traditional pig types, and large commercial pig herds which use modern genotypes, derived from overseas breeding programs. Consumption is variable between different parts of the country, but overall it is 0.77kg per head of population, which is 11% of total terrestrial meat production. The majority of pigs are slaughtered in lower level (types C and D) slaughterhouses, and marketed through butchers and local markets. Some pigs are slaughtered in villages for home consumption.

11.4 Red meat production and marketing

Red meat production is mainly beef and buffalo meat, supplemented by imports from Australia of some processed meat and much larger numbers of live cattle, which are fattened and slaughtered in Indonesia (Hadi et al., 2002). Sheep and goat production is a small proportion of the total, used mainly for specialised products such as satay.

In past decades cattle and buffalo meat production was principally a by-product of the use of animals for traction, but in recent decades cattle production has become an independent industry producing specifically for the meat market, while overall use of animals for traction has declined. As shown in Figures 5 and 6, beef cattle numbers have grown steadily, while buffalo numbers have remained steady. Dairy cattle numbers have also grown over recent years as milk production has grown in importance, and culled dairy cattle are used for meat production.

Cattle are reared by many rice farmers as a sideline enterprise making use of rice straw as a principal feed supply, and cattle manure is used for fertiliser on rice paddies. Typical herd sizes are 1 to 3 head, and are limited by quantities of feed available. Animals are housed for most of the time, and tethered in grazing areas when feed is available. Principally in the more eastern parts of Indonesia, cattle are grazed on natural pasture continuously, in areas unsuited to cropping, or areas which alternate between arable crops and grazing at different stages of the crop production cycle.

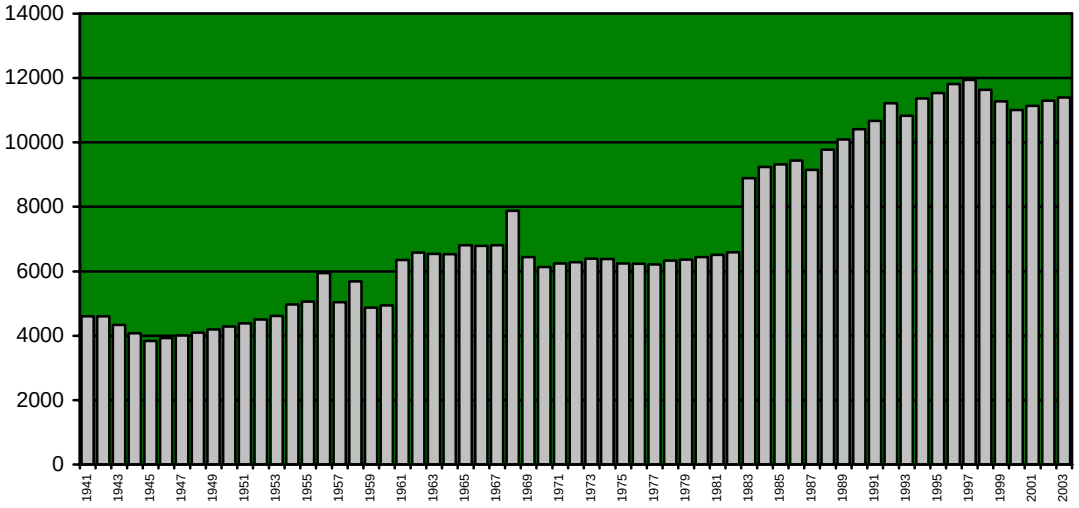

Figure 4: Beef cattle population 1941-2003 ('000).

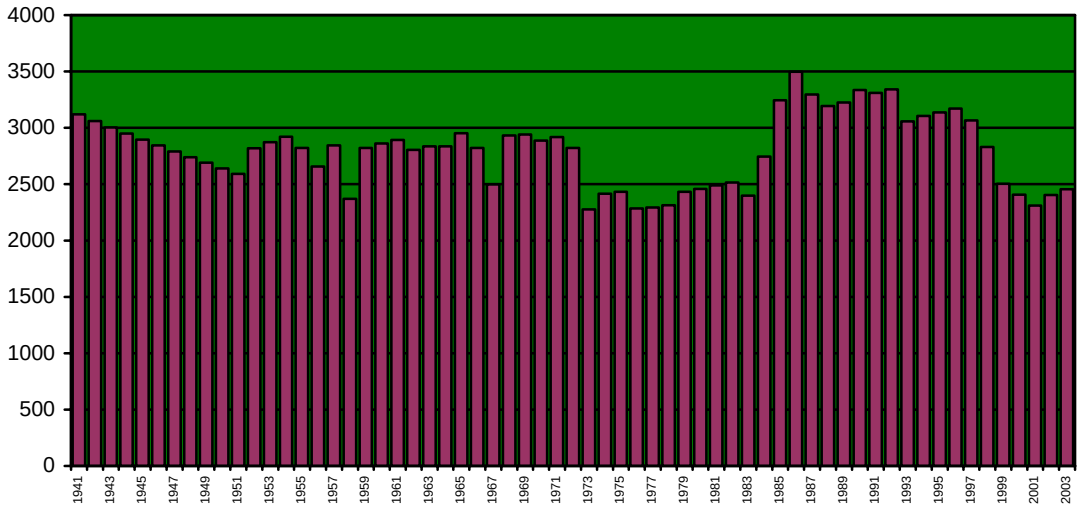

Figure 5: Buffalo population 1941-2003.

Live cattle imported from Australia are fattened either in feedlots or by individual farmers, then sold to slaughter. Almost all cattle are slaughtered in type A and B government slaughterhouses, as described later in this report. Consumption of beef is intermediate in scale, with part of the output going to the high income end of the population in cities, and a small proportion being consumed by village populations. Sheep and goats are reared in small flocks using "scavenging" grazing opportunities, and slaughtered both in slaughterhouses and in villages, for production of particular foods for which their meat is valued, such as satay. Sheep and goats are valued in mixed smallholder farming systems because maintenance costs are low. They utilise marginal land and crop residues, carry lower risk than cattle and are easy to market (Knipscheer et al., 1983)

12 An overview of vegetable production and marketing in Indonesia

The main vegetables grown in Indonesia are potato; chilli; yard long bean; shallot; cabbage; kidney bean; cucumber; Chinese cabbage; green mustard; leek; spinach; French beans; eggplant; garlic; and carrot (see Table 4). The three main vegetables are shallots (83, 614 ha), potatoes (61,557 ha) and cabbage (57,765 ha). Production has increased over recent years for most vegetables. Vegetable cultivation for commercial sale takes place mainly in Java. The majority of production takes place during the dry season (March-April) and harvest begins before the start of monsoon in July-August. A few vegetables are grown year-round. The seasonal variation in production, combined with short shelf-life of most vegetables, creates shortages during the hot rainy season. Most of the farmers grow traditional varieties of vegetables, although some commercial varieties are also cultivated.

Source CBS http://www.bps.go.id/sector/agri/horti/table7.shtml

Year	Shallots	Potatoes	Cabbages	Chili	Mustard Green	Carrots	French Beans
1997	294,423	813,368	1,338,504	156,715	441,856	227,321	295,312
1998	287,506	998,032	1,459,232	164,944	462,384	332,846	311,994
1999	323,855	924,058	1,447,910	183,347	469,996	286,536	282,198
2000	772,818	977,349	1,336,410	174,708	454,815	326,693	302,684
2001	861,150	831,140	1,238,079	142,556	434,043	300,648	228,840
2002	766,572	893,824	1,232,843	150,589	461,069	282,248	230,020
2003	762,795	1,009,979	1,348,433	176,264	459,253	355,802	247,782
2004	757,399	1,027,040	1,432,814	194,588	534,964	423,722	267,619
2005	732,609	1,009,619	1,292,984	187,236	548,453	440,002	283,649
	Garlic	**Leeks**	**Cauliflower**	**Chinese Radish**	**Red/Kidney Beans**	**Yardlong Beans**	**Cucumber**
1997	102,283	294,426		49,547	92,013	368,352	489,595
1998	83,664	287,506		12,651	104,148	447,596	506,889
1999	62,222	323,855		13,967	98,854	386,188	431,950
2000	59,008	311,319		7,745	100,914	313,526	423,386
2001	49,573	283,285		6,880	98,721	317,408	431,921
2002	46,393	315,132		7,779	94,650	310,295	406,141
2003	38,957	345,720	86,222	26,313	90,281	432,365	514,210
2004	28,851	475,571	99,994	30,625	107,281	454,999	477,716
2005	20,733	501,437	112,927	54,226	132,218	466,387	552,891
	Watermelon	**Tomatoes**	**Egg Plant/ Aubergine**	**Pumpkin/ Chajota**	**Swamp Cabbage**	**Spinach**	**Melon**
1997		460,542	279,625	41,007	188,594	73,790	
1998		547,260	311,765	84,873	201,147	98,410	
1999		562,406	300,323	121,233	211,597	81,433	
2000	179,860	593,392	270,748	158,654	215,303	65,723	27,081
2001	240,299	483,991	244,371	137,673	193,825	64,360	37,140
2002	266,904	573,517	272,700	172,125	205,351	71,011	59,106
2003	455,466	657,459	301,030	103,451	208,450	109,423	70,560
2004	410,195	626,872	312,354	179,845	212,870	107,737	47,664
2005	366,702	647,020	333,328	180,029	229,997	123,785	58,440

Table 4: Quantity of vegetable production (metric tonnes) by year.

12.1 Production systems

The large majority of vegetable production takes place in the smallholder sector. The vegetable planting area in Indonesia can be divided into three categories: lowland (altitude 0-200 m); medium altitude land (altitude 201-800 m); and high land (altitude above 800 m). Horticultural production and cropping systems can be divided into 6 systems based on commercialisation (indicated by proximity to urban centres) and temperature (Bahar, 1992).

Production in the highlands can be characterised into 2 systems:

1. Intensive, commercialised farming systems, located in relatively homogeneous production areas (e.g. mountainous areas around Bandung and Malang)
2. Less intensive farming systems, often in the remote highlands, commercial production of horticultural crops, in combination with perennial crops, fruit trees, and secondary food crops.

In the medium altitude areas the following major vegetable production systems are found:

1. Farms close to urban markets. Fully commercialized systems produce large volumes of high-value horticultural crops
2. Farms further away from urban markets. These farms grow relatively fewer perishable crops mainly because of high transport costs.

In the rainfed lowland areas, land use is split between horticultural commodities and less labour-intensive crops such as rice, cassava, soybean, corn, and peanuts. In the lowlands two systems predominate:

- Intensive, highly commercialized systems, including the production of leafy vegetables, such as kangkong
- Less intensive systems, in combination with cereals.

Less than 10% of the fresh vegetable production is attributed to large producers and/or suppliers. Such companies tend to supply large retailers, multi-national supermarkets and restaurant chains with higher quality whole and fresh cut produce (mainly lettuce, leafy greens and carrots) and are also the main exporters of fresh agricultural produce. As a result they have been required to develop quality assurance programs based on GAP and HACCP to access and/or maintain these markets. It is estimated that 5% of small scale farmers or growers produce vegetables under contract to large companies and thus contribute to large integrated supply channels. These people are, therefore, under a greater degree of 'regulation' through these market assurance programs. Small niche export markets, mainly to ASEAN countries (e.g. export of capsicum to Singapore) have also been established by a few large companies for a small range of vegetable crops, but volume and diversity is limited.

12.2 Input use

Vegetable cultivation requires major inputs, particularly water, fertilizer and pesticides. For example, for shallot, fertilizer guidelines issued in 1986 recommend 150-200 kg N, 90 kg P, 100 kg K, and 100 kg S, combined with 5 tonnes/ha of compost. Farmers have been found to apply considerably higher rates. Similarly, pesticide use was found to be higher than recommended. An agronomic survey in 1986 showed that pesticides accounted for 30-50% of the cost of production of chilli. Farmers applied 54-97 kg/ha on shallot, whereas the recommendation is only 22.4 kg/ha (On Farm Client Oriented Research 1990, quoted by Darmawan and Pasandaran).

12.3 Marketing

12.3.1 Domestic

Vegetable marketing channels in Indonesia are shown in Figure 7. A separation exists between the channel for local consumption and the channel for shipment to other regions. Vegetables destined for metropolitan markets are gathered by village collectors (pengepak), and then transported via inter-village collectors to large urban areas. The marketing of vegetables in towns is undertaken by the 'bazaar vendors' (pedagangkaki lima), who are usually village women who collect vegetables (about 100-200 kg at a time) from nearby farmers and transport them (by minibus) to the bazaar for sale. Their customers include housewives, as well as peddlers and keepers of small grocery stores (warung) in town.

It is estimated that of the vegetables produced in villages, about 70% is handled by village collectors and inter-village collectors, 10% is sent to the informal wholesale market by small collectors, and 20% is taken by bazaar vendors to local towns. In Indonesia, 99% of vegetables produced are sold in markets, mainly in large cities (Hayami and Kawagoe, 1992). The move away from traditional farming systems to new farming systems (commercial vegetable production) has greatly strengthened the integration of villages with markets. The Indonesian Government promotes the establishment of horticultural cooperatives, which are believed to reduce marketing costs.

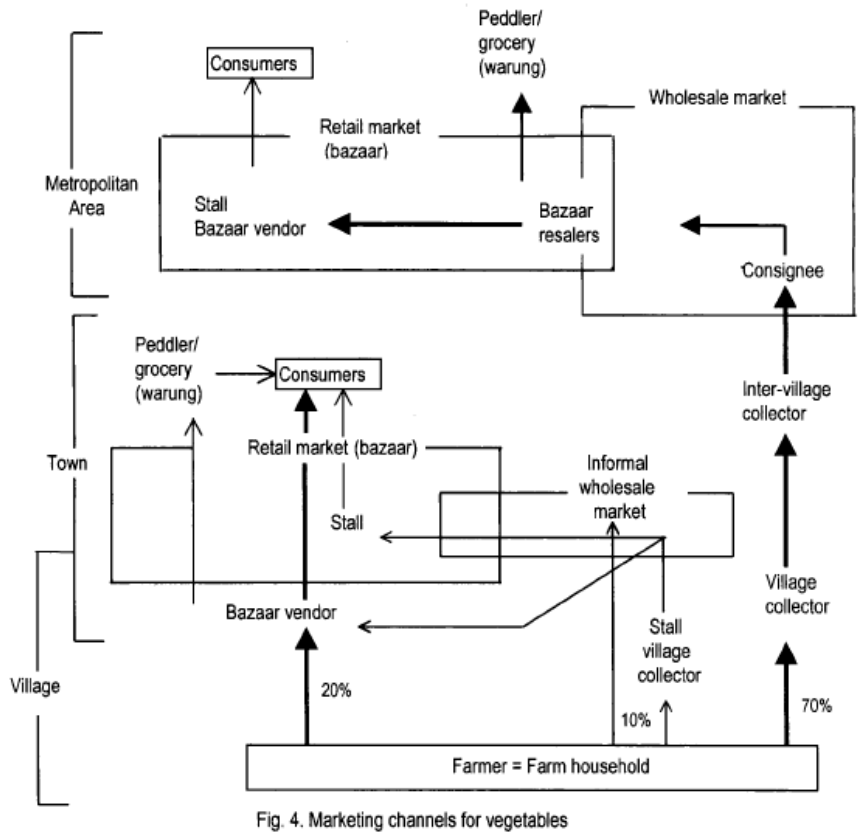

Fig. 4. Marketing channels for vegetables

Figure 6: Marketing channels for vegetables in Indonesia (from Darmawan and Pasandaran).

12.3.2 Export

The export of vegetables from Indonesia was valued at just over US$5m in 2005 (Table 5: CBS data). The value of fresh products amounted to only US$0.7m. Fresh, chilled or frozen product amounted for most of the export earnings. Exports are mainly to ASEAN countries and include cabbage, potatoes, shallots and capsicum.

Table 5: Value (US$) of vegetables exported from Indonesia in 2005.

Product	1st quarter	2nd quarter	3rd quarter	4th quarter	total
Leeks & other alliaceous vegetables	184	1,849	17,260	12,516	31,809
Other leguminous vegetables fresh or chilled	94,778	155,769	343,465	84,042	678,054
Other vegetables, fresh or chilled	148,756	409,310	256,189	194,090	1,008,345
Other vegetables frozen	20,590	26,171	3,239	458,142	508,142
Mixtures of vegetables frozen	333,382	225,591	371,204	566,069	1,496,246
Other preserved vegetables	67,160	39,292	70,503	113,677	290,632
Other vegetables dried	81,381	122,456	151,802	104,155	459,794
Other dried leguminous vegetables	27,513	3,066	30,524	103,535	164,638
Other vegetables & mixtures	53,390	141,266	125,928	206,508	527,092
Total	827,134	1,124,770	1,370,114	1,842,734	5,164,752

Source CBS: http://webdev.bps.go.id/tabel/

12.4 Conclusions

Vegetables are grown, harvested and handled under a wide range of climatic conditions, using various agricultural inputs (e.g. agricultural chemicals, fertilisers, etc.) and technologies, and on various farm sizes. Biological, chemical and physical hazards may, therefore, vary significantly from one production unit, or area to another.

12.5 Acknowledgements

The main source for this section was a book chapter by Darmawan and Pasandaran[1] and data from the Central Bureau of Statistics (CBS), Indonesia[2].

[1] *http://www.avrdc.org/pdf/dynamics/Indonesia.pdf#search=%22indonesia%20vegetable%20marketing%20delima%22*

[2] *http://www.cbs.id*

13 An overview of production and marketing of shrimp in Indonesia

Traditional brackish water shrimp culture in Indonesia, based on the capture of wild broodstock, has been practised for many decades by smallholder farmers. Intensive, large scale and semi-intensive smallholder production, based on the tiger shrimp (*Penaeus monodon*) began in the mid 1980s. The volume and value of production has increased steeply since this time, but disease outbreaks (e.g. yellow head virus (YHV) in 1991 and white spot virus (WSV) in 1997) have curbed production (Table 6). Large scale production is found predominantly in Lampung, South Sumatra, North Sumatra and Maluku Province. Among Indonesia's fishery products, shrimp contribute the largest foreign exchange earnings (approximately 50%). The majority (approximately 70%) of shrimp production is destined for export, primarily to Japan; the United States of America (USA); and the EU (Table 7:). More recently the Pacific shrimp (*Penaeus vannamei*) has been introduced. Culture is based on specific pathogen free larvae from large-scale commercial hatcheries. The Pacific shrimp plays a central role in the government's plan to increase shrimp production over the next 5 years (Table 8.). A key driver for the expansion of shrimp culture is the contribution it is expected to make to export earnings. The production target for shrimp production in 2005 was 300,000 tonnes; year on year increases in production of 16% are anticipated, resulting in production of 540,000 tonnes in 2009 (expected to be worth US$1.9b) (table 8:). Part of the national plan for expansion includes responsible use of antimicrobials (especially the elimination of banned products, e.g. chloramphenicol) and integrated coastal zone management to minimise the impact of other water use (e.g. industry) within the catchment on water quality.

Table 6: Shrimp production in Indonesia (FAO FishStat[3] data).

	Species				
Year	Giant tiger (P. monodon)	Whiteleg (P. vannamei)	Banana	Metapenaeus shrimps	Total
1962	0		17	-	17
1963	10		43	-	53
1964	25		85	-	110
1965	63		170	-	233
1966	128		170	50	348
1967	275		340	100	715
1968	588		340	200	1,128
1969	710		460	316	1,486
1970	859		1,320	800	2,979
1971	1,039		2,140	1,076	4,255
1972	1,256		2,924	1,500	5,680
1973	1,561		2,802	3,834	8,197
1974	1,788		4,546	2,782	9,116
1975	3,803		3,675	1,255	8,733
1976	5,099		4,253	3,363	12,715
1977	4,079		8,904	5,662	18,645
1978	4,600		8,996	5,479	19,075
1979	6,965		8,560	5,798	21,323
1980	6,317		8,021	6,697	21,035
1981	7,219		10,087	7,671	24,977
1982	8,783		9,039	9,507	27,329
1983	7,550		7,069	9,970	24,589
1984	10,318		8,010	10,410	28,738
1985	13,068		10,200	10,480	33,748
1986	15,424		11,540	10,110	37,074
1987	25,202		14,430	11,720	51,352
1988	44,450		15,120	12,930	72,500
1989	63,676		15,740	12,780	92,196
1990	67,355		14,950	17,820	100,125
1991	96,811		16,440	17,210	130,461
1992	98,358		18,510	18,230	135,098
1993	87,285		24,790	18,810	130,885
1994	83,193		20,280	21,550	125,023
1995	89,344		26,920	20,566	136,830
1996	96,237		24,470	22,130	142,837
1997	96,317		26,000	34,180	156,497

[3] *Available from http://www.fao.org/fi/website*

1998	74,824		19,000	17,300	111,124
1999	92,726		24,500	16,300	133,526
2000	90,483		23,200	16,500	130,183
2001	103,603		21,850	16,100	141,553
2002	112,840		21,002	18,389	152,231
2003	132,761		29,746	19,297	181,804
2004	131,399	53,217	28,727	16,928	230,271

13.1 Current Status

It is estimated that in 2004, brackish water shrimp (mixed shrimp and milk fish production) covered 489,811 ha, of which 75% was small-scale traditional production, 15% semi-intensive and 10% intensive production. Output varies from 400 kg/ha/crop for extensive to 1,500 kg/ha/crop for semi-intensive and 3,000 kg/ha/crop for the intensive systems. The average production of brackish water culture for the period 2000 – 2004 increased by about 8.6% per year.
In 2004, the total volume of fisheries exports was 223,020 tonnes with a total value of US$ 1,167,890, of which shrimp contributed US$887.2 m (Table 7:). Shrimp exports increased by 9 % per year for volume and 3 % per year for value during the period 2000 – 2004.

Japan was the main destination for shrimp exports at 49,282 tonnes (35.34 %); followed by the USA at 40,538 tonnes (29.07 %); China 2,411 tonnes (1.73 %); and the EU at 16 tonnes (0.01 %). Shrimp were exported as fresh, frozen, and canned products (Table 8:).

Table 4: Volume and value of shrimp exports from Indonesia by importing country, 2004.

I t e m s	**Japan**	**China**	**EU**	**USA**	**Others**	**Total**
Fresh						
Volume (ton)	579	48	-	105	5,880	6,612
Value (US $ 1.000)	3,226	13	-	1,257	9,834	14,330
Frozen						
Volume (ton)	48,338	2,314	16	32,799	36,144	119,595
Value (US $ 1.000)	384,654	12,933	95	222,683	176,423	796,788
Canned						
Volume (ton)	366	49	16	7,633	5,179	13,243
Value (US $ 1,000)	3,260	54	-	55,446	17,249	76,009
Total						
Volume (ton)	49,282	2,411	16	40,538	47,203	139,450
Value (US $ 1,000)	391,140	13,000	95	279,385	203,507	887,127

Source : Export Statistic Of Fisheries Commodities (2004).

Table 5. Target of shrimp production and export from aquaculture, 2005 - 2009

I t e m s	2005	2006	2007	2008	2009	%/Year
1. Production (ton)	300.000	350.000	410.000	470.000	540.000	16
P. monodon	97,823	109,888	126,228	146,615	162,355	
P. vannamei	202,178	240,112	283,773	323,385	377,645	
2 Export :						
Volume (ton)	147,000	171,500	200,900	230,300	264,600	15.83
Value(US $ 1,000)	1,073,100	1,251,950	1,466,570	1,681,190	1,931,580	16,23

13.2 Constraints

A case study by the World Trade Organisation (WTO) identified a number of internal and external challenges to the shrimp industry in Indonesia (Oktaviani and Erwidodo, 2005). Within the country, farmers face many challenges: disease (e.g. WSV); shortage of juveniles (larvae and fry); and shrimp feed and medicine. Effective regional planning is critical to ensure high water quality. The rapid growth of shrimp production in Indonesia has resulted in pond construction in areas not well suited to sustainable shrimp culture. Pollution of the water catchment by local industries, agricultural land use and human habitation has resulted in poor water quality (e.g. high levels of microbial and chemical residue contamination) with resulting disease and food safety issues. A system for shrimp culture health management exists and includes water quality control - however this system has not been widely implemented.

Externally, the Indonesian market has suffered from flooding of relatively 'cheap' imported shrimp into world markets, mainly from Vietnam and China, which has reduced profitability of shrimp production. World prices began to decline in 2002 when the US government enacted an anti-dumping measure against China, Thailand, Vietnam, Brazil and Ecuador. There is some evidence that some cheap imported shrimp are 'trans-shipped' to Indonesia's main export markets – the US and Japan (Anon., 2004a) Quality standards used by major importers, namely Japan, the United States and the EU are the other main external challenge. Indonesia's shrimps have been found to be contaminated by antibiotics such as oxytetracyline, chlortetracyline, and chloramphenicol (Anon., 2004b). The EU has since September 2001 required that shrimp imports be free from chloramphenicol and meet strict standards for maximum residue level (MRL) for other antimicrobials. The Indonesian government has banned the use of chloramphenicol in animal health (including use as an in-feed supplement) (Oktaviani and Erwidodo, 2005). The government and the Indonesian Fishery Business Association (GAPPINDO), encourages farmers to abandon the use of chloramphenicol, particularly during the harvest stage of cultivation.

The WTO case study (Oktaviani and Erwidodo, 2005) considered that for the Indonesian production system, efforts to meet the current international quality standard is likely be the major challenge for Indonesia's shrimp production in the near future, particularly for small-scale traditional systems which are susceptible to disease and therefore rely on antimicrobial therapy. However, the Indonesian government has taken action to some good effect. In 2001 the Government reiterated a chloramphenicol banning regulation that had been enacted in 1982, and established a special task force, at both the regional and national levels, to enforce the ban. Regular monitoring (carried out in all major shrimp producing regions) found that 8.6% out of 10,115 samples from seven provinces were found to contain chloramphenicol (Oktaviani and Erwidodo, 2005).

13.3 Food chain – production to consumption - Smallholder farmers

Smallholder farmers are often organised into locality based farmer groups (~25 per group). Middlemen buy shrimp directly from farmers or farmer groups. The output from many farmers is pooled and sold on to processors (Figure 8). Pooling the produce from many farms creates problems for implementing traceability when issues arise. Some middlemen are thought to cheat farmers using practices which increase food safety risks. Infrastructural problems may compromise food safety, such as a lack of ice making machines, or production of ice with contaminated water. Cold stores and processors in general have HACCP programmes and maintain records that would allow traceability back to this point in the supply chain.

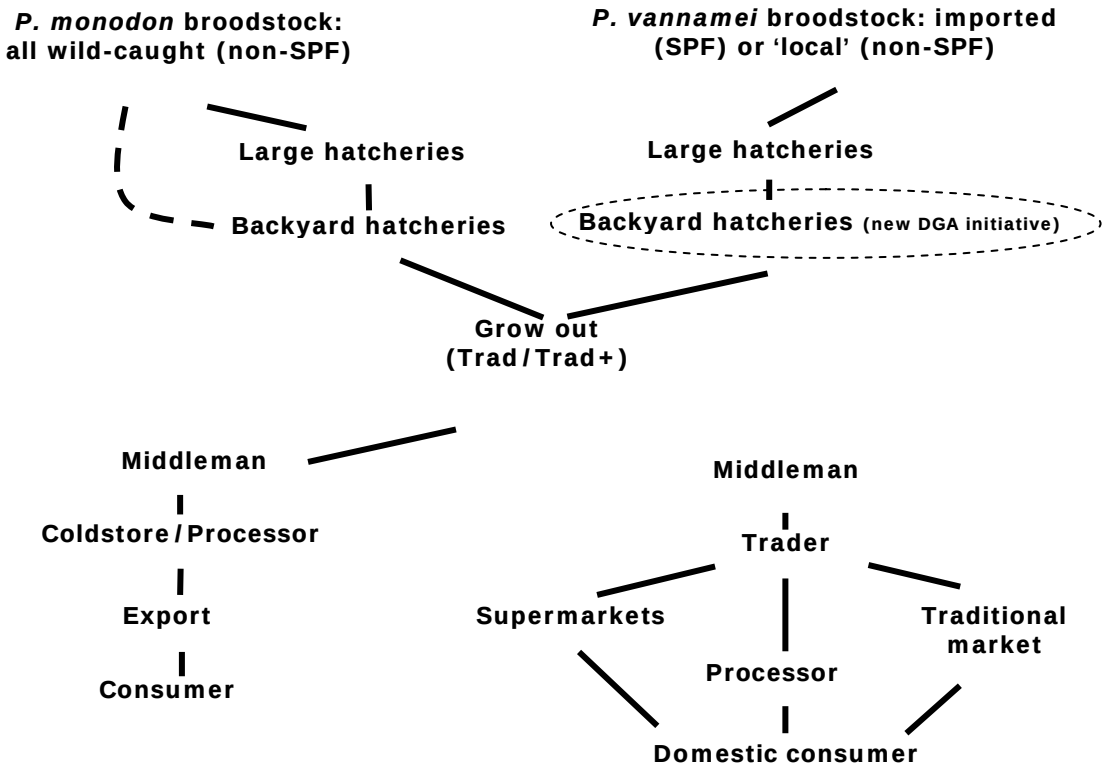

Figure 7. Indonesian smallholder shrimp supply chain – export and domestic (source: Dr Callinan)

13.4 Large-scale production

Large-scale intensive production is exemplified by PT Charoen Pokhand Indonesia, part of the CP Group of companies, which is the largest shrimp producer in the world. Production is fully vertically integrated. The company owns feed mills with a capacity of 181,800 MT per year, 50% of all shrimp feed production in Indonesia. Advanced hatchery facilities cover 128 hectares and produce high quality disease free (SPF) and resistant stock. The hatchery supplies the ongrowing operation as well as selling stock to other farmers. Ongrowing takes place in Lampung, Medan and Paiton and cover a total of 160,000 hectares (3,700 ponds) which produce 50,000 MT per year. Water is disinfected and recirculated within a closed system. Antibiotic usage is minimised. Processing capacity is at about 53,000 MT per year. The company operates to international food safety standards, has a comprehensive biosecurity programme and has complete chain traceability (including raw material used for feed).

13.5 Extension and certification

The responsibility for agricultural extension has been devolved to the district government. There is a shortage of aquacultural extension workers at the district level. As part of the GAP and biosecurity, a system of certification for hatcheries and grow out farms has been established. Take-up has been relatively low (up to 2004, 7 shrimp hatcheries and 13 farms had received a GAP certificate).

13.6 Acknowledgements

A report by Dr Fatuchri for the Directorate General of Aquaculture (October 2005) was used as one of the main sources for this report

14 Demand drivers for food safety in Indonesia

14.1 What drives demand for food safety?

Demand drivers for food safety in Indonesia currently originate from either government regulation or from market forces operating through market chain participants such as food processors and major retail organizations such as supermarket chains.

A comprehensive set of government regulations to enforce food safety standards exists in Indonesia. However, enforcement is inconsistent (appendices 1& 2). Moreover it is unlikely that stricter enforcement of current regulations would on its own meet the need. A mix of drivers is needed.

Domestic and export markets create economic drivers for food safety, both through price signals and through imposition of requirements which suppliers must meet in order to have product accepted for sale. Consumer awareness of food safety risks is not very well developed amongst the majority of the Indonesian population. Market forces operate to enhance food safety in only a few sectors of the food supply market, such as supermarkets (hypermarkets); fast food chains; hotels; and major restaurants. At present, market drivers for food safety are more clearly apparent in the export market than they are in the domestic market.

Of the commodities under consideration, only shrimp have a significant export market, and hence there are more clearly apparent demand drivers to ensure that products meet the required standard. Stringent, well enforced regulations in importing countries have created strong economic drivers for high food safety standards (notable control of antimicrobial residues) in shrimp destined for export.

14.2 Government intervention and regulation

Food safety regulation in Indonesia is based on the Indonesia National Standard (SNI) which are issued by the National Standardisation Institute. A number of government agencies and directorates have responsibility for food safety. Lack of adequate regulations are cited as an obstacle to food safety by the Directorate of Environmental Health, but not by any other organisations. Poor monitoring and enforcement of the current regulations are important issues. For example; the work of the National Agency of Drugs and Food Control, which has the responsibility for inspecting food manufacturers and distributors, is constrained by limited technical and scientific capacity, and poor laboratory facilities. Many of the regulatory controls in Indonesia are overcomplicated and sometimes inconsistent or unclear. For example, the file of all current regulations which govern the activities of street vendors runs to 90 pages, and the requirements imposed on

vendors are difficult to understand and interpret accurately. It is unlikely that most street vendors are aware of the existence of these regulations, and certainly would not have sufficient understanding of their content to be in a position to comply. In addition, multiple (and sometimes inconsistent) regulations apply to the same area of food safety, resulting in confusion. The lack of monitoring of potential food safety hazards and poor enforcement of food safety regulations effectively reduces to a low level the effectiveness of government intervention and regulation as drivers for food safety. Major suppliers of food products tend to follow international standards for food safety practices, and hence would comply with Indonesian regulations in most respects, particularly those recognized internationally to be important influences on food safety.

14.3 Market drivers

14.3.1 Export markets

The large majority of shrimp are exported. Most importing countries, e.g. the EU countries and North America, have set very low values for maximum acceptable levels of antimicrobial, chemical and microbiological contaminants, based on the Codex Alimentarius Standards. Consignments are routinely tested. Additionally, requirements for traceability have been implemented. EU standards are enforced and regulated at the country level, whereas the USA and Japan enforce food safety regulations on a company basis. In 2001 the EU began testing 100% of imports of shrimp from Indonesia (and other countries) for residues of chloramphenicol and nitrofurans. The acceptable residue level was 0.3 parts per billion (ppb), a level of contamination that many Indonesian laboratories might find difficult to detect. In response, the Government reiterated a ban on the use of these antibiotics in aquaculture, that had been enacted in 1982, and began regular monitoring. Nevertheless, detection of chloramphenicol in Indonesian shrimp in 2001 resulted in a fall in exports to the EU of 64%. Food safety regulations implemented by countries importing Indonesian shrimp provide strong financial drivers for food safety.

14.3.2 Domestic markets

No hard evidence exists on which to estimate the demand from the Indonesian consumer for stringent food safety standards. However, the level of concern as reflected in media attention and other indicators appears to be low most of the time, with occasional peaks when a specific issue achieves prominence. Mild to moderate cases of gastroenteritis associated with microbial contaminants of food products are considered "normal", and only serious disease problems affecting unusually large numbers of people are likely to come to official attention. Only a very small proportion of consumers are fully familiar with modern food safety standards and safe food handling procedures, and most consumers are unaware of the extent of risky practices.

Traditional Indonesian practices, such as short market chains, prompt cooking of harvested foods at high temperatures in the home, and use of spices in cooking, have no doubt been protective in the past. They also limited the scale and visibility of food-borne disease outbreaks – which on anecdotal evidence were quite common but localised. This may be due to a lack of food safety awareness, or because consumers consider that food preparation methods eliminate most hazards. Nevertheless, some producers and organisations consulted for the preparation of this report considered that outbreaks of FBD can negatively affect the image of a company or product.

14.3.3 Changes in the operation of the domestic market

In most traditional rural areas of Indonesia food is in part produced by the family, and in part purchased in traditional open markets (pasar) or bought from carts off roadside or mobile sellers. Apart from packaged goods, the market chain remains short for most products, and fresh products were not kept in the shop for long. However, mini-markets

gradually emerged in the larger urban areas to provide a reliable supply of food items, and have continued to grow in numbers. Their density is highest in Jakarta and other densely populated cities of Java, but numbers are quite limited in the more distant parts of the country. In 1971, the first supermarket was established in Jakarta. There was no growth for a decade, but then, numbers of supermarkets began to grow rapidly, and there are now almost 1,000, a high proportion of them in Java. Even larger and more comprehensive hypermarkets were introduced by international companies from the mid 1990s, and have grown in number in the densely populated cities, particularly in Java. At the end of 2005 there were 83 hypermarket outlets operating in Indonesia, compared with only 68 at the end of 2004. In addition to hypermarkets, at the end of 2005 there were 961 supermarkets and 6,272 mini-markets operating in the country.

Supermarkets, hypermarkets, international standard hotels and large restaurant chains are in a position to apply their own private food safety and other quality standards. This allows supermarkets to charge premium prices for 'quality' branded products and, therefore, to pay higher farm gate prices for product which meets their requirements. Thus, these retailing organizations may generate economic drivers for food safety. Factors encouraging them to give emphasis to food safety include demand by the public for greater quality assurance on foods, lack of trust in government regulation, and in the case of international companies, the imposition of global standards to which all parts of the company must conform. Enquiries to people familiar with this high end of the retail sector in Indonesia, it appears that all three of these factors are operating to a steadily growing extent, as the mix of purchasing patterns changes in the major Indonesian cities. International companies are very aware of the adverse publicity that can be generated by FBD incidents far beyond the area in which an incident occurs, and therefore prevention of such incidents throughout the global organization is a high priority. Consequently, these organizations expect high food safety standards from their suppliers. Many lay down stringent food safety standards which in Indonesia, typically, can only be met by large-scale producers.

At present in Indonesia, companies which impose their own food safety and quality standards on food products they use in their business tend to import a substantial proportion of products rather than buy all their requirements locally within Indonesia. Therefore, there is a need to build improved food safety systems within Indonesia before demand can become apparent, but there will inevitably be little motivation to establish such systems unless there is a benefit from doing so. Experience elsewhere has been that such developments take many years to evolve, and often rapid progress is precipitated by a serious disease outbreak which attracts national media attention to the issue.

14.4 Conclusion

Currently, the impact of government regulation in achieving a safe food supply for the Indonesian population is patchy and limited, with most of the protection coming from use of traditional food production and handling systems. However based on experience in other countries, as urbanisation of the community proceeds at a rapid rate and food supply chains lengthen and diversify, the frequency of FBD outbreaks will increase. Refinement and modernisation of the regulatory framework and enhanced implementation of regulatory measures, combined with increased monitoring to verify compliance, will strengthen the government drivers for food safety. Clear drivers from importing countries have ensured very high food safety standards in large-scale production of Indonesian shrimp. Small-scale producers have been less able to respond to these drivers, for reasons discussed in section 5. The lack of traceability within the small-scale sector reduces the incentive to maintain high food safety standards, and undermines national commitment to expansion of this important export industry.

15 Main food safety risks in Indonesia

The main food safety risks in Indonesia were identified through a series of information gathering and consultation processes. Discussions were first held with key stakeholders using a structured questionnaire to obtain information about organizations involved in food safety, their activities (Appendix 2 and 3), and the views of interviewees on important food safety risks, how they should be managed, and what research needs they see as most urgent.

15.1 Institutional issues

Government departments and institutes, producer and industry organisations and other people with relevant knowledge and experience were interviewed individually using a structured interview format and asked to identify problems and obstacles in food safety (a full report of the responses of each organisation is given in Appendix 3). Many of the respondents highlighted institutional issues: overlapping of responsibility and authority between different government institutes involved in food safety; lack of coordination between institutes; poor enforcement of regulations; and a lack of laboratory capacity (both trained personnel and physical resources). A notable conclusion from the various consultation processes was that there is debate among the various food safety specialists about which organizations have responsibility for particular aspects of food safety, and considerable uncertainty about how particular types of incidents and issues would be dealt with. A lack of understanding of food safety issues by both farmers and consumers was also noted.

15.2 Red and white meat

The principal food safety risks are associated with handling practices late in the food chain, rather than with practices during the rearing of the animals. The majority of animals are reared under traditional husbandry systems, and while they may be infected at the time of slaughter with a number of food-borne pathogens, concentrations at this point are typically low. Whether or not these organisms may later cause human disease depends largely on slaughter practices and post-slaughter processing of the carcase.

One exception to this is anthrax, which causes outbreaks in some parts of Indonesia. In cases where people are unaware of the risks, these animals may be consumed and those involved in preparation and consumption of such animals may be exposed to anthrax. Vaccination of animals at-risk and education about the risks of eating anthrax affected animals are the most appropriate responses, and this is a very special case of FBD. A second issue is where animals imported for local fattening and subsequent slaughter have previously been treated with a hormonal growth promotant, and are slaughtered shortly after importation instead of being fattened further in accordance with normal practice. This is a minor problem which is best dealt with by taking measures to avoid premature slaughter of imported animals.

The main issues exposing consumers to food-borne infections and other hazards relate to poor hygiene at slaughter, and faulty handling and storage of foods during processing and marketing. Both of these can cause high bacterial loads and rapid spoilage, or exposure to specific disease agents such as pathogenic *E. coli* and enterotoxigenic staphylococci.

Slaughtering practices are variable between the different classes of slaughterhouses, which are classified into types A to D. There are almost 1,000 slaughterhouses registered, of which 1% are Type A, 2% are Type B, and the remainder are Type C and D. Almost 80% of registered slaughterhouses process ruminants, 20% process pigs, and there are

only nine registered poultry slaughterhouses, all other poultry being slaughtered in unregistered sites.

Type A slaughterhouses have relatively modern facilities and follow accepted international procedures and produce meat for export. They are almost all located in Java and have the best veterinary supervision of slaughter and processing. Type B slaughterhouses are also mainly in Java, and produce meat for the upper price range of the domestic market, whereas Types C and D are located throughout Indonesia, produce for the local market around their location, and have low hygiene standards. The level of veterinary supervision and adherence to effective hygiene practices falls off very rapidly from Type A to Type D, so the likelihood of food safety hazards being associated with meat rises rapidly.

Where storage of cooked or partly cooked meals allows bacterial growth, enterotoxigenic *Staphylococcus aureus* and *Bacillus cereus* are the most frequently identified causes of food-borne illness, being commonly associated with traditional food chain handling procedures. Salmonellae and *Escherichia coli* are also commonly isolated in food safety investigations following outbreaks of illness, although only relatively large-scale outbreaks are usually investigated. *Campylobacter* is not routinely cultured for using procedures which would detect it, and (based on the absence of evidence to the contrary) is not thought to be a significant problem. This contrasts with its high importance in developed countries. The explanation for this major difference is uncertain, but is possibly due to foods being well cooked and incorporating a range of spices. Norovirus is not seen as a significant issue, although the nature of the investigations undertaken in food poisoning incidents would be unlikely to detect it even if it were causing problems. Other potential causes of FBD such as *Listeria* and *Yersinia* are not routinely considered in investigations. If they occur, they would probably be more associated with modern food handling practices than traditional ones.

Although laboratory investigation methods currently used for food safety monitoring in Indonesia would not detect most of the pathogens that are of concern in developed countries, the limited evidence available suggests that the pathogens of current importance are the ones which are found in 'traditional' food production and distribution systems, such as enterotoxigenic *Staph. aureus*, pathogenic *E. coli* and Salmonellae. It is likely that as Indonesian food production and distribution evolves to fit a far more urban population, the pattern of food-borne hazards of importance will gradually shift towards that seen in highly developed environments.

Because of the nature of the slaughtering and processing practices, bacterial contamination of meat and consequent spoilage at tropical temperatures is a major issue, which has traditionally been managed through the addition of formaldehyde or borax (sodium borate) to products during preparation. Use of both products is banned because of their health risks, but it appears that they are still commonly used because they remain the most practical method of extending shelf-life.

Antibiotic contamination due to use of antibiotics during the growing period is of concern and is monitored, but antibiotics are not used extensively in white meat production.

A new risk which has emerged in relation to home slaughter is avian influenza, which has caused human disease and deaths in various parts of Indonesia, but has been relatively rare in relation to the level of exposure of the rural community to avian influenza H5N1.

Indonesia has not had a case of Bovine Spongiform Encephalopathy (BSE), although in the past it has imported risk materials, and the current policy allows importation of meat and bone meal from low risk countries for use in the poultry industry. It would not be useful or appropriate for Indonesia to conduct research on BSE, but it is important to maintain vigilance to avoid the BSE agent entering the Indonesian food chain.

Other food safety risks originate from illegal methods used to prolong shelf life, in particular, the use of borax and formaldehyde in meat products.

15.3 Vegetables

15.3.1 Background

Recent outbreaks of food-related illnesses linked to fresh produce worldwide have increased concerns about the safety of fresh fruits and vegetables. Pathogenic micro-organisms are not part of the natural ecology of fresh produce. Therefore, disease causing microbes present on vegetables are present due to inadvertent contamination, which can occur when produce comes into contact with contaminated water or equipment; improperly composted manure; unsanitary human handlers; and food preparers and/or pests. Contamination of vegetables may occur during growth, harvest, processing or preparation in the home. As many potentially pathogenic micro-organisms are ever-present in the environment, exposure of vegetables to these contaminants depends on opportunities and the level of good agricultural practice and hygienic measures employed. The likelihood of contamination may also depend on the type of crop. For example ground crops that are not peeled, such as field-grown lettuce, tomatoes and spinach, are more prone to contamination, compared with vegetables such as potatoes which are peeled and cooked. Total elimination of contamination through treatment and processing, other than heat, is difficult.

Microbiological contamination of vegetables is effectively eliminated through cooking. However, trends in recent years have favoured increased consumption of raw vegetables in salads, an increased range of vegetables used raw, and lighter cooking of vegetables. While nutritionally this is a positive development, it also increases the exposure of consumers to vegetable-borne pathogens and increases opportunities for cross-contamination, which has contributed significantly to food-borne illnesses.

These global trends, in conjunction with the importance of vegetables in the Indonesian diet, suggest that microbiological causes of FBD arising from the consumption of vegetables constitute a significant health impact. While the extent of the human health impact is currently unknown improvements to the hygienic production of vegetables through implementation of good agricultural and horticultural practices throughout the food supply chain are seen as an important step to improving the ultimate safety of vegetable products and in preventing food-borne illness. Such measures should however be kept in perspective as cross-contamination can occur at any point within the food supply chain, including within the home and a whole of chain approach must be taken to effectively reduce microbial FBD.

15.3.2 Small scale production

The major concern around the small scale vegetable production industry is that of public health. In this respect, produce in the small scale setting is considered to have a high likelihood of contamination with pathogenic micro-organisms as well as chemical residues such as pesticides. The routes of contamination within the supply chain and the nature of contaminants found on produce in Indonesia are unknown due to a lack of data, but a range of practices associated with vegetable production as outlined below are considered important potential sources of food safety problems.

Human effluent

The use of human effluent for fertilizer is prohibited in Indonesia and for cultural reasons is considered not to be widely practised. The accidental contamination of crops from this route may occur in villages through poor location of waste facilities, via direct contamination or indirect through contaminated surface irrigation water. The food-borne

viruses such as Hepatitis A and E, Noroviruses; parasites such as *Cryptospridium* and *Cyclospora*; and bacteria such as *Salmonella* and pathogenic *E. coli* are the most likely public health hazards, capable of contaminating fresh produce and causing disease.

Pesticide use

Excessive levels of pesticides are considered to be a major food safety issue in locally gown produce from smallholder farms. Excess contamination is thought to occur through improper use of pesticides and use of unregistered chemicals. There was some anecdotal evidence of occasional illness in farmers through occupational exposure to pesticides, most likely from the organophosphate class of pesticides, but no documentation of this was available. There is no routine monitoring or systematic testing of crops for pesticides and comprehensive maximum residue limit (MRL) standards have not been developed for Indonesia. As a result, there has not been sufficient incentive for farmers to ensure compliance with chemical application standards, since enforcement measures to achieve compliance are unlikely, and the benefits of expanding market size and achieving higher price premiums from entering new market segments are not available or are not understood and acted upon.

Guidelines for pest control and use of pesticides are being implemented by larger producers but this is still not widespread, and effort directed to enhancing education is still poor.

15.3.3 Large scale production

The major issues experienced by the large fresh vegetable producers are in the area of their capacity to consistently comply with quality standards. Market failures have been seen when chemical (pesticide) residue levels, despite complying with Indonesian standards, have been above those required by some markets. One large company has had difficulty in complying with domestic supplier requirements for pesticide MRLs in lettuce. The export of capsicums to Singapore has been disrupted as a result of these markets demanding more stringent MRL standards than apply within Indonesia.

In large scale production farms, the quality of the water source used for both irrigation and washing can vary, depending on the season, and this presents difficulties in assuring quality of the final product. Problems with reduced shelf-life of products have occurred when water quality is poor.

Large scale producers of vegetables in Indonesia report that the major microbiological concerns are pathogenic *E. coli*, *Staphylococcus aureus*, *Salmonella* spp. and *Listeria monocytogenes*. Chemical risks (other than pesticides) cited were chlorine and heavy metals such as lead; copper; and zinc.

Although there has been no evidence in Indonesia that vegetable products from large scale producers have been responsible for human illness, such establishments (as demonstrated by large, widely disseminated food-borne outbreaks overseas) pose a potentially high food safety risk if controls are inadequate. This is due to: greater scale of production and wider geographical distribution of product; a higher degree of processing and handling that brings with it greater potential for introduction of hazards through cross-contamination from workers (e.g. Norovirus, Hepatitis A, Salmonella); equipment or the environment (*L. monocytogenes*, Salmonella); and in the case of fresh cut ready-to-eat vegetables, extended periods between harvest and consumption due to the longer production and distribution chain. The latter may lead to further growth of pathogenic micro-organisms if already introduced. Fresh cut ready-to-eat products may also be packed under modified atmospheres and refrigerated to extend shelf-life. This may enhance conditions for the growth and survival of some pathogens such as *Listeria monocytogenes* and *Clostridium botulinum*.

15.4 Shrimp

15.4.1 Background

The key shrimp food safety risks can be categorised according to the following stages of the production and processing chain: production; processing; distribution; and retail. Shrimp food safety risks are summarised in Table 9. Microbial, heavy metal and antimicrobial residues contamination are the most important shrimp food safety risks. Microbial contamination may occur throughout the shrimp production chain (including use of contaminated water and ice; cross contamination; poor personal hygiene by food handlers during processing; distribution; and retail).

Table 6: Shrimp food safety risks.

Production
Heavy metal contamination
Antimicrobial residues
Chemical residues (e.g. pesticides)
Microbial contamination (e.g. salmonella & vibrios)
Processing and retail
Foreign bodies (e.g. stones) and organic matter contamination
Contaminated water and ice
Spoilage
Disinfection (leading to chemical contamination)
Distribution and retail
Cross-contamination
Inadequate cold chain facilities

During production, microbial contamination may result from using water that has been contaminated with untreated sewage. Similarly, the proximity of human habitation to shrimp ponds may result in direct contamination with human waste. Ruminant and other livestock grazing the pond banks or kept near the ponds may result in animal waste directly entering the ponds. Some small-scale farmers fertilise ponds with chicken manure to stimulate algal growth-a practice which will lead to microbial contamination. It was also suggested that some bacterial shrimp diseases may result in low levels of microbial contamination which are amplified during processing. Pesticide residues may result from use by the farmer of pesticides to control crustacean or mollusc pests in the ponds, or from a contaminated water supply (due to agricultural use of pesticides in the catchment). Heavy metal contamination results mainly from industrial activity contaminating water supplies. Nationally, the importance of heavy metal contamination is uncertain but unlikely to be high. However, it could be an important issue in some areas.

15.4.2 Microbial contamination

Management programmes successfully control microbial contamination in large scale production. The main challenge is adapting and transferring, where appropriate, these practices to small-scale producers. Sources of microbial contamination fall into two broad categories: those related to the water supply; and direct contamination of the pond. In the first category the contamination may occur at some distance from the farm and is generally outside the control of the farmer. Indeed, farmers might often be unaware of the level or type of microbial contamination in the pond or of their product (rapid, pond-side tools for detection of microbes in small-scale production might facilitate the implementation of management strategies). Large scale producers are able to ensure that

the water supply is unpolluted or treated, options which are not generally available to the small-scale producers.

GAP for the management of direct contamination at the farm level are adequately developed and available, but not widely implemented. Traceability of product back to the producer is needed to underpin a system of incentives or penalities for food safety. Traceability is not currently possible in relation to small-scale producers. The low volume of production per smallholder (~200kg per harvest) is a major obstacle to effective traceability. In some areas, farmers are working together in farmer groups which might allow traceability back to the farmer group, if not the farmer.

Management practices exist, or could be developed based on current knowledge, to mitigate microbial contamination at other stages in the food chain (i.e. processing; distribution; and retail). However, the data does not exist to evaluate the type and level of contamination in the marketed product (or the number of FBD outbreaks related to shrimp) or where in the food chain contamination occurs. Therefore, currently it is not known where effort should be focused.

15.4.3 Residues

Antimicrobials are used in both hatcheries and on-growing farms. However, bacterial infections are generally a greater problem for hatcheries, compared with on-growing farms, and antimicrobial usage is probably greatest at this stage of production. Antimicrobials may be used in feed (usually mixed on the farm) or added directly to the pond (at the water inlet). There are two main problems: the use of banned antimicrobial (e.g. chloramphenicol); and residue levels of antimicrobials which are registered for shrimp production, but are present in product at concentrations which exceed the MRL.

Many small-scale producers purchase small quantities of antimicrobials in unlabelled bottles. Therefore, they may be unwittingly using a banned antimicrobial and receive no information about usage (i.e. dose rate). Secondly, the small-scale producer may not be able to understand the instructions for use if available, or have the means to measure the quantities used. On-growing farmers may unknowingly purchase larvae that have been treated with a banned antimicrobial. Farmers are likely to be guided in their choice of antimicrobial by the salesperson, who may give unwise advice. Inappropriate use will result in residues greater than MRLs if excessive amounts are used or withdrawal periods are not observed. In general, farmers do not have access to veterinary advice or diagnostic facilities to assist them in identifying, preventing and treating bacterial problems. Currently, the scientific basis for recommending alternatives to antimicrobials in shrimp production is inadequate.

The problems of pesticide residues mirror those discussed above for antimicrobials. Pesticides might have contaminated the water used in shrimp production, some distance from the farm (due to agricultural run off), which farmers can do little about. The other sources of pesticide residues are due to the use of banned pesticides or inappropriate use of pesticides registered for use in aquaculture.

Heavy metal residues are mainly a problem for production located in the proximity of industrial centres. The problem lies in water management at a regional level. Monitoring is required to provide advice to farms on the likelihood of heavy metal residues. Current government facilities cannot provide an effective monitoring service. Expensive equipment (Liquid Chromatography/ Mass Spectrometry; and LC-MS) is required to detect heavy metal contamination at the low levels required by the EU for imported products (ppb v. ppm).

Exported shrimp products have to be tested for residues by the laboratories of the designated competent authorities (CA). Therefore, shrimp destined for export must be tested by the government fisheries laboratories. Independent laboratories are not permitted to do this work, though their capacity might be comparable if not better. This situation is currently under review.

16 Potential interventions to address the identified food risks

A number of interventions to address the identified food risks were recommended. For a number of food risks, further research will be required to better characterize the risks before appropriate interventions could be developed.

16.1 Red and white meat

Two main interventions were identified for red and white meat:

- Interventions to reduce the total bacterial load and the pathogen load of chicken meat
- Low cost safe methods of extending the shelf-life of meat.

16.2 Vegetables

The main interventions identified for vegetable production were protocols for GAP and good hygiene practice (GHP) for village farmers.

16.3 Shrimp

Interventions were identified in two main areas: antimicrobial residues; and training and extension. The problem of antimicrobial residues can be addressed through a number of related interventions:

- Systems to ensure traceability of product back to small-scale shrimp producers
- Development and implementation of a system of incentives and penalties to encourage safe use of antimicrobials
- Promotion of alternatives to antimicrobial therapy.

The second intervention identified was the implementation of an improved system for extending food safety messages, including the appropriate use of antimicrobials to farmers through training programmes and other activities (e.g. demonstration farms).

16.4 General

Various issues were raised which are not specific to any one of the product groups of interest, but relate to food safety procedures in general in Indonesia. These relate to the suitability of current regulations, the capacity of government agencies and laboratories to provide the compliance monitoring and problem-solving support needed to improve food safety, and the development of a food safety framework which better meets the emerging needs of Indonesian society as the population becomes increasingly urban rather than rural.

16.5 Summary

Interventions for meat and vegetables will reduce food safety risks to the Indonesian consumer. It is not possible to priority rank these interventions owing to the lack of information on occurrence of disease due to the various food-borne hazards. Since the majority of shrimp are exported, the interventions identified seek to reduce costs associated with the rejection of consignments (due to residues) and to improve the food safety image of Indonesian shrimp.

17 Research questions for food safety in Indonesia

Considerable effort was made to gather data to directly assess the occurrence, severity and principal causes of FBD in Indonesia, but scientific evidence is sparse, and did not provide an adequate basis for objective evaluation. It was therefore necessary to rely heavily on opinion and accumulated experience of the people who participated in the information gathering activities. An important component of the research activity should therefore be work to provide scientific data which would clarify which issues deserve priority in later research projects.

17.1 Red and white meat

17.1.1 Introduction

In order to better understand the food safety risks, it is necessary to examine the supply chain along its length, both to characterise the risks and to identify the points in the chain where they arise. The issues are more complex and of greater concern in relation to the more traditional small-scale production systems, and research should focus on these systems (FAO Poultry Sectors 3 and 4), rather than the large scale commercial types of production through poultry companies (FAO Sectors 1 and 2). A major challenge is how to find ways to encourage and support the small-scale end of both white and red meat sectors to follow simple, low-cost measures to improve food safety. This is an important area to research. It is also necessary to raise the profile of food safety to the consumer, so that consumers will in future expect higher food safety standards and producers will be encouraged and provided incentive to meet those expectations.

17.1.2 Potential projects

Microbial risks along the chicken meat food chain

Microbial risks along the chicken meat food chain need to be urgently examined in the small-scale poultry production and processing system. The flocks being classified in FAO sectors 3 (small commercial broiler units in villages), and 4 (small family flocks in villages). Sector 3 is particularly important in this context, because the meat will be marketed widely and could therefore put quite large numbers of people at risk. In addition, when inexperienced producers scale up from a backyard to a small commercial flock, they may lack adequate understanding of the health risks which can arise. Sector 3 producers buy DOC from commercial suppliers, and then expose them to a whole range of hazards in the village. Such birds would not be exposed in most sector 1 and 2 flocks. Others may buy chicks or older birds from local suppliers who may also be less than expert, which adds another source of risk. In contrast, sector 4 flocks typically breed their own replacements and thus gain a degree of protection by being self-contained.

A valuable study would therefore be to compare levels of FBD agents in broiler chickens reared as commercial operations in village environments with traditional village chickens (ayam kampung) reared under free-range conditions. The study would examine risks at

production level, and then (for sector 3 particularly) the risks through the transport system; slaughterhouses; and live bird markets, including slaughter in the live bird markets. It would be desirable for such a study to deal with an area of high poultry population density such as Java, and a much less dense area such as Sulawesi, but the most critical study location would be Java. Sampling would also be undertaken on poultry meat after processing into market-ready products, and on these products at the point of consumer purchase (for example; bakso vendors and chicken meat available for sale in local traditional markets and supermarkets). The work would identify which pathogens are present at each stage of production, and would use molecular epidemiology techniques to evaluate whether the pathogen populations at various stages were being maintained from earlier exposures, or represented fresh re-contamination of product after elimination of the organisms present on birds sampled earlier in the chain. Experience in other countries with such studies suggests that the pathogen load is dynamic as the bird moves through the market chain, and it cannot be assumed that levels of organisms found at one point in the chain will be an accurate guide to levels at a later point. Organisms associated with product spoilage but not with disease would be studied in parallel with pathogens, since these organisms are important in the Indonesian environment, and at this stage of investigation it would be very helpful both for this study and for the next one proposed, if bacterial load variation could be better defined in relation to risk factors.

Considering the importance of avian influenza at present in Indonesia, the study design described for typical food-borne pathogens would also provide an ideal opportunity for investigating avian influenza virus epidemiology in chickens and the risks of exposure of the village population. This falls marginally outside the range of true food-borne agents, but a cooperative study with another research group may be able to gain considerable benefit from sharing field activities and support resources.

As a further stage in the work, the effects of various techniques for reducing the total bacterial load and especially the pathogen load would be evaluated, using both unapproved methods such as formaldehyde or borax, and approved methods (including if possible, results coming from the project to be described below – safe methods for extending shelf-life). This would then allow safe methods of extending shelf-life to be promoted to processors and vendors.

It would be desirable to later conduct a similar study for locally-produced red meat and pork, especially for beef. Most red meat and pork is produced in government controlled slaughterhouses, kept in cold stores and sold from there to butchers and market vendors daily, then sold to consumers who typically cook it on the same day that they buy it. Some red meat is also processed into products such as bakso, and sold by street vendors. However, the urgent need is for a study of chickens.

Safe methods of extending shelf life of meat products

The use of formaldehyde and borax are not appropriate or legal methods to extend shelf life, but they are low in cost and achieve the vendor's objective of minimising wastage of unsold product. Hence, they continue in use. This research project would develop low cost safe methods of extending shelf-life, and would then undertake follow-up field activities to ensure that the new methods were adopted, including field testing within the project described above. It would be a laboratory study in the first phase, so could be initiated rapidly, with the hope that appropriate methods could be identified fairly quickly, using information from the published literature to guide the work.

Understanding knowledge and attitudes of consumers and meat handlers concerning food safety issues

At present, views of both consumers and handlers at various stages of the meat chain about how food safety risks might arise and how they should be managed are not

documented or well understood. If members of these various groups have either little knowledge, or a seriously flawed understanding of factors influencing food safety, then this would be an important element of guidance for any public information program to reduce food safety risks.

Such a study would be conducted using social science methods, which would require the involvement of experts in evaluating community understanding of issues affecting their well-being. The study could be undertaken fairly quickly, and at a moderate cost. It would not directly improve food safety, but would provide essential guidance for implementing the findings from the other two projects described above.

17.2 Vegetables

17.2.1 Food chain hygiene

There is a need to comprehensively explore and collate sources of information across the vegetable supply chain to determine how both, methods of preparation and consumption of vegetables and the agricultural practices relating to their production, processing and sale (risk factors) may impact food safety and human health. As much of the data relating to food safety and public health are generated at district and sub-district level. More active methods to collate data and experiences concerning food safety risks must occur at this level. In order to capture this data, careful planning (including resource allocation) for meetings and consultations with the various agencies and appropriate personnel at provincial, district and sub-district level is required.

As a complementary activity, other countries in the region with similar farming practices should be approached and asked to provide information from their experience which would provide evidence linking FBD and safety issues to the consumption of fresh produce. This would include identification of the points within the supply chain that may be amenable to interventions. Such data may then be compared with the Indonesian situation and used to help determine the major potential hazards and commodities that may cause human illness. The study would aim to identify where in the supply chain these hazards may most likely arise, and what interventions could be developed to prevent contamination. The study would also assess whether the major causes of FBD in Indonesia, and risk factors for their occurrence, are similar between Indonesia and neighbouring countries with equivalent farming practices. A risk profile for the small-scale fresh vegetable industry should be developed in order to better define those priority areas along the food supply chain that can be targeted through food safety interventions.

17.2.2 GAP protocols for small-scale farmers

Protocols for the development of GAP and GHP for village farmers needs to be developed. In so doing, they need to be tailored for the local situation, taking into consideration the major food hazards that can be introduced at the farm level, and promote farming practices that reduce contamination of fresh produce. GAP programs developed in countries with similar farming practices should be used to develop GAP programs for Indonesian farmers. Data from other countries should be used to identify the major hazards. A pilot study could both develop and test the implementation of commodity specific GAP and GHP programs for small scale vegetable growers in Indonesia. Pooling of farms within sub-districts will be undertaken to share resources and ensure production benefits are maximized. A number of farms producing the same crops will be identified and trained to implement GAP and GHP with the aim of collectively contributing their crops to a collection centre for distribution and marketing. Inputs and resources will be shared across the farms. The study will focus on those vegetable crops that have a potential to gain higher premium markets through improvements in the quality of production. Priority may also be given to those commodities that present the highest risk

of FBD based on local and international data collected through the initial data gathering exercise.

17.3 Shrimp

17.3.1 Microbial contamination

The research programme should focus on addressing the main knowledge gaps, i.e. the most important pathogens causing FBD; points in the food chain where contamination occurs; and the main sources of contamination etc. A risk assessment approach should be adopted to identify missing data and identify priorities. The starting point should be a risk profile based on the available information of shrimp related FBD (e.g. disease incidence, main pathogens). This work should include a risk communication strategy to ensure involvement of all necessary stakeholders. Food safety data related to shrimp borne human disease are likely to be sparse, and it is suggested that a review of data from other countries in the region with similar production systems, but better human health monitoring data be reviewed. An analysis of the most important hazards may indicate where contamination has occurred (e.g. *S. aureus* and *B. cereus* are indicative of food handling contamination). Following the risk profiling, further detailed field studies of the sources of contamination will be required.

The key components of the proposed research are: compilation of data from neighbouring countries with similar food safety issues; risk profiling microbial FBD at the consumer level (review of existing data; prioritization of hazards; and identification of knowledge gaps); and identification of potential sources for microbial contamination along the supply chain.

17.3.2 Antimicrobial residues

The research programme into antimicrobial residues should have a number of components: investigation of the use of antimicrobials in small scale shrimp production; feasibility study of the application of traceability to small-scale shrimp production; identification of appropriate incentives and penalties to motivate small-scale producers to adopt food safety practices; and identification and critical review of alternatives to antimicrobial usage.

Accurate data from a prospective longitudinal study of randomly selected farms is needed to quantify and characterise the use, misuse and effectiveness of antimicrobials in small-scale farms. In particular, the study should examine the extent to which antimicrobials are used to compensate for poor management. The main outputs of this project will underpin the development of appropriate extension messages (directed as necessary at antimicrobial usage and deficient management). There is a strong risk that farmers participating in the study will modify their practices as a consequence of being informed that a study is underway, and this possibility will need to be taken into account in the study design.

Farmers will have an incentive to minimise the risk of antimicrobial residues if the product they sell can be traced back to the farm of origin in the event of discovery of an unacceptable residue level. A desk study will assess how traceability might be introduced into the small-scale sector, and a pilot study in one area of Indonesia would be established.

A final part of the programme should investigate alternatives to antimicrobial usage, such as probiotics. A desk study will systematically review the available information from Indonesia, Asia and elsewhere, particularly with respect to the efficacy of different alternative control methods.

17.3.3 Extension, training and participation in food safety by small-scale farmers

The research programme in the area of extension and training for small-scale farmers should include a review of the current system and infrastructure for delivering extension advice to small-scale farmers and the currently used methods and materials. Based on this review, research should focus on the development of appropriate extension methodology, messages and materials. Clearly this project should draw on results from the other programmes. The results of this work should need to be evaluated in the field through pilot studies, possibly in collaboration with other projects. This research should include an assessment of what factors can best motivate farmers to adopt food safety measures.

17.3.4 Research priorities - poultry meat chain risk study

Research

This research project would make a significant contribution to knowledge and contribute towards strengthening the scientific community in Indonesia. Scientists from a number of disciplines (e.g. epidemiology; microbiology; molecular biology; and food technology) would work together in a multidisciplinary environment. This project could provide a template for the integration of veterinary and food science disciplines in food safety research. It presents an opportunity to implement innovative epidemiological study designs and molecular techniques in Indonesia, under conditions where they could be very practically and usefully applied, and would reliably provide much improved understanding of the issue ranked highest by workshop participants.

Benefit to small-scale producers

The focus of the project is on village chicken production (free range and broiler), and is therefore targeted at small-scale producers. The outputs of the project will allow the development of interventions to improve the food safety of chicken meat from this production system. The extent to which improved food safety will translate into improved returns to the producer is uncertain. The key beneficiary of this project is the Indonesian consumer (decreased risk of FBD). Secondly, retailers and processors (decreased wastage). Lastly, the producer, who may, depending on market forces, be able to command a higher price for a safer product.

Incentives and constraints for adoption

Interventions that extend shelf-life and therefore reduce wastage will be adopted if they are cost-effective. Interventions at the farm level that decrease food safety risks to consumers will only be adopted if higher food safety standards achieved by producers are recognized and gain higher prices or wider market access. Interventions at other stages in the food chain will be adopted if regulations are enforced and financial penalties are incurred if food safety standards are not met. Currently, the regulatory environment does not provide strong incentives for adoption of strategies to improve food safety.

Likely impact

The importance of village production and the importance of extending shelf-life indicate that the potential impact of interventions, in terms of reduced wastage and decreased cases of FBD is high. The information on which to make an accurate assessment of impact does not currently exist, but estimates could be made as part of this study.

Other donor activity

No existing or recent donor activity in this area has been identified.

17.3.5 Better methods for extending meat product shelf-life

Research

This project proposes applied research to address a specific issue – extending shelf-life of meat products which must be kept without refrigeration. From a scientific point of view this project would not make the same contribution to the Indonesian science base as the previous project. This project focuses on both research and implementation. The benefits of the project would be further enhanced if it was expanded to produce a low-cost "dipstick" test for the presence of formaldehyde and borax, so that illegal use of these chemicals could be detected on the spot when their use is suspected.

Benefit to small-scale producers

The key beneficiaries of this work will be processors and street vendors (through reduced wastage and lower overall costs), and particularly consumers. The risk of FBD will be lower for consumers throughout Indonesia, and the substantial risk of toxic effects of formalin and borax will be greatly reduced. Additionally, the likely improved efficiency should result in decreased prices to the consumer. Realistically, direct benefits to producers will be very low.

Incentives and constraints for adoption

There are clear financial incentives for adopting methods to extend shelf-life of meat products. More stringent enforcement of legislation that bans the use of formaldehyde and borax would further enhance incentives to adopt alternative methods, and the proposed development of rapid tests for the chemicals would greatly assist in these efforts.

Likely impact

The wide use of illegal methods to extend shelf-life of meat products, indicate that this is an important problem. Cost-effective and safe alternatives are likely to be readily adopted and make significant impact in terms of reduced wastage, decreased cases of FBD and reduced exposure to toxic chemicals.

Other donor activity

No other existing or proposed donor activity in this area has been identified.

17.3.6 Enhance consumer knowledge (meat)

Research

The project will draw primarily on social science disciplines and will help forge inter-disciplinary research, between biological and social science in Indonesia.

Benefit to small-scale producers

Consumers should benefit in terms of improved implementation of food safety messages derived from other projects, for meat and other commodities. It therefore has the advantage of cutting across commodities. By also directly targeting meat handlers, consumers should also benefit from improved food safety.

Incentives and constraints for adoption

The project will effectively investigate incentives that consumers have to adopt improved food safety practices.

Likely impact

Currently, the level of contamination due to food handlers and consumers is not well established. However, based on the experience in other countries it is likely to be significant. Therefore, the potential impact of this project is substantial.

Other donor activity

No other donor activity in this area has been identified.

17.3.7 Vegetables - pilot smallholder GAP

Research

This project is focused on both highly applied research (to generate GAP protocols) and their implementation through pilot studies. The work would strengthen the food safety science base in Indonesia and development linkages between the research community and agricultural services.

Benefit to small-scale producers

The small-scale producers may benefit through more cost-effective use of purchased inputs such as pesticides and herbicides. Farmers may be able to access additional markets (e.g. restaurant chains) and achieve higher prices if their produce is less contaminated.

Incentives and constraints for adoption

Some supermarket and restaurant chains pay premium prices for produce that meets minimum quality standards that includes levels of microbiological and residue contamination. Currently, large-scale producers, who can document and demonstrate the safety of their products, supply these markets, and many of the products are supplied from outside Indonesia. It is uncertain whether small-scale producers could compete with larger producers for this market. In addition, these markets are currently small, although they are growing steadily. There is no guarantee that all, or a majority of vegetables produced under GAP protocols by small-scale producers could command higher prices.

Likely impact

The level of FBD due to vegetable consumption is not known and therefore the impact of improved food safety cannot be estimated. From the viewpoint of the farmer, the main benefit will derive from more cost-effective use of purchased inputs.

Other donor activity

A Dutch funded project has developed GAP for vegetable production, but concluded in its recently released report (February 2007, after the workshop and information gathering in Indonesia had been completed), that there were major barriers to achieving successful implementation (section 11). It would therefore be essential to structure any new study to take account of findings from this recent study.

17.3.8 Vegetables - food chain hygiene

Research

Research into the contamination with both micro-organisms and residues will make a significant contribution to strengthening the scientific community.

Benefit to small-scale producers

The project may produce results that can be used to develop interventions to improve food safety. Financial benefits to producers will only be realised if higher prices can be achieved for products with lower levels of contamination.

Incentives and constraints for adoption

Some supermarket and restaurant chains pay premium prices for produce that meets minimum quality standards that includes levels of microbiological and residue contamination. However, these markets are currently small and there is no guarantee that vegetables with lower levels of contamination can command higher prices.

Likely impact

The impact is uncertain. The level of FBD due to vegetable consumption is not known and therefore the impact of improved food safety cannot be estimated. The potential value that could be added to vegetables by providing assurances of lower food safety risks is likely to be small.

Other donor activity

A Dutch funded project has applied HACCP methodology to examine food chain risks for vegetables, and there is a risk of duplicating previous work (section 11).

17.3.9 Better methods for extending vegetable product shelf-life

Research

There would be a market opportunity if Indonesian vegetable products could be marketed with extended shelf-life (for example by being snap-frozen while fresh) and the market for these products could be developed and promoted. This would substantially extend the season for perishable vegetables, and therefore allow output to be expanded by smallholders. ACIAR has previously funded a project on extending shelf-life of leafy vegetables in relation to China, and findings from this study could be adapted and applied in Indonesia, together with cooperative activities with supermarkets, designed to increase acceptance of long shelf-life vegetables.

Benefit to small-scale producers

If the goal of extending shelf-life could be achieved and demand could be increased, the gains to small-scale producers would be considerable, because a high proportion of vegetables are produced by small-scale producers, and their market opportunities and potentially the prices they receive would be substantially increased if the selling season for their products could be extended and waste could be reduced.

Incentives and constraints for adoption

There are clear financial incentives for supermarkets to adopt technologies which lengthen shelf-life, but the effects will be negative for street vendors and some mini-markets, where long shelf-life products are unlikely to be able to be handled and stored. Any technology which was cost-effective is likely to be adopted quite rapidly by supermarkets because it offers both a point of difference and reduced vegetable wastage.

Likely impact

If suitable technology could be developed and made commercially effective, it is likely to provide benefits to producers, supermarkets and consumers. The key beneficiaries of this work will be producers, who will have expanded market opportunities for their products, supermarkets which adopt the technology, and consumers who will have access to higher

quality product for a longer time during each year. The risk of FBD will be lower for consumers and the improved efficiency and lower wastage should result in decreased prices to the consumer.

Other donor activity

ACIAR has funded related work in China, which could be applied in Indonesia. No other existing or proposed donor activity in this area has been identified.

17.3.10 Shrimp – manage microbial risks

Research

A research project would strengthen scientific capacity and strengthen linkages between all relevant stakeholders in the field of shrimp health. An expansion of shrimp production features in the national development plan and this project would strengthen research capacity in this strategically important area.

Benefit to small-scale producers

Large-scale producers have systems in place to minimise and manage microbial contamination. This project is therefore targeted at small-scale producers.

Incentives and constraints for adoption

Smallholders generally sell their shrimp to traders. Producers are only likely to adopt strategies that might be developed as a result of this research, if shrimp can be traced through the food chain back to the producers. A desk study to investigate the potential for implementing methods of traceability and a pilot study of a feasible system would need to be undertaken as an essential component of this or another project. Since the majority of shrimp are exported, international requirements for microbial safety will drive the adoption of methods to mitigate microbial contamination.

Likely impact

The potential economic benefits from this research project are not well defined. Shrimp is an expensive product not commonly consumed by Indonesians, and therefore shrimp are unlikely to be a significant source of FBD in the Indonesian community. Microbial contamination does not appear to be a major issue for importing countries (which regularly test consignment for microbial contamination), although antimicrobial residues are of more concern, and research to reduce shrimp disease in the ponds and hence reduce antimicrobial use would therefore have merit. Efforts to investigate microbial contamination could assist exporters to attain improved prices for exported shrimp, and reduce spoilage.

Other donor activity

No other donor activity in this area has been identified.

17.3.11 Shrimp - control antimicrobial residues

Research

Antimicrobial residues are and will continue to be the major food safety issue for shrimp production in Asia. This project will serve to strengthen Indonesia's scientific capacity in this area.

Benefit to small-scale producers

Large-scale producers have systems in place to minimise and manage antimicrobial contamination. This project is therefore targeted at small-scale producers. Antimicrobial

residues are primarily a problem for small-scale producers, who ultimately bear the cost of rejected consignments (through lower net prices and reduced demand).

Incentives and constraints for adoption

Strong international market drivers for the adoption of interventions to decrease the risk of antimicrobial residues exist. However, for these drivers to function at the level of the smallholder, product traceability is essential. Traceability should ensure that small-scale producers benefit from producing shrimp to high and certifiable food safety standards (and are penalised for selling shrimp contaminated with antimicrobial residues). A desk study to investigate the potential for methods of achieving traceability, and a pilot study on implementing traceability would need to be undertaken as a component of this project.

Likely impact

This project will not provide significant health benefits to the Indonesian consumer. The clear driver for this research is the low level of antimicrobial contamination acceptable to most importing countries (notably those of the EU). The goal of this research is to minimise the significant financial losses that result from the rejection of exported shrimp. Currently, little solid evidence appears to be available about the nature and extent of antimicrobial usage in shrimp production in Indonesia, and efforts to gather information were unrewarding. It is therefore difficult to assess what impact the results of this research may ultimately have in terms of reducing the number of rejected consignments. Nevertheless, the project costs are low, and a good return on expenditure is likely.

Other donor activity

No other donor activity in this area has been identified.

17.3.12 Shrimp – training smallholders in food safety

Research

This project would bring together experts in agricultural extension with veterinarians and others working in fish health. Collaboration between a number of stakeholder groups, which is essential if the results of the research are to improve the livelihoods of small-scale producers, will be fostered and supported.

Benefit to small-scale producers

The benefits to small-scale producers will ultimately depend on the quality of the extension messages. There is good reason to believe that small-scale management of shrimp production can be significantly improved by the adoption of currently available best practice.

Incentives and constraints for adoption

The extension messages will need to be supported by sound financial analysis (based on a cost-benefit analysis).

Likely impact

The scale of the problems facing small-scale shrimp producers suggest that the impact of improved food safety programs for these people could be considerable, and the anticipated growth in the scale of production (and therefore the number of producers) will further boost the expected benefit. However the benefits will take several years to accrue.

Other donor activity

ACIAR is (in work being undertaken by the University of Sydney), already investigating how the results of research on shrimp health and production can be disseminated through

existing extension services. The proposed project could be linked to this pre-existing activity.

17.4 A review of the food safety policy and regulatory environment in Indonesia

The prospects for improving food safety in each of the three food product categories examined are constrained by the national framework on which action must be based (policy; regulation; and enforcement). This was widely identified by stakeholders interviewed for this project as an important issue in relation to all three commodity areas (Appendix 3).

In particular, the areas of concern were:

- overlapping responsibilities and inadequate coordination between the various agencies which play a role in food safety
- lack of support infrastructure (e.g. laboratories)
- excessively complex and inconsistent implementation of food safety legislation
- prescriptive regulatory framework rather than a risk management framework
- inadequate performance auditing and enforcement of regulations.

Overall, it can be concluded that the current national food safety regulations and their enforcement do not generate strong drivers for food safety. A review of the current policy and regulatory / institutional environment would lay the foundations for future action to build an effective food safety regulatory regime which manages risks rather than prescribes and controls specific actions. The Codex Alimentarius provides the international framework within which countries are encouraged to develop their national food safety programs, and over recent decades the structure of Codex has shifted progressively away from a prescriptive rule-based approach to a risk management approach. Within a country this can only be achieved once the appropriate legal framework has been established, and Indonesia does not yet have a framework of this nature in place. Therefore, a valuable step would be to undertake the work necessary to develop a new approach which could be converted into official regulations.

The Dutch funded project on GAP for vegetable production (HORTIN) provides a specific example of the importance of government regulation. Local government has the responsibility to certify and audit the SI SAKTI system for GAP. However, local agencies do not appear to be in a position to do so, though the specific constraints (e.g. lack of resources; appropriate infrastructure etc) were not clearly identified (Asandi et al., 2006). Thus, whilst well researched GAP protocols may exist, the incentives for adoption are low, whilst the system for certification and auditing is not operating. Similarly, the adoption of food safety measures for white meat will have considerably great impact in an environment of tight regulation of illegal practices and regular monitoring of food safety. This project would have the following aims:

- clearly describe the current complex food safety policy and regulatory environment in Indonesia
- compare Indonesia's system with other Asian countries
- identify any weaknesses in current arrangements
- assess the physical and human resources required for an effective regulatory system

- make recommendations to both reform that current government regulatory system and to stimulate, where appropriate, alternative systems (e.g. supermarket assurance schemes).

This project would strengthen food safety policy research in Indonesia and build collaborations between biological and social scientists, thereby making a significant contribution to the strengthening of the science base in Indonesia. The benefits of this research will be an improved regulatory environment which should benefit both producers and consumers. Producers should be able to better access high price markets (e.g. export and supermarkets) by complying with governmental and non-governmental certification schemes. This project will help create an environment which in the long term facilitates financial rewards (i.e. higher farm gate prices) for high standards of food production, but will not achieve any immediate benefit to either producers or consumers.

Likely impact

An improved regulatory and policy environment has potential to ultimately improve food safety across all commodities. However, these benefits are difficult to quantify, and will be slow to accrue. It would however facilitate gains from other food safety improvements if the national risk management framework were modernised and simplified.

Other donor activity

Australia has provided significant assistance to Indonesia on this general theme, as described in the next section, and any support by ACIAR would need to be targeted at a specific sub-component of the topic, to ensure that it could be smoothly integrated with other related work.

18 Similar activity by other donors and other research organisations

18.1 Integrated food safety system in Indonesia (1998)

AusAID funded public sector linkages projects have worked with the National Agency for Drug and Food Control, Jakarta which is an autonomous agency that reports directly to the President, and covers food safety legislation; control; inspection (there are 4000 district food inspectors in Indonesia); laboratory services information; and education/training of food inspectors. BPOM has a central laboratory, and small branch offices in 26 provinces, some with laboratories. The AusAID funded projects have largely focused on providing operational training of inspectors, and establishing structures for a national food safety body. Initially, a national integrated food safety system was developed that implemented risk assessment at a national level through 3 networks:

- Food intelligence network (risk assessment)
- Food control network (risk management)
- Food promotion network (risk communication).

The system was launched in May 2004.

Other projects have also been launched:

- 2002 – institutional strengthening of food safety in small and medium sized enterprises; strengthening food analysis; and improvement of food monitoring

- 2003 – food stars program – voluntary program for business that provides recognition of food hygiene training in businesses handling food, and has helped establish HACCP and Good Processing Management programs in selected industries
- 2004 and since has focused on wider and deeper implementation of the food stars system - during 2006/07 the food stars system will be extended to milk, poultry and seafood.

18.2 World Wildlife Fund (WWF) – trilateral partnership on shrimp product safeguarding

The trilateral 'Public Private Partnership' on shrimp provides a forum for dialogue and cooperation between government agencies, industry and other stakeholders. The aims of the project are threefold:

- enhance market access
- contribute to sustainable development
- alleviate living value of smallholders.

One component of the strategy is to improve food safety in order to reduce trade barriers and facilitate market access of shrimp products for Indonesia and Malaysia into the EU and other developed markets.

18.3 The shrimp product safeguarding partnership: Indonesia - Malaysia - The Netherlands (2003-2006)

Following an initiative first proposed at the World Summit on Sustainable Development (WSSD) in Johannesburg, The Netherlands launched a partnership between government agencies, business and non-governmental organisations to improve market access. The focus was on improving food quality standards, and a number of countries, including Indonesia, became involved. Indonesia and Malaysia identified shrimp as product that would benefit from the project. The initiative for a partnership on market access with Indonesia and Malaysia commenced in October 2003, and ended in 2006. A targeted action plan to enhance food safety, sustainability and environmental standards in the production and export of shrimp products was developed with the overall goal of enhancing market access. The partnership seeks to ensure that exported shrimp meet quality standards related to health, the environment and matters under the Sanitary and Phytosanitary Agreement of the World Trade Organisation.

It was acknowledged from the outset that achieving quality and safety standards requires a whole food chain approach from: cultivation; production; transport; storage; and processing of shrimps, through to export. The project's activities are aimed at policy development; strengthening quality control systems; and production/marketing development. Specific activities related to food safety included:

- *Training courses on legislation and control:* which addressed the following issues: i) is residue legislation adequate and can this legislation be enforced; and ii) are forbidden substances included in national legislation
- *Training course on MRL problems and solutions*
- *Identification of laboratory capacity-building needs*: in public laboratories or private accredited labs, including training and equipment needs
- *Research of background values of banned substances (antibiotics) in the shrimp habitat*: in particular availability of data needed for decision making

- *Research on alternative drugs to replace banned substances*: each country was to look into the possibilities regarding alternative drugs.

A further project based on a quality assurance programme and laboratory staff training in Indonesia (in the detection of antimicrobial and heavy metal residues) is currently being planned to follow up the earlier phase of activity.

18.4 Improving productivity and profitability of smallholder shrimp aquaculture and related agribusiness in Indonesia - ACIAR project FIS/2005/169 (2007-2010)

This project will start in 2007. It will work with farmer groups and other supply chain small and medium size enterprises to implement best management practice in the areas of health management (including biosecurity); product quality; food safety; and social and environmental sustainability.

The project will work with 'traditional' smallholder farmer groups and associated supply chain enterprises. In its first two years, the project will develop and test enterprise-level interventions ('better management practices', (BMPs)) and participatory extension methodologies, to be delivered and supported by appropriately skilled extension and health management services. The BMP programmes will seek to improve biosecurity, food quality and safety. In the third and fourth years, the project moves into a broad dissemination and implementation phase using the extension messages based on the BMP, to be delivered by existing government and non-government resources with support from the project.

18.5 HORTIN – Horticultural research between Indonesia and the Netherland

18.5.1 Development of good agricultural practice (GAP) to improve food safety and product quality in Indonesian vegetable production

The HORTIN project ran between 2004 and 2006. The description in this section is based on a recent report (Asandi et al., 2006). The project aimed to develop and test a protocol for the improvement of safety and product quality of vegetables in Indonesia. The main driver for the project was international requirements for food safety and standardisation. The project had a number of stages:

- description of the food chain
- risk assessment for farm-based food processing
- development of a GAP protocol (based on bottlenecks in food safety identified using HACCP).

The GAP protocol was tested by 14 farmers and food chain supply parties. The project found that in Indonesia, the stakeholders who are involved in vegetable production, processing and marketing did not consider food safety to be a major issue. It was found that members of the food chain had never received complaints about chemical residues or foreign material, and only a few complaints about microbiological problems.

The risk assessment found the issues of significance to be lack of hygiene awareness and procedures, and pesticide residues. The team commented that insufficient regulation, labelling and access to information were serious constraints to implementing GAP for pesticide residues. The other bottlenecks were the absence of laboratory testing facilities and poor product handling procedures. The farmers who participated in the trial were

described as highly motivated. It was suggested that supermarkets should provide incentives for certified growers using GAP. The project identified higher price levels as the most effective driver for implementation of GAP. However, the potential market size opportunity for higher priced products (i.e. supermarkets and export) were not considered, nor were barriers to entry to these markets. Penetration into the higher priced markets also rely on official certification of the GAP protocols by the government, which will require integration of the system into the SI SAKTI system.

The impact of this project relies on an effective and widely accepted government system of certification and audit (the responsibility of local government). It was noted that local governments, who are responsible for auditing the SI SAKTI certification system, are not currently able to do so. Thus, farmers receive no official recognition for the improved safety of their product. Alternative schemes operated by supermarkets may be required to fill the gap left by government.

18.5.2 Overlap with the proposed project

There are clearly large areas of overlap between the completed HORTIN project and the vegetable food safety projects recommended in this report. GAP protocols were developed and tested. Food chain risks were, to some extent, evaluated through a HACCP approach. It was concluded that the most important obstacle to the adoption of GAP is the poor implementation of official certification and auditing. Research into the appropriate policy and institutional environment to build an effective food safety regulatory regime would address this issue. Investigation of alternatives to government schemes (e.g. schemes certified by non-governmental organisations or supermarkets) should be investigated as part of this project. The HORTIN project identified some areas where research could improve the GAP protocols. A number of assumptions were made regarding food safety risks, including the use of contaminated water. Research is needed to examine these assumptions. The development of integrated pest management (IPM) as part of GAP could result in more cost-effective control of pests.

19 Institutional research capacity in Indonesia

Indonesian agencies capable of participating in cooperative research programs exist in all of the areas under consideration. Appendix 3 provides the information gathered about each of the relevant bodies, both within government and in the private sector. In a number of cases there is however a lack of clarity about where particular responsibilities lie, and which organizations would be most appropriate to involve in each of the activities considered.

20 Conclusions and recommendations

20.1 Major risks

Identification and prioritisation of the major food safety risks was constrained by the very limited information on incidence of FBD in Indonesia (with either a known or an undefined causal agent), and virtual absence of information which would link known outbreaks to particular food products or handling practices. The very restricted scope of diagnostic services available prevent a positive diagnosis being made for many of the important bacterial pathogens likely to be present, because most of these pathogens require specialised laboratory media and techniques to detect and identify, and would be missed by simple aerobic culture on standard media.

20.2 The regulatory and enforcement environment

The constraints on improving food safety in Indonesia imposed by the current institutional arrangement have been identified a number of times in this report. Many of the respondents interviewed highlighted the overlapping responsibilities of government departments, the lack of auditing and enforcement, and over-complex regulation as constraining their work and creating obstacles to improving food safety in Indonesia. The Dutch funded project, HORTIN, found that the inability of local government to fulfill its responsibility to certify and audit GAP for vegetable production was the major constraint to successfully implementing GAP (Asandi et al., 2006). The importance of transparently assuring the independence of auditors and audits would be crucial to the credibility of the scheme. Research into the regulatory and enforcement environment cuts across the commodity groups identified, and as outlined earlier could make a valuable long term contribution to enhanced food safety.

20.3 Commodity-specific research programmes and their potential benefits

Although the discussion groups worked independently in preparing their recommendations, most of the research programmes developed during the workshop fell into two broad categories. Firstly, for each commodity, a food chain hygiene project was proposed to investigate the type and source of microbial contamination along the food chain. The nature of these projects reflects the current lack of information about microbial contamination and FBD in Indonesia. In the second category, projects were developed that focused on specific food safety issues, i.e. the use of formalin to extend the shelf-life of poultry; antimicrobial residues in shrimp; and the development of GAP for vegetable production.

Data does not exist on which to compare the benefits of the three food chain hygiene projects. However, shrimps are essentially a luxury food item and not consumed regularly by the average Indonesian consumer. Based on the experience from other countries and knowledge of food preparation in Indonesia, white meat food hygiene is likely to produce greater benefits in terms of health to the Indonesian consumer than a similar project with vegetables. This view is supported by the results of the workshop scoring exercise.

Of the commodities considered, only shrimp are exported in any quantity. Antimicrobial residues in shrimp currently cause considerable economic loss when contaminated consignments have to be diverted to local markets. The government has a strategy to increase shrimp production, based on continuing expansion of exports. Antimicrobial residues pose a threat since their regular occurrence may result in a decline in export markets. Research targeted at reducing antimicrobial residues in shrimp has a high chance of generating considerable benefits in terms of increased export revenue, and the strong international regulatory system will drive adoption of methods to reduce the risk of contamination. This view is supported by the workshop which ranked this research programme highly with respect to national economic benefit. This issue has been highlighted by the WTO (Oktaviani and Erwidodo, 2005) and a three year Dutch funded programme was completed this year. Further Dutch funded work plans to develop a quality assurance programme, and train laboratory staff (in the detection of antimicrobials and heavy metals). International guidelines for safe shrimp production have been developed. ACIAR funded research will need to avoid duplication of existing results and complement other ongoing projects.

The use of formalin as a preservative in meat products remained widespread although it was well known to be illegal. The problem can be addressed in two ways:

- the development alternative methods to extend shelf-life (the focus of recommended project 2)
- better enforcement of the current regulations (captured by recommended project 4). Similar arguments apply to some extent to the use of antimicrobials. The use of chloramphenicol is banned but it appears still to be widely available and used.

Research into consumer awareness of food safety should be directly linked with an implementation project to ensure that the findings of research contribute to the improvement of food safety in Indonesia.

The main vegetable commodity research identified was the development and testing of GAP protocols. Subsequent research has shown that the Dutch funded HORTIN project has undertaken similar research, and it would be difficult to avoid duplicating this work if the project put forward at was pursued. The HORTIN project identified the lack of accreditation for GAP schemes, an issue that would be addressed by the policy project put forward as a useful addition to the commodity-specific projects.

20.4 Intervention points

Research identified either takes a whole chain approach (the food chain hygiene projects) or focus on specific problems at points in the chain (i.e. production, retail or the consumer) (table 10).

Table 7: Intervention points for the identified research project

Project	Production	Handling	Processing	Transport	Retail	Consumer
1.white meat hygiene						
2. improve shelf-life for meat						
3. consumer knowledge						
4. microbial food hygiene						
5. control antimicrobial residue						
6. dev. ext & training smallholders						
7. pilot GAP						
8. improve shelf-life for vegetables						
9 food chain hygiene						

Areas of intervention indicated by shading.

20.5 Recommendations for research

The activities are listed in recommended priority order, and as discussed further below:

20.5.1 Priority Activity 1

A study of poultry food safety risks through the production and processing chain to set priorities for future research and action.

The results of this project will be used to focus future research and interventions. Its impact is therefore potentially far reaching. No overlap with other activities in Indonesia were identified.

Indonesian participant organizations suggested for possible involvement are the National Laboratory for Animal Product Quality Control in Bogor; the Department of Veterinary Public Health at Bogor Agricultural University; and poultry industry organizations. It is suggested that an Australian university with strong expertise in food safety and microbiological epidemiology be chosen as the partner organization.

20.5.2 Priority Activity 2

Laboratory studies to replace the use of formaldehyde and borax on meat products by developing better and more cost-effective methods of extending product shelf-life.

Clear regulatory drivers exist which should facilitate the adoption of new methods to extend product shelf-life. These drivers would be strengthened by a tighter enforcement regime, and development of a "streetside" on the spot instant dipstick test to detect presence of formaldehyde or borax in retail products, especially bakso. This would substantially enhance enforcement and exert pressure in favour of adoption of new technologies.

Potential Indonesian participants are the Centre of Drug and Food Control, Jakarta; the National Laboratory for Animal Product Quality Control in Bogor; and a Food Technology Department in an Indonesian university. The departments in the Universities at Bogor; Yogyakarta; and Malang should all be considered for this role. It is suggested that CSIRO be used as the Australian partner for this project, with assistance from Food Standards Australia New Zealand in relation to confirming the suitability and safety of new technologies that are developed.

20.5.3 Priority Activity 3

Development of methods for safely extending shelf-life of vegetables grown in Indonesia.

Following on from ACIAR Project PHT/1994/016, which successfully developed techniques that substantially reduced wastage and increased shelf-life of leafy vegetables grown in China, it would be realistic to undertake a similar project in Indonesia to identify suitable technologies for the principal vegetables grown in Indonesia. The priority vegetables are different in the two countries, but it is likely that a relatively low cost project could adapt the concepts used in the project in China, to provide similar benefits in Indonesia.

Potential Indonesian participants would be the Indonesian Vegetables Research Institute; supermarket companies; and vegetable marketing companies such as PT Saung Mirwan. The Australian organizations which undertook the project in China should be considered as partners. They are the Queensland and Victorian Departments of Primary Industries, and the University of Adelaide.

20.5.4 Priority Activity 4

Design of appropriate food safety regulatory policy and implementation strategy in Indonesia.

Government drivers for the adoption of food safety practices rely on effective regulation and enforcement. A number of weaknesses in the current food safety system have been identified, and Australia has already made contributions to the modernization of the system. Clearly, the deficiencies and inconsistencies in the regulatory framework and its implementation are causing widespread frustration in the food industry as a whole, and is no doubt a factor in the inadequate compliance currently being achieved. It would be desirable to build on past joint activities between Indonesia and Australia, and take further steps towards an effective food safety framework which would be acceptable to industry and capable of realistically achieving improved protection of Indonesian consumers.

Potential participants are the National Agency for Drug and Food Control, the Ministry of Agriculture (especially the Directorate General of Agricultural Produce and Processing Management), and independent Indonesian experts in relevant areas of policy and legislation. Appropriate Australian partners include Food Standards Australia New Zealand; the Australian Quarantine and Inspection Service; and independent consultants working in this field.

20.5.5 Priority Activity 5

Methods to reduce risk of antimicrobial residues in shrimp marketed by small-scale producers.

Clear regulatory and financial drivers exist to drive the adoption of strategies to reduce antimicrobial contamination. These drivers will be strengthened for small-scale producers by a system to trace product back to the farm of origin. We believe that this project complements other ongoing and existing research in the area of antimicrobial contamination in shrimp.

Potential participants are the Agency for Marine and Fisheries Research and Development; the National Agency for Drugs and Food Control; the National Centre for Fish Quality Control; Indonesian shrimp industry bodies (there are a number which represent different interests and direct consultation would be required to identify a suitable collaborator); and the Fisheries Department at Bogor Agricultural University. Appropriate Australian partners include a fisheries department at an Australian university; CSIRO; and private consultants working in this field.

Indonesia currently has limited measures in place to protect the safety of food consumed by its population. The scale of food safety problems is largely unknown, as are the critical points in the supply chain for the three food commodities studied. To some extent people have been protected from major FBD outbreaks in the past by the fact that a very high proportion of the population lived in rural villages as subsistence farmers. In this situation, the supply chain was very short, and traditional protective measures (such as cooking foods shortly after harvesting with few intermediate handlers, and the use of spices in cooking) have mitigated the risk. However, the rapid pace of urbanization which has occurred in recent decades means that over half of the population now lives in urban areas, and this trend will continue and intensify. These people rely on much longer food chains arising from fewer but larger scale producers, with far greater opportunity for microbial and chemical hazards to be expressed and affect large numbers of people.

This study examined the nature and scale of food safety risks for vegetables, shrimp and both red and white meat. It found that objective evidence of the true hazards and where they occurred in the chain was sparse for all three product categories, and therefore

gaining a better understanding of this underpinning information was an important step if other elements of the national research program were to be correctly focused on major problems. However, some immediate problems could also be identified. Two forms of chemical contamination of products (use of inappropriate preservatives in meat products and contamination of shrimp by antimicrobials) are known to require investigation with a view to minimizing the hazards. An opportunity also exists to begin to explore the practical application by farmers of improved practices in the three product types using knowledge gained both within and outside Indonesia.

Through the consultation processes undertaken in Indonesia, a structured evaluation of potential research projects undertaken by Indonesian participants in the workshop, and subsequent information gathering about priorities and the likelihood of achieving a substantial benefit, nine projects were formulated into a list of tasks which could potentially be undertaken in the immediate future by joint Indonesian-Australian research teams. Of these nine, five are recommended, and are listed in recommended priority order for allocation of resources. The projects vary in the type of research required to produce a useful answer to the particular issue, and each would make a valuable contribution to meeting the needs of Indonesian society and building successful research collaboration between Indonesia and Australia.

21 References

Anon., 2004a. Dipertimbangkan Larangan Sementara Impor Udang' (Temporary Shrimp Import Ban To Be Considered), . Kompas.

Anon., 2004b. 'Segera Benahi Udang untuk Meningkatkan Pangsa Pasar' (Reorganize Shrimp Business Immediately to Increase the Market Share). Kompas.

Asandi, A., Schoorlemmer, H., Adiyoga, W., Dibyantoro, L., van der Voort, M., Sulastrini, N., Sulastrini, I., 2006. Development of good agricultural practice to improve food safety and product quality in Indonesian vegetable production. HORTIN - Horticultural research collaboration between Indonesia and the The Netherlands, Wageningen, p. 90.

Bahar, A., 1992. Research and development program for vegetables. In, Proceedings of the national vegetable workshop, Lembang Horticulture Research Institute, Lembang, Indonesia, pp. 22-24.

Darmawan, D.A., Pasandaran, E., Indonesia.

Hadi, P.U., Ilham, N., Thahar, A., Winarso, B., Vincent, D., Quirke, D., 2002. Improving Indonesia's Beef Industry. ACIAR, Canberra, p. 128.

Hayami, Y., Kawagoe, T., 1992. The agrarian origins of commerce and industry: a study of peasant marketing in Indonesia. St Martin's Press New York.

Johnston, J., Fontanilla, B., Silvano, F., 1991. The economic impact of vaccinating Village Fowls: a case study from the Phillipines. In: Spradbrow, P. (Ed.), Newcastle disease in Village Chickens: Controls with thermostable oral vaccines, Kuala Lumpur, Malaysia, pp. 62-71.

Knipscheer, H., Boer, J., Sabrani, M., Soedjana, T., 1983. The Economic Role of Sheep and Goats in Indonesia: A Case Study of West Java*. Bulletin of Indonesian Economic Studies 19, 74.

Oktaviani, R., Erwidodo, R., 2005. Indonesia's Shrimp Exports: Meeting the Challenge of Quality Standards. MANAGING THE CHALLENGES OF WTO PARTICIPATION: CASE STUDY 18.

Rushton, J., Viscarra, R., Guerne Bleich, E., Mcleod, A., 2005. Impact of Avian Influenza outbreaks in poultry sectors of five South East Asian Countries (Cambodia, Indonesia, Lao PDR, Thailand, Viet Nam) outbreak costs, responses and potential long term control. World's Poultry Science Journal 61, 491-514.

WHO, F., 2004. Integrated Food Safety System in Indonesia. FAO/WHO Regional Conference on Food Safety for Asia and the Pacific. FAO / WHO Seremban, Malaysia.

SECTION 3: APPENDIXES

22 Appendixes

22.1 Appendix 1: Food safety research in ACIAR – recent food safety related projects

Project Number	Project title
ADP/2000/004	International food safety regulation and processed food exports from developing countries: A comparative study of India and Thailand
AH/2006/163	Assessment of zoonotic diseases in Indonesia
AH/2006/161	Management of pig associated zoonosis in the Lao PDR
AH/2006/050	Control and characterisation of highly pathogenic avian influenza strains in poultry in Indonesia
AH/2004/040	The epidemiology, pathogenesis and control of highly pathogenic avian influenza (HPAI) in ducks in Indonesia and Vietnam
AH/2004/032	Identification of policy responses to minimise negative socio-economic impacts of an avian influenza epidemic in Indonesia
AH/2001/054	The identification of constraints and possible remedies to livestock production by zoonotic diseases in the South Pacific
CP/2005/167	Optimising the productivity of the potato/Brassica cropping system in Central and West Java
CP/2004/048	Integrated disease management (IDM) for anthracnose, Phytophthora blight and whitefly transmitted geminiviruses in chilli pepper in Indonesia
FIS/2007/029	Support for antibiotic residue testing in fisheries products, Indonesia
FIS/2005/169	Improving productivity and profitability of smallholder shrimp aquaculture and related agribusiness in Indonesia
FIS/2000/061	Development and delivery of practical disease control programs for small-scale shrimp farmers in Indonesia, Thailand and Australia
FIS/1994/011	Prawn health management and disease control to sustain hatchery and pond production systems
HORT/2006/111	Managing trade risks arising from the use of crop protection chemicals in horticultural crops in the Philippines and Australia
HORT/2006/034	Managing trade risk arising from the use of crop protection chemicals in horticultural crops in the Philippines and Australia
HORT/2000/081	Bioremediation technology for insecticide residues in horticulture
PHT/1996/004	Monitoring mycotoxins and pesticides in grain and food production systems for risk management in Viet Nam and Australia
PHT/1990/009	Minimising pesticide residues in stored grain by use of mixtures
PHT/1988/006	Fungi and mycotoxins in Asian food and feed stuffs

22.2 Appendix 2: Organisations interviewed for the initial questionnaire study

Government

- Directorate of Veterinary Public Health, Directorate General of Livestock Services, Department of Agriculture
- Directorate of Quality and Standardization, Directorate General of Processing and Marketing of Agricultural Products, Department of Agriculture
- Center for Information and Biosecurity, National Agency for Agricultural Quarantine, Department of Agriculture
- Directorate General of Horticultural Production, Department of Agriculture
- Directorate of Environmental Health, Department of Health
- Deputy of Food Safety and Hazardous Substances, National Agency of Drugs and Food Control

Laboratory

- National Laboratory for Animal Product Quality Control, Ministry of Agriculture
- Veterinary Public Health Laboratory Jakarta
- Centre of Drugs and Food Control, National Agency of Drugs and Food Control
- National Centre of Development and Control of Fish Products, Ministry of Marine Affairs and Fisheries
- Indonesian Vegetables Research Institute, Department of Agriculture

Large-scale producers

- PT Saung Mirwan (Vegetable)
- PT Bina Mentari Tunggal (Red Meat)
- PT Amindo Prima Sejahtera (White Meat)
- PT Suri Tani Pemuka (Shrimp)

Producer and retail associations

- Indonesian Meat Importers Association (ASPIDI)
- National Meat Processors Association (NAMPA)
- Indonesian Retail Merchants Association (APRINDO)
- Indonesian Food and Beverage Manufacturers Association (GAPMMI)
- Indonesian Chamber of Commerce and Industry, Standing Committee for Food Security
- Meat industry companies
- People knowledgeable about retail food marketing and the role of supermarkets and hypermarkets in Indonesia

Others

- Prof. Dr. F. G. Winarno
- ICD/SEAMEO TROPMED RCCN University of Indonesia

22.3 Appendix 3: Organisations and people contacted regarding other donor food safety activity in Indonesia

Organisation	Person	Communication
Dutch embassy, Jakarta, Indonesia	Hans v.d. Zijden	Provided names and emails for organisation funded by the Netherlands in Indonesia
Farm Economics & Management Wageningen UR Applied Plant Research Lelystad, The Netherlands	Dr. Herman Schoorlemmer	Provided report on the HORTIN project (vegetable GAP)
Wageningen University The Netherlands	Frank Joosten	Emailed to request information about shrimp project. No response received.
World Wildlife Fund - tripartite PPP project	Dr Lida Pet-Soede	Emailed to request information about the tripartite project.
Sydney University	Dr Richard Callinan	Provided information on the ACIAR funded small holder shrimp production project