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## Assessment of Smallholder Indigenous Poultry Producer Viability in Cambodia

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## Mekong Team Working Paper No. 9

## Table of Contents

<b>1. INTRODUCTION .....</b>	<b>I</b>
<b>2. NATIONAL OVERVIEW .....</b>	<b>3</b>
ECONOMIC OVERVIEW .....	3
POPULATION .....	4
AGRICULTURE .....	6
LIVESTOCK SECTOR .....	8
POULTRY SECTOR .....	8
<i>Production Systems</i> .....	11
Small-scale Farms .....	13
Broiler Farms .....	15
Layer Farms .....	16
Duck Farms .....	16
<i>Breeding/Incubator Farms</i> .....	17
<i>Wholesalers/Importers</i> .....	17
<i>Veterinarians</i> .....	18
<i>Marketing</i> .....	19
<i>HPAI in Cambodia</i> .....	20
<b>3. OVERVIEW OF SELECTED PROJECT SITES .....</b>	<b>21</b>
KAMPOT PROVINCE .....	22
<i>Geography</i> .....	22
<i>Population</i> .....	23
<i>Economy</i> .....	23
<i>Livestock</i> .....	25
<i>HPAI Experience</i> .....	26
<i>Summary</i> .....	27
SIEM REAP PROVINCE.....	28
<i>Geography</i> .....	28
<i>Population</i> .....	29
<i>Economy</i> .....	30
<i>Livestock</i> .....	33
<i>HPAI Experience</i> .....	36
RECOMMENDATIONS FOR STUDY INCLUSION .....	36
<b>4. METHODOLOGY.....</b>	<b>37</b>
CONSUMER SURVEYS .....	37
<i>Purpose:</i> .....	37
<i>Implementation:</i> .....	37
Willingness to Pay for Certified Poultry Experiment .....	38
<i>Products:</i> .....	39
POULTRY FARMER SURVEYS.....	39
<i>Purpose:</i> .....	39
<i>Implementation:</i> .....	39
1. Smallholder Producer Surveys.....	40
2. Largescale Chicken and Duck Producers (>100 birds) .....	41

<i>Products:</i> .....	42
AGGREGATOR SURVEYS .....	42
<i>Purpose:</i> .....	42
<i>Implementation:</i> .....	42
<i>Products:</i> .....	43
MARKET VENDOR SURVEYS .....	43
<i>Purpose:</i> .....	43
<i>Implementation:</i> .....	44
<i>Products:</i> .....	44
OTHER SURVEYS.....	44
ENUMERATION TEAMS .....	45
QUESTIONNAIRE TRANSLATION .....	45
DATA ENTRY.....	45
INSTITUTIONAL COOPERATION .....	46
<b>5. SURVEY FINDINGS.....</b>	<b>47</b>
HOUSEHOLD / CONSUMER.....	47
CHICKEN AND DUCK PRODUCERS.....	54
<i>Smallscale Poultry Producers (&lt;100 birds)</i> .....	54
LARGESCALE DUCK PRODUCER SURVEY .....	66
AGGREGATOR SURVEY.....	77
MARKET VENDOR SURVEY .....	83
<b>6. POLICY RECOMMENDATIONS .....</b>	<b>86</b>
<b>7. REFERENCES .....</b>	<b>88</b>
<b>8. ANNEX: SUMMARY STATISTICS.....</b>	<b>91</b>
ANNEX 1: HOUSEHOLD / CONSUMER SURVEY.....	91
ANNEX 2: FARMER SURVEY .....	96
ANNEX 3: LARGESCALE CHICKEN PRODUCER SURVEY .....	103
ANNEX 4: LARGESCALE DUCK PRODUCER SURVEY .....	107
ANNEX 5: AGGREGATOR SURVEY.....	114
ANNEX 6: VENDOR SURVEY .....	121

## List of Tables

TABLE 1:	EMPLOYED POPULATION (>10 YEARS OLD) BY EMPLOYMENT STATUS, STRATUM, AND SEX .....	4
TABLE 2:	NUMBER OF HOUSEHOLDS BY GROUP OF CROP PRODUCTION AND SEASON (% HOUSEHOLDS) .....	6
TABLE 3:	AVERAGE YIELD PER SQUARE METER OF CROP PRODUCTION BY SEASON (MILLION RIELS) .....	6
TABLE 4:	COSTS FOR CROPS PRODUCTION BY SEASON AND GROUP ITEM (PERCENT).....	7
TABLE 5:	PER CAPITA DAILY CALORIE INTAKE FROM SELECTED FOOD ITEMS .....	7
TABLE 6:	NUMBER AND DENSITY OF POULTRY BY PROVINCE .....	10
TABLE 7:	NUMBER OF COMMERCIAL FARMS AND HEAD OF POULTRY BY PROVINCE .....	13
TABLE 8:	CALENDAR FOR SELECTED ASPECTS OF SMALLSCALE CHICKEN RAISING .....	15
TABLE 9:	CALENDAR FOR SELECTED ASPECTS OF DUCK RAISING .....	17
TABLE 10:	CHICKEN DISEASE CALENDAR.....	20
TABLE 11:	AGE DISTRIBUTION OF THE POPULATION IN KAMPOT PROVINCE .....	23
TABLE 12:	DISTRIBUTION OF EMPLOYED PERSONS BY SEX IN KAMPOT PROVINCE (PERCENT) .....	23
TABLE 13:	DESCRIPTION OF HOUSEHOLDS BY POVERTY LEVELS IN SOUTHERN CAMBODIA .....	24
TABLE 14:	PRICE OF CHICKEN PRODUCTS IN SOUTHERN CAMBODIA 2007 (PER HEAD).....	26
TABLE 15:	FARM GATE PRICE OF DUCK PRODUCTS IN SOUTHERN CAMBODIA 2007 .....	26
TABLE 16:	HPAI CASES IN POULTRY IN KAMPOT PROVINCE, 2004-2007 .....	26
TABLE 17:	HPAI CASES IN HUMANS IN KAMPOT PROVINCE, 2004-2007.....	27
TABLE 18:	PERCENT OF HOUSEHOLD INCOME FROM POULTRY IN KAMPOT VILLAGE CASE STUDY .....	27
TABLE 19:	AGE DISTRIBUTION OF THE POPULATION IN SIEM REAP PROVINCE .....	29
TABLE 20:	EMPLOYMENT STATUS BY SEX IN SIEM REAP (PERCENT).....	30
TABLE 21:	ECONOMIC ACTIVITIES BY REGION IN SIEM REAP CASE STUDY (PERCENT HH) .....	30
TABLE 22:	DESCRIPTION OF HOUSEHOLDS BY POVERTY LEVELS AND REGION IN SIEM REAP .....	32
TABLE 23:	PRICE OF CHICKEN PRODUCTS IN SIEM REAP 2008 (RIEL/KG) .....	34
TABLE 24:	FARM GATE PRICE OF DUCK PRODUCTS IN SIEM REAP 2008 .....	34
TABLE 25:	HPAI OUTBREAKS IN POULTRY IN SIEM REAP PROVINCE, 2004-2007 .....	36
TABLE 26:	SUMMARY OF CONSUMER SURVEY OBSERVATIONS .....	37
TABLE 27:	SMALLHOLDER FARMER SURVEYS (<100 BIRDS) .....	41
TABLE 28:	LARGESCALE CHICKEN AND DUCK FARMER SURVEYS.....	41
TABLE 29:	AGGREGATOR SURVEYS .....	43
TABLE 30:	NUMBER OF MARKET VENDOR SURVEY OBSERVATIONS.....	44
TABLE 31:	HOUSEHOLD SAMPLE SIZES.....	47
TABLE 32:	GENDER OF SURVEY RESPONDENTS.....	47
TABLE 33:	FREQUENCY OF MARKET VISITS IN SELECTED LOCATIONS. ....	48
TABLE 34:	HOUSEHOLD POULTRY EXPENDITURE (1000 RIELS/WEEK). ....	48
TABLE 35:	FREQUENCY OF POULTRY PURCHASES (PERCENT RESPONDENTS). ....	49
TABLE 36:	HOUSEHOLD POULTRY CONSUMPTION. ....	49
TABLE 37:	FORM OF POULTRY PURCHASED (PERCENT) IN SELECTED LOCATIONS. ....	50
TABLE 38:	AVERAGE PRICE OF POULTRY BY BREED AND FORM PURCHASED (RIELS/KG; RIELS/EGG). ....	50
TABLE 39:	METHODS FOR DETERMINING QUALITY OF CHICKEN AND DUCK MEAT .....	52
TABLE 40:	COULD SAFETY OF POULTRY PRODUCTS BE IMPROVED? .....	52
TABLE 41:	CERTIFICATION PROGRAMME INTEREST EXPRESSED BY RESPONDENTS. ....	53
TABLE 42:	WHY PEOPLE DON'T WANT TO PAY FOR SAFETY CERTIFIED CHICKENS.....	53
TABLE 43:	BREAKDOWN OF EXPECTED FARMER SURVEY OBSERVATIONS .....	54
TABLE 44:	GENDER OF SURVEY RESPONDENTS.....	55
TABLE 45:	AGE OF SURVEY RESPONDENTS. ....	55
TABLE 46:	YEARS OF POULTRY RAISING EXPERIENCE.....	55

TABLE 47:	OTHER HOUSEHOLD ECONOMIC ACTIVITIES. ....	55
TABLE 48:	DUCK GRAZING ACTIVITIES IN HOUSEHOLDS' RICE FIELDS IN 2008. ....	56
TABLE 49:	FINANCING OF POULTRY PRODUCTION BY LOCATION. ....	56
TABLE 50:	INCOME FROM POULTRY PRODUCTION.....	57
TABLE 51:	USE OF CASH INCOME FROM POULTRY PRODUCTION.....	57
TABLE 52:	LABOR DIVISION FOR PARTICIPATING IN POULTRY KEEPING. ....	58
TABLE 53:	AVERAGE TIME DEVOTED TO POULTRY KEEPING. ....	58
TABLE 54:	SMALLHOLDER CHICKEN FLOCK SIZES IN SELECTED LOCATIONS. ....	59
TABLE 55:	PERCENT OF SMALLSCALE CHICKEN FARMERS THAT ALSO RAISE DUCKS ....	59
TABLE 56:	ARE BIRDS KEPT IN AN ENCLOSURE? .....	59
TABLE 57:	FOOD PROVIDED TO CHICKENS IN SELECTED LOCATIONS. ....	60
TABLE 58:	SOURCE OF WATER PROVIDED TO POULTRY IN SELECTED LOCATIONS. ....	60
TABLE 59:	SOURCE OF PHARMAEUTICALS AND VETERINARY SERVICES. ....	60
TABLE 60:	POULTRY PRODUCT FARMER SALE PRICE BY LOCATION (RIELS/KG; RIELS/EGG).....	61
TABLE 61:	BUYER OF PRODUCTS IN SELECTED LOCATIONS (PERCENT). ....	61
TABLE 62:	LOCATION OF TRANSACTION. ....	62
TABLE 63:	BUYER-SELLER RELATIONSHIPS (PERCENT). ....	62
TABLE 64:	ITEMS COVERED BY VERBAL AGREEMENTS (IN PERCENTAGES). ....	62
TABLE 65:	NATURE OF BUYER-SELLER RELATIONSHIPS PRIOR TO TRANSACTION.....	64
TABLE 66:	NUMBER OF FARMERS WHOSE POULTRY WERE CULLED. ....	64
TABLE 67:	IMPORTANCE OF FACTORS IN DECIDING WHOM TO TRADE WITH ....	65
TABLE 68:	RISK PERCEPTION (AVERAGE RANKING, 0 TO 5). ....	65
TABLE 69:	IMPORTANCE OF FACTORS IN DECIDING WHOM TO TRADE WITH.....	65
TABLE 70:	GENDER OF PRODUCERS.....	66
TABLE 71:	AGE OF PRODUCERS. ....	66
TABLE 72:	OTHER ECONOMIC ACTIVITIES UNDERTAKEN BY PRODUCERS. ....	67
TABLE 73:	RICE PRODUCTION AND DUCK GRAZING (NR, PERCENT OF RICE CULTIVATORS).....	67
TABLE 74:	INCOME FROM POULTRY IN 2008 (1000 RIELS).....	67
TABLE 75:	WORK HOURS ATTENDING TO DUCKS PER DAY (ALL WORKERS). ....	67
TABLE 76:	BARRIERS TO PRODUCTION EXPANSION. ....	68
TABLE 77:	PRIMARY ECONOMIC DUCK PRODUTCION ACTIVITY. (PERCENT PRODUCERS).....	68
TABLE 78:	AVERAGE FLOCK SIZE BY PRODUCTION STRUCTURE AND LOCATION. ....	68
TABLE 79:	TYPE OF FEED PROVIDED. (PERCENT OF PRODUCERS) .....	69
TABLE 80:	WATER ACCESS. (PERCENT OF PRODUCERS).....	69
TABLE 81:	SOURCE OF VETERINARY SERVICES AND PHARMACEUDICALS. (PERCENT OF PRODUCERS) .....	69
TABLE 82:	COMMON SYMPTOMS IN DUCKS PRIOR TO DEATH FROM DISEASE.....	70
TABLE 83:	ACTIONS TAKEN WITH BIRDS THAT DIE FROM DISEASE. ....	70
TABLE 84:	USE OF DUCK MANURE.....	70
TABLE 85:	BIOSECURITY MEASURES UNDERTAKEN. ....	71
TABLE 86:	LARGESCALE CHICKEN FARMER COST STRUCTURE – AVERAGE VALUES .....	72
TABLE 87:	MEDIUM-SCALE DUCK EGG PRODUCER COST STRUCTURE IN KAMPOT.....	73
TABLE 88:	MEDIUM-SCALE MIXED DUCK PRODUCER COST STRUCTURE IN SIEM REAP .....	74
TABLE 89:	MEDIUM-SCALE DUCK EGG PRODUCER COST STRUCTURE IN KAMPOT.....	75
TABLE 90:	MEDIUM-SCALE MIXED DUCK PRODUCER COST STRUCTURE IN SIEM REAP .....	76
TABLE 91:	SAMPLE OF AGGREGATORS IN SELECTED LOCATIONS. ....	77
TABLE 92:	GENDER OF TRADERS. ....	77
TABLE 93:	AGE OF TRADERS.....	77
TABLE 94:	YEARS OF EXPERIENCE OF TRADERS. ....	77
TABLE 95:	AGGREGATOR MONTHLY HOUSEHOLD INCOME FROM POULTRY BY LOCATION (PERCENT).....	78

TABLE 96:	NUMBER OF PEOPLE TRADING POULTRY PRODUCTS. ....	78
TABLE 97:	AVERAGE MONTHLY TRADING VOLUME BY PRODUCT.....	79
TABLE 98:	AVERAGE PURCHASE PRICE FOR POULTRY PRODUCTS IN SELECTED LOCATIONS .....	79
TABLE 99:	AVERAGE SALE PRICE FOR POULTRY PRODUCTS IN SELECTED LOCATIONS .....	79
TABLE 100:	CHICKEN MEAT AGGREGATOR COST STRUCTURE .....	81
TABLE 101:	VENDOR SAMPLE BY LOCATION. ....	83
TABLE 102:	GENDER OF RESPONDENTS BY LOCATION. ....	83
TABLE 103:	AGE OF RESPONDENTS BY LOCATION. ....	83
TABLE 104:	YEARS OF EXPERIENCE AS MARKET VENDOR. ....	84
TABLE 105:	TYPE OF MARKET SPACE IN SELECTED LOCATIONS.....	84
TABLE 106:	TYPES OF POULTRY PRODUCTS SOLD (PERCENT OF VENDORS). ....	84
TABLE 107:	AVERAGE MARKET VENDOR SALE PRICE IN SELECTED LOCATIONS. ....	85
TABLE 108:	AVERAGE DAILY TRADING VOLUME OF POULTRY PRODUCTS IN SELECTED LOCATION. ....	85
TABLE 109:	PRE-PURCHASE CONTRACTUAL AGREEMENTS BY SOURCE AND LOCATION. ....	85
TABLE A1.1.	GENDER OF SURVEY RESPONDENTS. ....	91
TABLE A1.2.	AGE OF SURVEY RESPONDENTS.....	91
TABLE A1.3.	HOUSEHOLD SIZES IN SELECTED LOCATIONS. ....	91
TABLE A1.4.	SELF REPORTED LITERACY OF SURVEY RESPONDENTS. ....	91
TABLE A1.5.	HOUSEHOLD SOCIO-ECONOMIC RANKING IN SELECTED LOCATIONS. ....	91
TABLE A1.6.	FREQUENCY OF MARKET VISITS IN SELECTED LOCATIONS. ....	92
TABLE A1.7.	FREQUENCY OF POULTRY PURCHASES (PERCENT RESPONDENTS).....	92
TABLE A1.8.	HOUSEHOLD POULTRY CONSUMPTION. ....	92
TABLE A1.9.	HOUSEHOLD POULTRY EXPENDITURE (1000 RIELS/WEEK).....	92
TABLE A1.10.	FORM OF POULTRY PURCHASED (PERCENT) IN SELECTED LOCATIONS. ....	93
TABLE A1.11.	DISTANCE TO MARKET WHERE POULTRY PRODUCTS ARE PURCHASED (KM) .....	93
TABLE A1.12.	AVERAGE PRICE OF POULTRY BY BREED AND FORM PURCHASED .....	93
TABLE A1.13.	CONCERNS ABOUT ATTRIBUTES OF POULTRY MEAT (RANKING 1 TO 5).....	93
TABLE A1.14.	METHODS FOR DETERMINING QUALITY OF CHICKEN AND DUCK MEAT .....	94
TABLE A1.15.	REASON FOR SAFETY CONCERN (RANKING 1 TO 5). ....	94
TABLE A1.16.	HOW RESPONDENTS HAVE CHANGED THEIR BEHAVIOR BECAUSE OF HPAI.....	94
TABLE A1.17.	RESPONDENTS KNOWLEDGE OF POULTRY ORIGIN. ....	94
TABLE A1.18.	CERTIFICATION PROGRAMME INTEREST EXPRESSED BY RESPONDENTS. ....	95
TABLE A1.19.	COULD SAFETY OF POULTRY PRODUCTS BE IMPROVED? .....	95
TABLE A1.20.	WHY PEOPLE DON'T WANT TO PAY FOR SAFETY CERTIFIED CHICKENS. ....	95
TABLE A2. 1:	GENDER OF SURVEY RESPONDENTS. ....	96
TABLE A2. 2:	AGE OF SURVEY RESPONDENTS.....	96
TABLE A2. 3:	FARMING HOUSEHOLD SIZES IN SELECTED LOCATIONS. ....	96
TABLE A2. 4:	OTHER HOUSEHOLD ECONOMIC ACTIVITIES. ....	96
TABLE A2. 5:	SEASONALITY OF HOUSEHOLD CROP PRODUCTION. ....	96
TABLE A2. 6:	AVERAGE SIZE OF RICE CROP (HECTARES). ....	97
TABLE A2. 7:	DUCK GRAZING ACTIVITIES IN HOUSEHOLDS' RICE FIELDS IN 2008. ....	97
TABLE A2. 8:	YEARS OF POULTRY RAISING EXPERIENCE. ....	97
TABLE A2. 9:	FINANCING OF POULTRY PRODUCTION BY LOCATION. ....	97
TABLE A2. 10:	MOTIVATION FOR RAISING POULTRY.....	97
TABLE A2. 11:	BARRIERS TO EXPANDING POULTRY PRODUCTION. ....	98
TABLE A2. 12:	ARE BIRDS KEPT IN AN ENCLOSURE? .....	98
TABLE A2. 13:	MATERIALS USED TO BUILD ENCLOSURE. ....	98
TABLE A2. 14:	NUMBER OF FARMERS BUYING CHICKS AND DUCKLINGS.....	98
TABLE A2. 15:	USE OF CASH INCOME FROM POULTRY PRODUCTION.....	99
TABLE A2. 16:	FOOD PROVIDED TO CHICKENS IN SELECTED LOCATIONS. ....	99

TABLE A2. 17:	SOURCE OF WATER PROVIDED TO POULTRY IN SELECTED LOCATIONS. ....	99
TABLE A2. 18:	SOURCE OF PHARMAEUTICALS AND VETERINARY SERVICES.....	99
TABLE A2. 19:	LABOR DIVISION FOR PARTICIPATING IN POULTRY KEEPING. ....	100
TABLE A2. 20:	AVERAGE TIME DEVOTED TO POULTRY KEEPING. ....	100
TABLE A2. 21:	POULTRY PRODUCT FARMGATE PRICE BY LOCATION (RIELS/KG; RIELS/EGG). ....	100
TABLE A2. 22:	BUYERS OF POULTRY PRODUCTS FROM FARMERS. ....	100
TABLE A2. 23:	LOCATION OF TRANSACTION. ....	100
TABLE A2. 24:	BUYER-SELLER RELATIONSHIPS (PERCENT). ....	101
TABLE A2. 25:	ITEMS COVERED BY VERBAL AGREEMENTS (IN PERCENTAGES). ....	101
TABLE A2. 26:	NATURE OF BUYER-SELLER RELATIONSHIPS PRIOR TO TRANSACTION. ....	101
TABLE A2. 27:	IMPORTANCE OF FACTORS IN DECIDING WHOM TO TRADE WITH.....	101
TABLE A2. 28:	RISK PERCEPTION (AVERAGE RANKING, 0 TO 3).....	102
TABLE A2. 29:	IMPORTANCE OF FACTORS IN DECIDING WHOM TO TRADE WITH.....	102
TABLE A3.1:	GENDER OF PRODUCERS.....	103
TABLE A3.2:	AGE OF PRODUCERS. ....	103
TABLE A3.3:	YEARS OF EXPERIENCE OF PRODUCERS. ....	103
TABLE A3.4:	OTHER ECONOMIC ACTIVITIES UNDERTAKEN BY PRODUCERS ....	103
TABLE A3.5:	YEARS OF EXPERIENCE OF PRODUCERS (THOUSANDS OF RIELS, PERCENT). ....	104
TABLE A3.6:	PEOPLE ATTENDING TO CHICKEN. ....	104
TABLE A3.7:	TIME SPENT ATTENDING TO CHICKENS PER DAY. ....	104
TABLE A3.8:	BARRIERS TO PRODUCTION EXPANSION. ....	104
TABLE A3.9:	FINANCING OF POULTRY PRODUCTION BY LOCATION. ....	104
TABLE A3.10:	BREEDS OF CHICKENS RAISED BY LOCATION. (PERCENT PRODUCERS) ....	105
TABLE A3.11:	AVERAGE NUMBER OF CHICKENS RAISED BY BREED AND LOCATION. (HEAD).....	105
TABLE A3.12:	BUYERS OF CHICKEN FROM FARMERS. ....	105
TABLE A3.13:	WHAT TO DO WITH DISEASE BIRDS.....	105
TABLE A3.14:	WASTE GENERATED (KG;LITERS).....	105
TABLE A3.15:	WHERE MANURE GOES.....	106
TABLE A3.16:	WHERE ANIMAL WASTE GOES.....	106
TABLE A3.17:	WHERE WASTE WATER GOES.....	106
TABLE A4.1.	GENDER OF PRODUCERS.....	107
TABLE A4.2.	AGE OF PRODUCERS. ....	107
TABLE A4.3.	YEARS OF EXPERIENCE OF PRODUCERS (THOUSANDS OF RIELS, PERCENT).....	107
TABLE A4.4.	OTHER ECONOMIC ACTIVITIES UNDERTAKEN BY PRODUCERS. ....	107
TABLE A4.5.	SEASONALITY OF RICE PRODUCTION.....	107
TABLE A4.6.	SIZE OF RICE CROP. ....	108
TABLE A4.7.	RICE PRODUCTION AND DUCK GRAZING (NR, PERCENT OF RICE CULTIVATORS).....	108
TABLE A4.8.	INCOME FROM POULTRY IN 2008 (1000 RIELS). ....	108
TABLE A4.9.	PEOPLE ATTENDING TO DUCKS (AT LEAST ONE PERSON IN GROUP).....	108
TABLE A4.10.	WORK HOURS ATTENDING TO DUCKS PER DAY (ALL WORKERS).....	108
TABLE A4.11.	BARRIERS TO PRODUCTION EXPANSION. ....	108
TABLE A4.12.	FINANCING OF POULTRY PRODUCTION BY LOCATION. ....	109
TABLE A4.13.	PRIMARY ECONOMIC DUCK PRODUCTION ACTIVITY. (PERCENT PRODUCERS) ....	109
TABLE A4.14.	AVERAGE FLOCK SIZE BY PRODUCTION STRUCTURE AND LOCATION.....	109
TABLE A4.15.	SOURCE OF DUCKLINGS.....	109
TABLE A4.16.	AGE DISTRIBUTION OF PURCHASED DUCKLINGS. ....	110
TABLE A4.17.	TYPE OF FEED PROVIDED. (PERCENT OF PRODUCERS).....	110
TABLE A4.18.	FEEDING PRACTICES. ....	110
TABLE A4.19.	WATER ACCESS. (PERCENT OF PRODUCERS).....	110
TABLE A4.20.	AGE DISTRIBUTION OF DUCKS.....	110
TABLE A4.21.	SOURCE OF VETERINARY SERVICES AND PHARMACEUTICALS. ....	111
TABLE A4.22.	BUYERS OF DUCK MEAT FROM FARMERS (PERCENT).....	111



TABLE A4.23.	BUYERS OF DUCK EGGS FROM FARMERS (PERCENT) .....	111
TABLE A4.24.	TYPE OF BUYER-SELLER AGREEMENT FOR REGULAR PURCHASE (PERCENT).....	111
TABLE A4.25.	ITEMS COVERED BY VERBAL AGREEMENTS (PERCENT) .....	111
TABLE A4.26.	EXTENT OF BUYER-SELLER RELATIONSHIPS (PERCENT).....	112
TABLE A4.27.	IMPORTANCE OF FACTORS DETERMINING WHOM TO TRADE WITH .....	112
TABLE A4.28.	COMMON SYMPTOMS IN DUCKS PRIOR TO DEATH FROM DISEASE. ....	112
TABLE A4.29.	ACTIONS TAKEN WITH BIRDS THAT DIE FROM DISEASE. ....	113
TABLE A4.30.	USE OF DUCK MANURE. ....	113
TABLE A4.31.	BIOSECURITY MEASURES UNDERTAKEN. ....	113
TABLE A4.32.	CULLING EXPERIENCE .....	113
TABLE A5.1:	GENDER OF TRADERS. ....	114
TABLE A5.2:	AGE OF TRADERS. ....	114
TABLE A5.3:	YEARS OF EXPERIENCE OF TRADERS. ....	114
TABLE A5.4:	NUMBER OF PEOPLE TRADING POULTRY PRODUCTS. ....	114
TABLE A5.5:	AVERAGE MONTHLY TRADING VOLUME BY PRODUCT.....	114
TABLE A5.6:	AVERAGE PURCHASE PRICE FOR POULTRY PRODUCTS IN SELECTED LOCATIONS .....	115
TABLE A5.7:	AVERAGE SALE PRICE FOR POULTRY PRODUCTS IN SELECTED LOCATIONS.....	115
TABLE A5.8:	SOURCE OF PURCHASE BY LOCATION (PERCENT). ....	116
TABLE A5.9:	TYPE OF AGREEMENT FOR AGGREGATORS PURCHASING CHICKEN AND DUCK MEAT .....	116
TABLE A5.10:	TYPE OF AGREEMENT FOR AGGREGATORS SELLING CHICKEN AND DUCK MEAT.....	116
TABLE A5.11:	WHAT DO VERBAL AGREEMENTS ENTAIL? (PERCENT).....	117
TABLE A5.12:	SANITARY MEASURES TAKEN BY POULTRY MEAT AGGREGATORS.....	117
TABLE A5.13:	OTHER ECONOMIC ACTIVITIES UNDERTAKEN BY AGGREGATORS .....	117
TABLE A5.14:	OTHER ECONOMIC ACTIVITIES UNDERTAKEN BY AGGREGATORS .....	117
TABLE A5.15:	PRODUCTS TRADED BY AGGREGATORS .....	118
TABLE A5.16:	AGGREGATOR MONTHLY HOUSEHOLD INCOME FROM POULTRY BY LOCATION .....	118
TABLE A5.17:	AVERAGE PURCHASE PRICE FOR POULTRY PRODUCTS IN SELECTED LOCATIONS .....	118
TABLE A5.18:	AVERAGE SALE PRICE FOR POULTRY PRODUCTS IN SELECTED LOCATIONS.....	119
TABLE A5.19:	AVERAGE PRICE MARK-UP FOR POULTRY PRODUCTS IN SELECTED LOCATIONS .....	119
TABLE A5.20:	SANITARY MEASURES TAKEN BY POULTRY MEAT AGGREGATORS.....	119
TABLE A5.21:	OTHER ECONOMIC ACTIVITIES UNDERTAKEN BY AGGREGATORS .....	120
TABLE A6.1:	GENDER OF RESPONDENTS BY LOCATION. ....	121
TABLE A6.2:	AGE OF RESPONDENTS BY LOCATION. ....	121
TABLE A6.3:	YEARS OF EXPERIENCE AS MARKET VENDOR.....	121
TABLE A6.4:	TYPE OF MARKET SPACE IN SELECTED LOCATIONS. ....	121
TABLE A6.5:	TYPES OF POULTRY PRODUCTS SOLD (PERCENT OF VENDORS).....	121
TABLE A6.6:	AVERAGE DAILY TRADING VOLUME OF POULTRY PRODUCTS IN SELECTED LOCATION. ....	122
TABLE A6.7:	PRE-PURCHASE CONTRACTUAL AGREEMENTS BY SOURCE AND LOCATION. ....	122
TABLE A6.8:	AVERAGE MARKET VENDOR SALE PRICE IN SELECTED LOCATIONS.....	122

## List of Figures

FIGURE 1:	CAMBODIAN GDP BY SECTOR .....	3
FIGURE 2:	AGE DISTRIBUTION OF CAMBODIAN POPULATION .....	4
FIGURE 3:	CAMBODIAN LABOR FORCE BY SECTOR .....	5
FIGURE 4:	MAP OF POVERTY LEVELS IN CAMBODIA .....	5
FIGURE 5:	POULTRY PRODUCTION IN CAMBODIA.....	8
FIGURE 6:	POULTRY MEAT PRODUCTION AND EGG CONSUMPTION IN CAMBODIA .....	9
FIGURE 7:	REGIONAL POULTRY DISTRIBUTION BY BREED .....	11
FIGURE 8:	CAMBODIAN POULTRY PRODUCTION BY PRODUCTION SYSTEM.....	11
FIGURE 9:	PRODUCTION CHARACTERISTICS FOR SMALLSCALE POULTRY PRODUCTION .....	14
FIGURE 10:	OVERVIEW OF STAKEHOLDERS INTERACTION IN CAMBODIAN POULTRY SECTOR (2004) .....	19
FIGURE 11:	LOCATION OF KAMPOT PROVINCE IN CAMBODIA .....	22
FIGURE 12:	LAND USE MAP OF KAMPOT PROVINCE .....	22
FIGURE 13:	DUCK DISTRIBUTION CHANNELS IN KAMPOT PROVINCE.....	25
FIGURE 14:	LOCATION OF SIEM RIAM PROVINCE .....	28
FIGURE 15:	LAND USE MAP OF SIEM REAP PROVINCE .....	29
FIGURE 16:	SOURCE OF POULTRY PRODUCTS IN SIEM REAP DOWNTOWN MARKET .....	35
FIGURE 17:	RANKING THE IMPORTANCE OF CHICKEN MEAT ATTRIBUTES IN SELECTED LOCATIONS.....	51
FIGURE 18:	AVERAGE RANKING OF SAFETY CONCERNS BY LOCATION. ....	51
FIGURE 19:	SEASONALITY OF TRADING.....	82



## **1. Introduction**

The purpose of this project is to produce an assessment of poultry supply chain conditions in the Kampot and Siem Reap market catchment areas. This will be done with detailed and separate surveys at four levels, producers, traders, vendors, and consumers. Modeled on the surveys already undertaken in Viet Nam and Thailand, these will elucidate production conditions, market access, contractual relationships, and consumer preferences and consumer willingness to pay.

Taken together, these results will inform policy initiatives to improve incentives for higher poultry quality (including health status) and higher value added at each stage of the supply chain. As in other case studies of the Mekong region, this activity will produce recommendations for sustainable market participation by smallholder poultry producers. This could include, but are not be limited to, programs for micro-credit and technology transfer, certified supply chains, and contract farming programs for bio-secure production of traditional bird varieties. In addition to reducing HPAI risk and the economic vulnerability of rural poor farmers, these recommendations will strive to increase product quality, safety and revenue across the traditional bird supply chain.

This report serves to contextualize the project, present the findings, and suggest the policy implications that follow. The report begins with a section on the background of Cambodia's economy, the agricultural sector, and the livestock sector. Subsequently, the literature on HPAI in Cambodia is reviewed, with emphasis on past livelihood studies and, from the review, an appropriate approach to the project is developed. Next, prospective project sites are reviewed for survey inclusion. Subsequently, survey results are presented, followed by a discussion of policy implications. The report ends with the summary statistics from all surveys.

## 2. National Overview

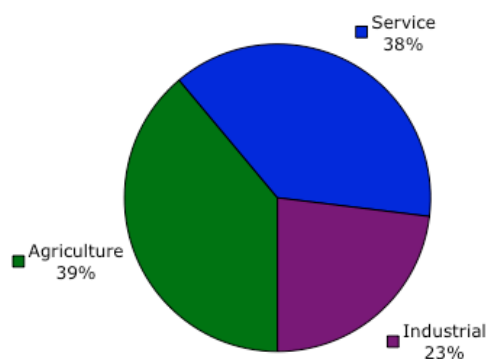
### Economic Overview

After several years of double digit growth rates, the Cambodian economy slowed to 8% GDP growth in 2007. While strong growth is expected to continue, it is likely to do so at a slower rate. Exports represent close to 30% of GDP and the country has a negative trade balance of 1.3 billion USD (ADB, 2008). Despite recent growth, there are high levels of inequality and much of the population lives in poverty. The gini coefficient for income inequality is 0.40, however, for food consumption the gini coefficient is only 0.15. Income inequality in Cambodia, as measured by Gini coefficient, is similar to levels in Thailand and slightly higher than levels in Vietnam.

Slightly more than one-third of the population is qualified by the United Nations as undernourished (FAO, 2005). These high levels of inequality exist largely within the context of an urban-rural divide. For example, in 2007 national per capita GDP was \$550. However, among the population involved in the agricultural sector per capita GDP was only \$148.

In 2006, Agriculture made up 39% of GDP and was the primary domestic activity for most households. In addition to agriculture, the service sector contributed 38% of the GDP, characterized by trading, communications, public utilities, air and land transport, hotels, and other tourism services. The other major component of GDP is industry. The industrial sector is dominated by manufacturing, located primarily in and around Phnom Penh, which accounts for 75% of industrial value added nationally (FAO, 2005).

**Figure 1: Cambodian GDP by Sector**

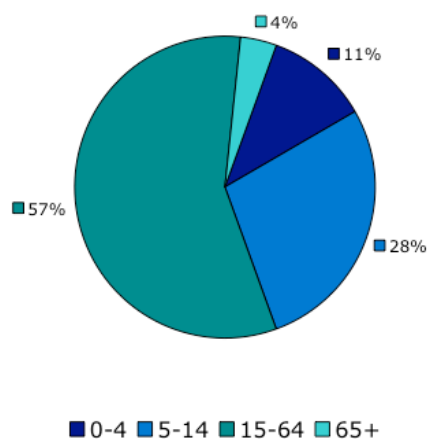


**Source:** National Institute of Statistics, 2004a

## Population

By 2007, the population of Cambodia had reached nearly 14 million. The Cambodian population is overall very young with close to 40% under the age of 14 in 2004.

**Figure 2: Age Distribution of Cambodian Population**



**Source:** National Institute of Statistics, 2004a

Employment in most of the country is characterized by self-employment (34%) and unpaid family work (43%) [table 1]. In fact, only 20% of the workforce consists of paid employment. However, in Phnom Penh, nearly half the workforce participates in paid employment and slightly more than a quarter of the workforce is self-employed, while slightly less than a quarter participates in unpaid family work. In 2004 the national unemployment rate was 7.2 percent.

**Table 1: Employed Population (>10 years old) by employment status, stratum, and sex**

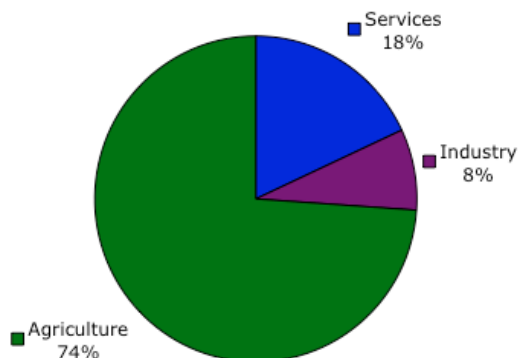
	All	Males	Females	Phnom Penh	Other Urban	Rural
Paid employee	20.0	23.3	16.6	48.0	26.3	16.7
Employer	0.1	0.1	0.1	0.1	0.2	0.1
Own account worker/Self-employed	34.4	39.7	28.8	27.1	34.5	35.0
Unpaid family worker	43.3	34.8	52.0	22.9	36.5	46.0
Other	0.5	0.6	0.3	0.7	0.2	0.5
NA	1.8	1.4	2.2	1.2	2.4	1.8
Total	100	100	100	100	100	100

**Source:** National Institute of Statistics, 2004b

In a nation where more than 80% of the population is classified as rural, agriculture is the most important economic activity. In 2007, 2.4 million males and 2.8 million females were working in

agriculture and the sector absorbs 150,000-250,000 individuals annually. While agriculture contributes 38% of the GDP, the sector accounts for 74% of the labor force (figure 3).

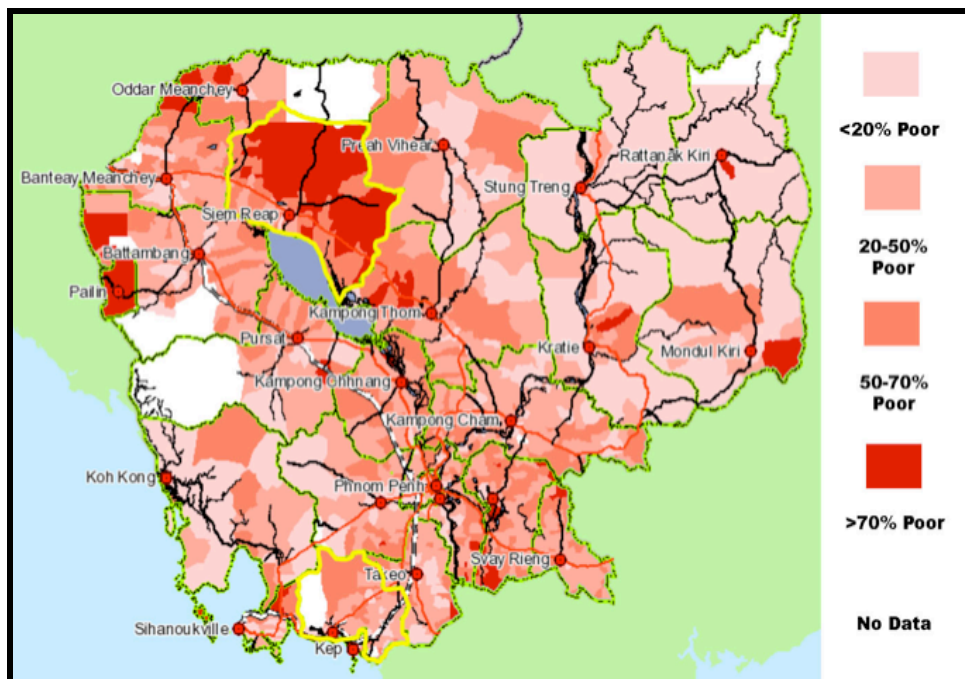
**Figure 3: Cambodian Labor Force by Sector**



**Source:** National Institute of Statistics, 2004a

Poverty levels in Cambodia are highest in rural areas with many pockets of high density near border areas (especially the Thai border). Siem Reap province has the highest density of poverty. In most areas of the province, more than 70% of the population is classified as poor.

**Figure 4: Map of Poverty Levels in Cambodia**



**Source:** The Atlas of Cambodia, available online at: <http://www.cambodiaatlas.com/>

## Agriculture

The type of agricultural activity undertaken varies by season. Cereals, and largely rice, are the most common crop group and are produced by more than 70% of households in the wet season and nearly 40% of households in the dry season. Fruits and vegetables are the next most common crops, produced by 10% of households in the wet season and almost 30% of households in the dry season.

**Table 2: Number of households by group of crop production and season (% households)**

Main group of crop production	Wet season	Dry Season	Total
Cereal harvested for grain	71.3	37.7	61.6
Tubers and leguminous plants	3.4	6.0	4.1
Industrial temporary crops	4.7	6.9	5.3
Vegetables	5.7	12.3	7.6
Fruits and nuts	10.5	27.5	15.4
Industrial permanent crops	3.6	8.1	4.9
Other crop not classified elsewhere	0.8	1.4	0.9
Total	100	100	100
Total # of hh involved in agriculture	2,148,500	874,000	3,023,000

*Source:* National Institute of Statistics, 2004b

Decisions regarding which crop to produce and which season(s) to produce them depend on many factors such as environmental factors, geography, seasonal prices, seasonal production costs, access to capital, and household dietary considerations. Consequently, seasonal yields for crops vary greatly. Table 3 illustrates average yield by crop group and season.

**Table 3: Average yield per square meter of crop production by season (Million riels)**

Main group of crop production	Wet season		Dry Season	
	Gross output	Net output	Gross output	Net output
Cereal harvested for grain	1,313	1,286	1,282	1,242
Tubers and leguminous plants	158	152	305	300
Industrial temporary crops	589	577	689	677
Vegetables	906	873	296	288
Fruits and nuts	1,833	1,689	449	441
Industrial permanent crops	168	165	130	127
Other crop not classified elsewhere	310	288	212	211
Total	1,242	1,210	787	765

*Source:* National Institute of Statistics, 2004b



The primary costs associated with crop production are planting materials, fertilizers, and payment for hired draft power. However, these costs also vary by season and the percentage of cost that goes toward energy, for example, increases more than five fold in the dry season (table 4). Total costs, as well as total output, are higher in the wet season.

**Table 4: Costs for crops production by season and group item (percent)**

Item	Wet Season	Dry Season	Total
Planting material	19.0	18.6	18.9
Chemical fertilizers	24.6	20.0	23.2
Animal & plant manure	6.4	1.6	4.9
Pesticide, weedicide, & fungicide	1.4	7.5	3.3
Electricity, Oil, gas, diesel oil for the farming	1.9	10.7	4.7
Storage items	3.2	2.6	3.0
Payment for hired draft power	25.1	16.5	22.4
Other hire labor charge	7.4	7.2	7.3
Irrigation charge	1.9	8.5	4.0
Service/technical supports from govt & others	0.0	0.1	0.1
Services/technical supports from govt & products	2.1	2.9	2.4
Repair and Maintenance of farm house, animal shed	1.3	0.5	1.0
Repair & maintenance of farm equipment	2.4	1.4	2.1
Rental paid to owner for farm land (in cash)	2.1	1.5	1.9
Rental paid to owner for farm land (in Kind)	1.1	0.3	0.9
Rental paid to owner for farm house, equipment, etc.	0.2	0.2	0.2
Total	100	100	100
Total, cost, million riels	495,894	228,433	724,327

*Source:* National Institute of Statistics, 2004b

High levels of home consumption of agricultural products mean that crop production decisions must take into account dietary considerations. Rice is the main source of nutrition for most Cambodians. Livestock products contribute one-tenth of caloric intake and poultry products constitute one quarter of livestock consumption (table 5).

**Table 5: Per Capita Daily Calorie Intake from selected food items**

Food Item	Calories per person per day
Rice	1,419
Wheat	18
Maize	107
Cassava	26
Sugar	79
Soybean Oil	11
Palm Oil	48

Milk	10
Animal Fats	16
Eggs	4
Pig meat	80
Poultry meat	9
Bovine meat	20

*Source:* FAO, 2005

With such a large proportion of the population working in the agricultural sector, in addition to agriculture's role in nourishing the population, its development is at the heart of economic development in Cambodia. Within the agricultural sector, the MAFF has highlighted livestock as the subsector with the most potential for development, followed by fisheries and timber (MAFF, 2007).

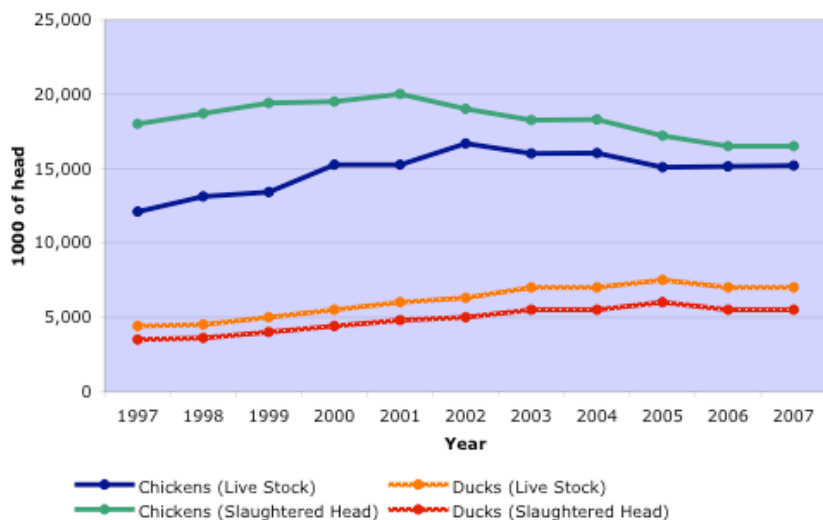
#### **Livestock Sector**

Livestock accounts for 15% of agricultural GDP and serves an important role in many rural households. Buffalo and oxen are often kept for fieldwork activities while poultry and pork are commonly kept to supplement household diets and income. Local market chains serve the domestic market and consequently live bird traders are key marketing agents. Additionally, village and animal health agents serve as advisors to livestock production.

#### **Poultry Sector**

The 1990s saw annual increases of poultry production of more than 6% to nearly double total production over the course of the decade. However, since 2002 the number of chickens produced has declined each year besides 2004, when levels held steady (figure 5). Meanwhile, duck production has continued to grow steadily and by 2007 Cambodia was producing more than 20 million head of poultry, 80% of which were chickens and 20% ducks. Because of the short production cycles for chicken, each year there are more chickens slaughtered than there are live chicken stock. However, the opposite is true for ducks where each year there are more live birds than there are slaughtered during the year.

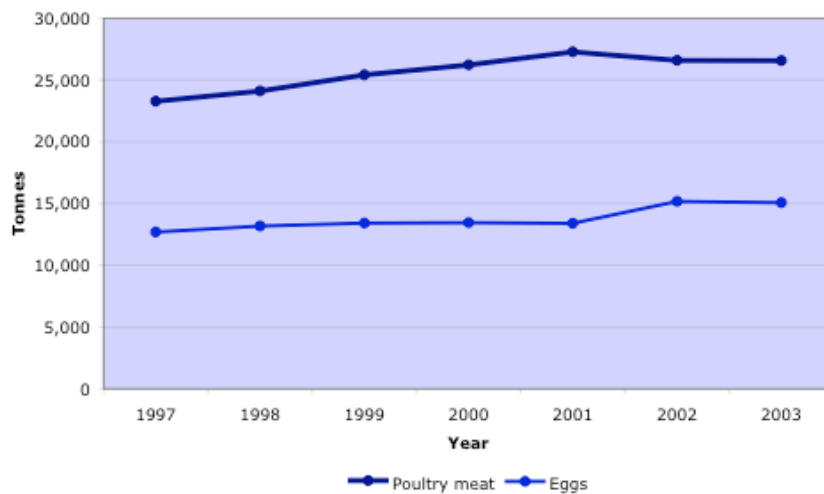
**Figure 5: Poultry Production in Cambodia**



Source: FAOStat

As incomes have continued to rise, poultry meat and egg consumption have been increasing in the past decade. By 2003, Cambodians were consuming more than 25,000 tonnes of chicken meat and 15,000 tonnes of eggs each year.

Figure 6: Poultry Meat Production and Egg Consumption in Cambodia



Source: FAOStat

The importance of livestock activities varies largely by region. Poultry densities are much higher in the southeast part of Cambodia (lower Mekong area, around Phnom Penh, close to Vietnam)

and in the north-west part (north and around Tonle Sap, close to Thailand) than in other parts of the country. Poultry densities are highly correlated to human densities.

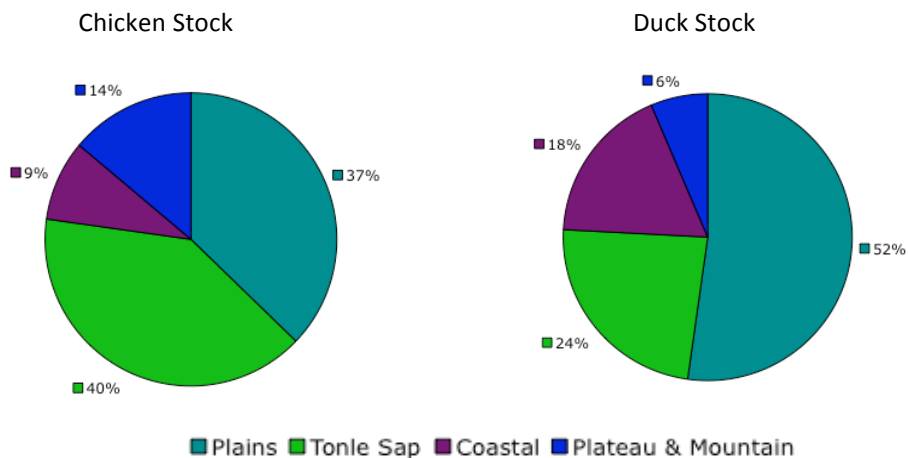
The provinces with the greatest number of poultry (heads) are Pursat, Takeo, and Kampong Cham, while the provinces with the highest density of poultry are Phnom Penh, Takeo, and Krong Preah Sinhanouk.

**Table 6: Number and Density of Poultry by Province**

Province	Number of Poultry (head)	Poultry Density (head/km <sup>2</sup> )
Banteay Mean Chey	450,533	67
Battambang	717,042	61
Kampong Cham	1,516,373	155
Kampong Chhnang	648,980	118
Kampong Speu	1,035,002	147
Kampong Thom	632,354	46
Kampot	1,146,019	235
Kandal	1,259,088	353
Koh Kong	52,779	5
Kratie	352,756	32
Krong Kaeb	29,771	89
Krong Pailin	25,334	32
Krong Preah Sihanouk	332,692	383
Mondul Kiri	30,430	2
Otdar Mean Chey	855,176	139
Phnom Penh	223,073	769
Preah Vihear	341,914	25
Prey Veng	1,269,111	260
Pursat	2,203,791	174
Rotanak Kiri	112,867	10
Siem Reap	769,104	75
Stung Treng	85,293	8
Svay Rieng	968,689	327
Takeo	1,622,549	455

*Source:* DAHP Survey 2003

In addition to being located near large human populations, poultry producers are concentrated in certain geographical regions. Most poultry are kept within the region of the Plain Valley (40 percent) and Tonle Sap Lake (37 percent). The remaining proportions are shared between the coastal region (11 percent) and the plateau and mountain regions (12 percent) as shown in figure 8.

**Figure 7: Regional Poultry Distribution by Breed**

*Source:* DAHP Census 2003

### Production Systems

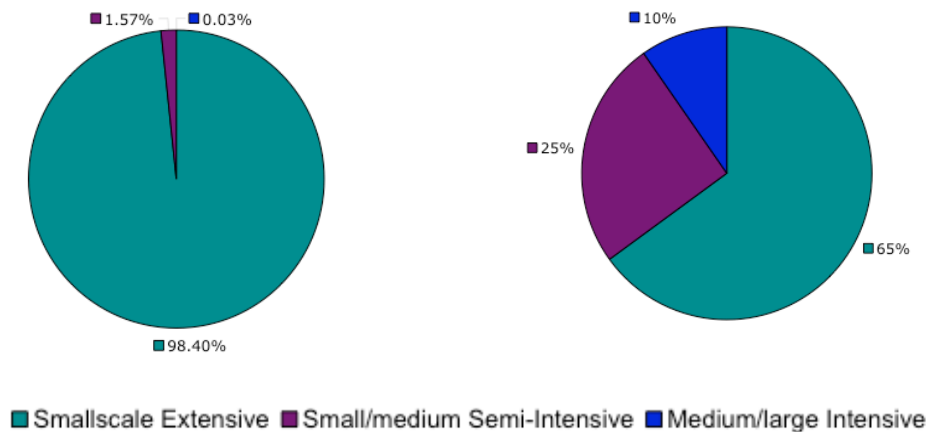
The Cambodian poultry sector consists of three general types of production systems; traditional small-scale production, semi-intensive small/medium scale commercial chicken/duck production, and medium/large scale intensive industrial chicken/duck production.

Traditional small-scale production is the most common system, accounting for more than 95% of poultry in Cambodia and involving 2,000,000 households (figure 9). In most rural households, raising poultry is one of many activities in an extensive agriculture production system. More than half of all Cambodian households keep some poultry, including 60% of rural households and 25% of urban households. Among smallholder households raising poultry, 80% raise only chicken, 19% raise ducks and chicken, and only 1% raise solely ducks (VSF, 2004).

**Figure 8: Cambodian Poultry Production by Production System**

*Number of Flocks*

*Number of Birds*



**Source:** Burgos et al, 2008

Local breeds raised including Skouy, Sampeov, Kragnas (chicken), Tear Angkam layers, Tear Sampeov layers & broilers, and Muskovi (ducks). The traditional system is characterized by small flocks and low inputs, allowing birds to scavenge for food and using hens for restocking the flock. Depending on the region, only 5-25% of chicken owners provide feed to supplement scavenging. Housing is very basic and mostly used for keeping birds safe from predators and thieves during the night. Some chickens spend their nights in trees. Birds produced in the traditional system are either consumed by the household, given/sold to neighbors/friends/family, or sold at the farm gate to traders.

Medium and large scale commercial poultry production did not begin to develop in Cambodia until the mid to late 1990s. The entrance of CP into the Cambodian poultry sector played an important role in facilitating development. Not only did CP provide contracting opportunities, but the company also established hatcheries and feed factories that allowed some independent farmers to purchase these products locally rather than import them. Nonetheless production in these systems are resource intensive and often continue to utilize imported products from Thailand, China, and Vietnam to run their farms (Burgos et al, 2008).

Commercial farms are major suppliers for large cities such as Phnom Penh, Battambang, and Siem Reap. However, less than half of Cambodian provinces have commercial poultry farms. The 2004 DAHP survey indicated 74 chicken layer farms, 108 broiler chicken farms, and 951 duck farms in Cambodia (table 7). The average size of a commercial farm is about 1,400 heads. Less developed production systems of this type rely both on naturally available feeds and

manufactured animal feeds. Advanced systems rely solely on commercial feed. Housing is semi-closed or closed. Broiler breed day-old-chicks are purchased from hatcheries and indigenous chicks are obtained from local markets or own-stock hatching. Housing varies from permanent to makeshift enclosures made with local primary building materials, such as mud bricks or bamboo, or tree branches. Compared to backyard farms, semi-intensive producers utilize more extensive bio-security measures, however, most of the system is still constructed from local materials (Burgos et al, 2008).

**Table 7: Number of Commercial Farms and Head of Poultry by Province**

Province	Chicken Broiler		Chicken Layer		Duck		Total head
	# farm	head	# farm	head	# farm	head	
Banteay Mean Chey	2	240	1	1,400	32	61,967	63,607
Battambang	6	18,000	1	6,000	48	178,755	202,755
Kampong Cham	4	1,900	2	3,500	177	80,789	86,189
Kampong Chhnang	1	1,000	0	0	36	54,125	55,125
Kampong Speu	41	204,900	8	148,200	0	0	353,100
Kampong Thom	0	0	0	0	13	9,200	9,200
Kampot	0	0	0	0	6	9,358	9,358
Kandal	18	63,032	46	158,395	11	13,740	235,167
Koh Kong	3	3,120	1	900	1	400	4,420
Kratie	0	0	0	0	0	0	0
Krong Kaeb	0	0	0	0	0	0	0
Krong Pailin	0	0	0	0	0	0	0
Krong Preah Sihanouk	0	0	0	0	146	64,194	64,194
Mondul Kiri	0	0	0	0	0	0	0
Otdar Mean Chey	0	0	0	0	0	0	0
Phnom Penh	10	37,085	5	42,955	17	27,574	107,614
Preah Vihear	0	0	0	0	0	0	0
Prey Veng	0	0	0	0	57	26,134	26,134
Pursat	0	0	0	0	0	0	0
Rotanak Kiri	0	0	0	0	3	230	230
Siem Reap	18	30,780	6	10,920	98	58,870	100,570
Stung Treng	0	0	0	0	0	0	0
Svay Rieng	0	0	0	0	3	600	600
Takeo	5	19,296	4	6,400	303	244,656	270,352

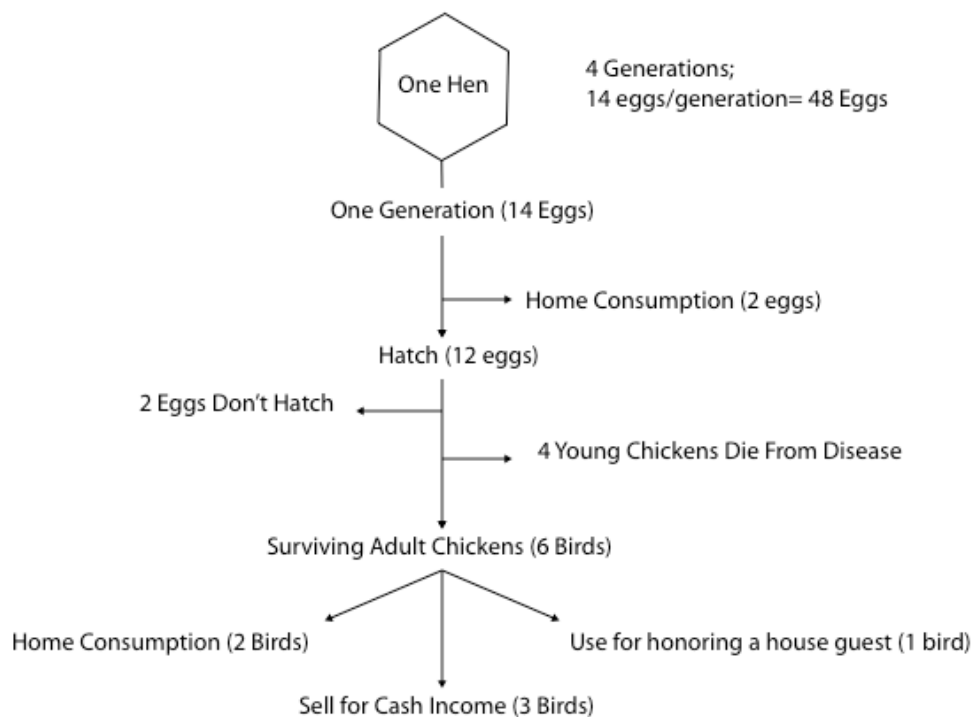
**Source:** DAHP Survey 2003

### Small-scale Farms

Small-scale farms are by far the most common farming system and is practiced all over Cambodia. Nationally there are estimated to be more than 1.8 million flocks (MAFF, 2006). However, poultry production for smallholders is only one of many activities within agricultural livelihood systems. Most flocks are small (<10 birds) and require minimal inputs.

Most households keep one or more hens to hatch eggs for restocking and home consumption. One local breed hen can produce about 14 eggs per cycle for four generations. Figure 10 illustrates an example of production activities for one generation of eggs. Of the 14 eggs laid, about 2 are consumed at home while 12 are left to hatch. Of the dozen eggs left to hatch, only six chickens survive to adulthood of which three are sold, two are consumed at home and one is kept for a special occasion to honor a house guest. Many households keep several hens and can produce a greater number of chickens, however, space limitations often prevent flock expansion.

**Figure 9: Production Characteristics for Smallscale Poultry Production**



**Source:** Constructed from description in Seng et al, 2007

Small-scale poultry rearing is largely a seasonal venture. September to early February is an ideal fattening period because there is extra chicken feed such as rice grain left over from the rice harvest. Moreover, chickens can be fully fattened for sale during the high price period of



Chinese New Year in February. There is often little home consumption in January as households prefer to sell their products during the high price period.

Khmer New Year in April is another high price period. Many households use the period between the two high price periods to fatten their chickens. However, the hot season begins in late March and the following months are high disease period. Nonetheless, many households raise chickens for sale or home consumption for Khmer New Year in April. After the hot season, in July and August, farmers begin to restock their flocks through hatching or obtaining chicks from outside sources.

**Table 8: Calendar for selected aspects of smallscale chicken raising**

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Main Raising/ Fattening Period												
High Price Period: New Years/Weddings												
High Disease Period												
Re-start chicken venture												

*Source:* adopted from description in Seng et al, 2007

### Broiler Farms

In 2004, DAHP recorded 108 chicken broiler farms with an average of more than 3,500 birds per farm. Broiler farms are mainly located in Kampong Speu, Siem Reap, Kandal and Phnom Penh. 68 of these farms are integrated with CP farms. As the integrator, CP provides DOCs, feedstuffs, pharmaceuticals and technical advice. The farms provide infrastructure and labor, and assume part of the financial risk. All birds are output to CP owned slaughter houses and farm owners are paid by the head based on performance indicators. Market weight for broilers tend to be about 1.88 kg. Most farms operate on batch production cycles where broilers are all the same age. (VSF, 2004)

Farms without contracts tend to provide commercial feed only for the first ten days and subsequently use home-made feed from local products such as corn, soybean, and fishmeal. DOCs are purchased from importers, some of whom work for CP. DOCs can be provided by CP

(integrated or private farms) as well as Medivet company and 3 other importers based in Phnom Penh. Prior to HPAI outbreaks, CP sold only 20% of its DOCs to private farms, however, after the outbreaks the proportion sold to private farms increased to 50% (VSF, 2004).

### **Layer Farms**

Layer farms produce eggs for human consumption and the manufacture of food products. In the 2004 DAHP survey, 74 chicken layer farms were recorded, 9 of which were contracted with CP. In addition there are 57 pullet farms owned by CP. The average flock size was slightly more than 5,000 birds. Pullet raising farms provide replacements for unproductive layers which are sold to be slaughtered for meat. Most layer breeds are imported because indigenous breeds are less productive (Burgos et al, 2004).

High-end producers use commercial feeds while other producers may use farm-made feeds for birds that are 7-10 days old. Private farms usually use 110-120 g/day/layer of feed. Birds are sold or slaughtered once laying rates drop below 60 percent. The average selling price for eggs is KHR 140 (USD 0.04) and for culled layers the price is KHR 3,500/kg (USD 0.90/kg). Replacement birds are either DOCs or young mature layers. Commercial egg producers compete with producers in neighboring countries, whose access to lower cost feedstuffs allow for cheaper production. One market survey found that 11 percent of chicken eggs and 36 percent of duck eggs came from neighboring countries (VSF, 2004).

The layer industry is geographically concentrated in Kandal and Kampong Speu, which collectively account for nearly 80 percent of the national layer population (table 7).

### **Duck Farms**

In 2004, the DAHP survey found 951 duck farms with an average of 900 ducks per farm. Duck farms tend to be less standardized than broiler farms, involving about 30% broiler ducks and 70% layers (Burgos et al, 2008). Duck raising cycles generally coincide with rice production periods and peaks of demand. Initial investment is moderate (feed mixer, feed storage structure) and ducks are raised outdoor near a pond and in fields. High quality feed is often provided during the first two weeks of rearing and subsequently lower-quality feed is provided. Production cycles depend largely on local rice production cycles.

There are no integrated farms, however, there exists a semi-integrated system with hatcheries where relationships are based on oral agreements. Broiler ducklings are purchased at one day of age and 90% are foreign breeds with Pekin being the most popular breed. The average production cycle lasts 65 days at the end of which ducks are about 2.7 kg. 95% of layer breeds are Kakis. Farms either purchase day old ducklings, young layers (4-6 months), or adult layers (8-10 months). Most ducklings are produced in Takeo province or imported from Vietnam. However, some eggs are imported from Thailand and Vietnam as well. October and November are the most popular months for purchasing ducklings. Duck laying cycles range from 4 to 24 months (Burgos et al, 2004).

**Table 9: Calendar for selected aspects of duck raising**

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Start raising ducklings for medium and large scale												
Sell male ducks												
Duck laying eggs												
High mortality rates												

**Source:** Seng et al, 2007

### **Breeding/Incubator Farms**

There is only one breeding farm in Cambodia. It is owned by CP and located in Kandal province. The farm produces day-old-chicks for broiler farms and pullet/layer farms. There are no duck or local chicken breeding farms, however, several provinces have hatcheries for production of local duck breed embryonnated eggs or ducklings. Takeo is the most important one with 20-30 hatcheries (VSF, 2004). Owners of hatcheries tend to have ties with local farmers and may offer credit and technical advice to trusted farmers. In Takeo province, many smallholder farmers purchase ducklings in May while commercial farmers purchase ducklings in October. The remaining months the hatcheries produce embryonnated eggs (Seng, 2007).

### **Wholesalers/Importers**

Wholesale importers of chicken and animal feed import products from Thailand and Vietnam and distribute them in Cambodia. There are 3 to 4 major wholesales based in Phnom Penh and

many regional agents operating at provincial scale. Operation volumes range from 80,000 to 175,000 chicks per month. Farmer orders are placed with the wholesalers in advance. The volume of feed imported by wholesalers depend on many factors including season and price, and range from 75 to 125 tonnes per month. The distribution network for national wholesalers consist of 20-25 trucking distributors throughout the provinces.

In addition, there are several wholesalers that specialize in trading pharmaceuticals. VE, Thom Thom, and Navetco sell premix, vaccines, and medicines through distributors as well as directly to some large farms. Only Thom Thom provides technical services (VSF, 2004).

### **Veterinarians**

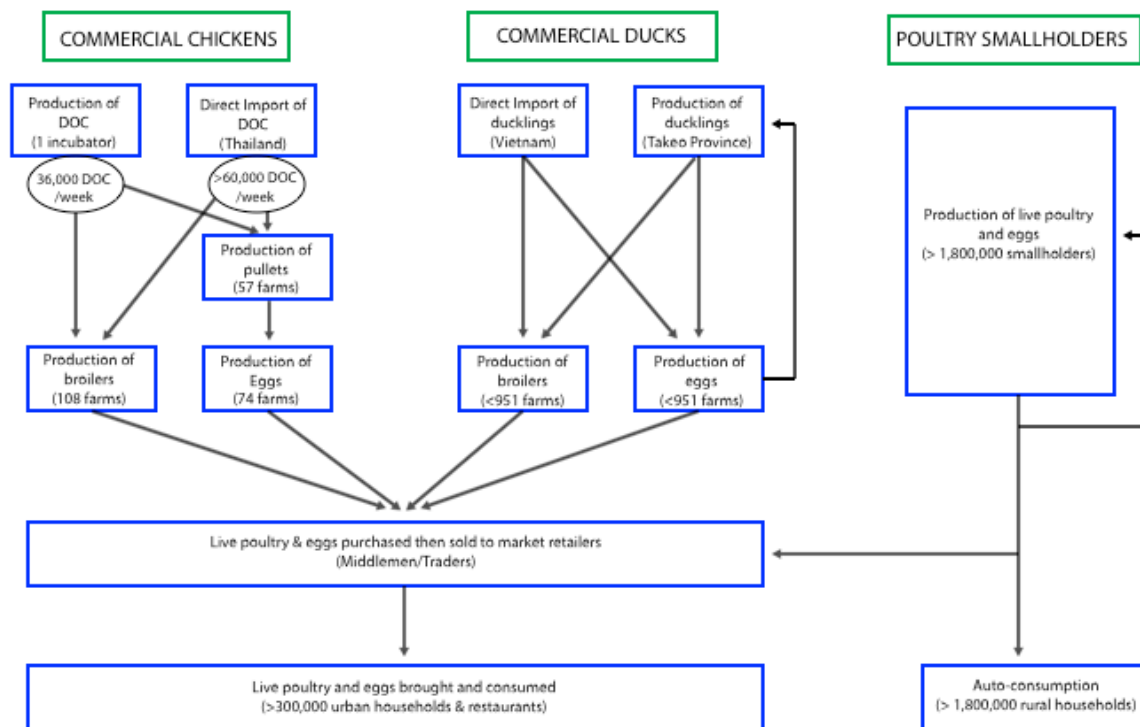
The Department of Animal Health and Production (DAHP) supervised 24 provincial offices as well as district offices which are supposed to provide veterinary services. In addition, village animal health workers (VAHW) provide local services. However, VAHW tend to spend more time providing technical advice about pigs, buffalo, and bovine as these livestock are more valuable. There are weak links between DAHP and VAHW. Medium and large-scale farms tend to use state veterinary services while small-holders tend to use village services. Employees in shops or distributors that sell pharmaceuticals are another option for technical advice.

## Marketing

Smallholders, in addition to home consumption, market some of their flock. Medium and large producers, on the other hand, generally sell all of the birds they produce. Middlemen play a key role in bringing poultry and eggs from producers to markets. They transport poultry on bicycles, motorbikes, cars, and trucks. Traders can aggregate to different levels (i.e., village, district, province, etc.) and sell to local markets and higher administrative districts. Moreover, much of the poultry production is sold in the largest markets of Phnom Penh and Siem Reap.

Market retailers exist at commune, district, and provincial levels. Consumers usually purchase live birds which are then slaughtered and prepared by the vendor at the market. While Cambodian products are not officially exported, there may be low levels of informal sale in neighboring countries during certain seasons. Imports from Thailand and Vietnam exist, but are difficult to estimate because much of the trade is informal.

**Figure 10: Overview of Stakeholders Interaction in Cambodian Poultry Sector (2004)**



Source: VSF, 2004

### HPAI in Cambodia

Cambodia has not been as affected by avian influenza as its neighbors, however, there have been 20 confirmed poultry cases and seven human deaths from HPAI since the disease was discovered in Cambodia in 2004. During that time, more than 20,000 birds have been affected by the disease.

There is a temporal pattern to the HPAI outbreaks. In the past four years, 70% of HPAI outbreaks in poultry have occurred between February and May while 25% have occurred between June and September, and 5% between October and January. Moreover, all 7 human cases have occurred between February and May. In addition, there has been some confusion among farmers between Newcastle disease and HPAI. Part of this problem arises out of nomenclature (Heckler, 2007). In addition, these diseases share similar temporal patterns, further confounding confusion (table 10). The most favorable season for raising poultry is July to December.

**Table 10: Chicken Disease Calendar**

Type of chicken diseases	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HPAI												
Newcastle												
Climatic stress (wet-cold)												
Fowl-pox												
Fowl Cholera												
Favorable season												
Highest mortality												

**Source:** Adapted from Seng et al, 2007

Three of the main challenges to developing the livestock sector are markets, access, and issues of land rights. Markets suffer from high transaction costs associated partly with paying unofficial fees along main transportation routes. Access, restricted by lack of irrigation and roads as well as the high cost of energy, is a limiting factor in expansion. Finally, there is underinvestment as a result of undefined land rights that arise out of the misuse of land concessions and the insecurity of land tenure (Wood, 2006).

### **3. Overview of Selected Project Sites**

This section provides an overview of selected project sites, including previous study inclusions, and highlights the benefits and drawbacks of including each site in our study. The project plan entails detailed sets of surveys related to chicken production including producer, middlemen, market vendor, and consumer surveys. In addition, an in-depth study of roaming duck flocks will be carried out including surveys of producers, the owners of rice fields where ducks scavenge, and other stakeholders to be determined in the field.

Selection for inclusion in the study is based on several factors, namely HPAI experience, provincial poultry production characteristics, geography/location, and levels of poverty. Seven provinces are eligible for inclusion, based on confirmed HPAI cases; Takeo, Kandal, Kampot, Kampong Cham, Kampong Speu, Prey Veng, and Siem Reap. We are primarily interested in smallholder production, however, we would prefer to include provinces where medium and large scale systems operate as well in order to understand how these systems interact. High densities of small/medium scale duck production is necessary in at least one province.

Given the purpose and scope of the project, we are proposing two sites to carry out three sets of surveys (2 chicken, 1 duck). A chicken study in Siem Reap should be included because of its mixed chicken production system (small, medium, and large scale), major poultry market, and high levels of poverty. Five of the seven provinces that experienced HPAI share a border with Vietnam. At least one of these provinces should be included in order to study cross-border trade. Among the provinces bordering Vietnam, Kampot is the best site for chicken and duck studies because of its four confirmed human HPAI cases (most of any province) and extensive smallholder chicken and duck production.

## Kampot Province

### Geography

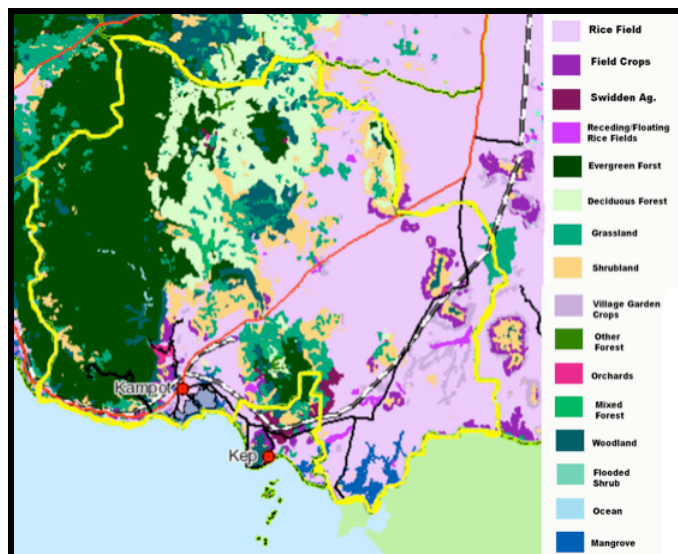
Kampot is located in the coastal region of southern Cambodia, near the Mekong delta bordering Vietnam. The province of Kampot covers a land area of 4,873 km<sup>2</sup> (2.7% of Cambodia). Of the area, 1,326 km<sup>2</sup>, or 27% of the province, is agricultural land while 2,748 km<sup>2</sup> (56%) is forested area (MAFF, 2007). Most of the forested regions lie in the western part of the province, while the eastern part of the province is primarily rice fields (figure 13). In addition, there are large areas of mangroves along near the coast near where Kampot borders Vietnam.

**Figure 11: Location of Kampot Province in Cambodia**



*Note:* Phnom Penh highlighted in red

**Figure 12: Land Use Map of Kampot Province**



*Source:* The Atlas of Cambodia, available online at: <http://www.cambodiaatlas.com/>



## Population

The province hosts a population of 654,000 and a human density of 127 people per km<sup>2</sup>. Within this area there are 104,498 households. The average household size is 5 people and 69% of household are male headed. There is also a substantial migrant population of 95,900, accounting for 18.2% of provincial population. 79% of migrants came from other villages within the province, while 18.4% come from other provinces and 2.5% come from other countries (presumably Vietnam) (NIS, 1998). The provincial age distribution is skewed slightly younger than the national average (table 14).

**Table 11: Age Distribution of the Population in Kampot Province**

Age Group	0-4	5-14	15-64	65+
Kampot Province	12	39	45	4
National Average	11	28	57	4

*Source:* National Institute of Statistics, 2004a

## Economy

Like most provinces in Cambodia, employment in Kampot is largely agricultural. In fact, the proportional of the provincial workforce engaged in own account work or working as an unpaid family employee are both higher than the national average.

**Table 12: Distribution of employed persons by sex in Kampot Province (percent)**

	Kampot Province			National Average		
	Both	Males	Females	Both	Males	Females
Paid employee	0.1	0.1	0.1	20.0	23.3	16.6
Employer	5.1	8.1	2.6	0.1	0.1	0.1
Own account worker/Self-employed	41.7	56.8	29.2	34.4	39.7	28.8
Unpaid family worker	53.0	35.0	67.9	43.3	34.8	52.0
Other	0.1	0.0	0.1	0.5	0.6	0.3
Total	100	100	100	100	100	100

*Source:* National Institute of Statistics, 2004

The most common occupation is farmer, accounting for 87% of the population. In addition, 6.2% of the population are traders and 5.5% are fisherman while 1.2% work for the government (MAFF, 2007). Yearly per capita food consumption in Kampot consists of 223 kg of rice, 36.5 kg of vegetables, 13.2 kg of meat, and 11 kg of fish. More than 90% of the population uses firewood for cooking, while 4% use charcoal, 2% use kerosene (NIS, 1998).

About half of all households in Kampot are considered poor, while 10-15% are considered well-off. Most households participate in smallscale agricultural activities at their homes. However, poor households often also participate in seasonal migration while the poorest households sell labor within their home villages. Medium households often work in garment factories or for the government, while the wealthiest households tend to run businesses such as grocery stores or rice mills. Characteristics of poverty levels in the region are described in table 16.

**Table 13: Description of households by poverty levels in Southern Cambodia**

Poverty Level	Characteristic	Description
<b>Poorest households</b>	Proportion of Pop.	10-15%
	Rice Land	<0.4 ha
	Type of house	4x5m; house in poor condition
	Number of Cattle	0-1 cows
	Transportation	None
	Non-farming Activity	Selling labor in village for agricultural activities
	Child Education	Maximum education is lower secondary school
<b>Poor households</b>	Proportion	35-40%
	Rice Land	0.4-1.0 ha
	Type of house	5x6 m; house in poor condition
	Number of Cattle	1-2 cows
	Transportation	Bicycle
	Non-farming Activity	Sell labor outside village; seasonal migration
	Child Education	Some children finish lower secondary school through grade 9
<b>Medium households</b>	Proportion	25-35%
	Rice Land	1-2 ha
	Type of house	5x7m; house in medium condition
	Number of Cattle	3-4 cows
	Transportation	Old motorbike
	Non-farming Activity	Work in garment factory; local government officials
	Child Education	All children finish lower secondary school through grade 9
<b>Better-off households</b>	Proportion	10-15%
	Rice Land	>2 ha
	Type of house	5x8m; house in good condition
	Number of Cattle	>5 cows
	Transportation	New motorbike
	Non-farming Activity	Run a rice mill; medium or large grocery business in community
	Child Education	All children finish upper secondary school (finish 12 grades)

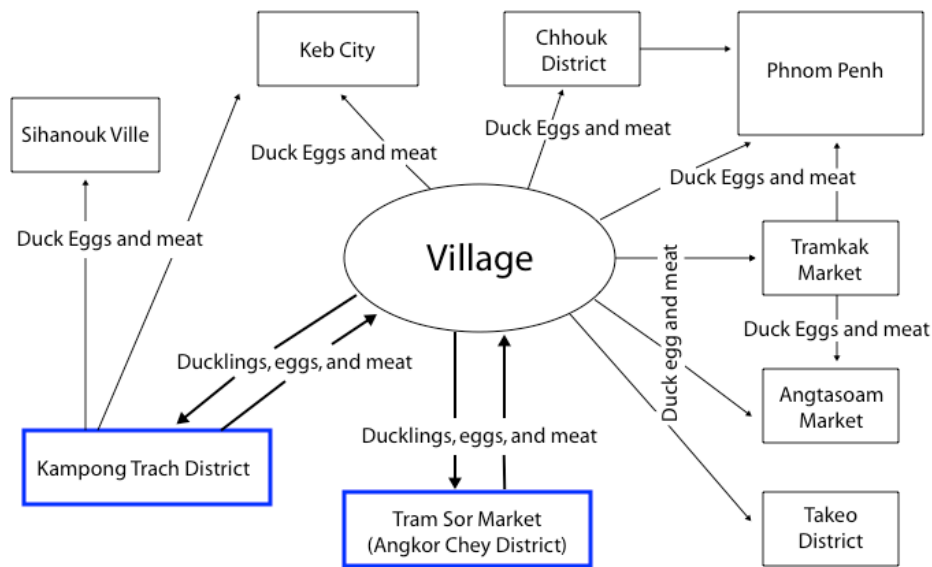
**Source:** Seng et al, 2007 (table derived from discussion groups in Kampot, Takeo, Kampong Cham, and Kampong Speu provinces)

**Livestock**

According to the MAFF, livestock is the number one priority for future development in Kampot province. In the 2004 DAHP survey, 1,146,019 head of poultry were recorded in Kampot province for a poultry density of 235 head/km<sup>2</sup>. Of the poultry raised in Kampot, 747,447 are chicken, 397,917 are ducks, and 655 birds are goose. The province ranks 6<sup>th</sup> nationally in terms of number of poultry and 7<sup>th</sup> in poultry density. In the same survey 6 commercial duck farms were observed which collectively held 9,400 ducks. No large-scale chicken farms were recorded in the DAHP survey.

Poultry products produced in Kampot are sold in local markets and transported to other provinces and cities (figure 14). Many products are sent to Phnom Penh, however, Sihanoukville and Keb cities are also outlets for Kampot products. Kampong Trach District and Tram Sor Market are trading hubs where ducklings, in addition to eggs and meat, are traded regularly. Tramkak market is also a major market where products are resold to Angtasoam market and middlemen who transport duck eggs and meat to Phnom Penh.

**Figure 13: Duck Distribution Channels in Kampot Province**



**Source:** Seng et al, 2007

Prices of poultry products depend on the size and type of the bird as well as the season. High season, approximately February-April, is the time when there are several festivals and many weddings occur. During the high season, most chicken products increase in price by about 2,000 riel (USD 0.50). Muscovy ducks increase by about 2,500 riel (USD 0.62).

**Table 14: Price of Chicken Products in Southern Cambodia 2007 (per head)**

Chicken Commodity	Farm Gate Price		Market Retail Price	
	Normal Season	High Season	Normal Season	High Season
Hen over 1 kg	9,500-10,000	10,000-12,000	9,500-10,000	10,000-12,000
Hen under 1 kg	7,000-8,000	10,000-12,000	9,500-10,000	10,000-12,000
Cocks over 1 kg	9,500-10,000	10,000-12,000	9,500-10,000	10,000-12,000
Cocks under 1 kg	6,500-7,000	8,000-8,500	8,000-8,500	-
Castrated chicken	-	13,500-14,000	-	14,000-15,000

**Source:** Seng, 2007 (1 USD=4,000 Riels)

*Note:* Prices from survey in Kampot, Takeo, Kampong Cham, and Kampong Speu Provinces

**Table 15: Farm Gate Price of Duck Products in Southern Cambodia 2007**

Duck Commodity	Normal Season	High Season
Duck eggs (per egg)	320-350	350
Female ducklings (per head)	700-1100	-
Male Ducklings (per head)	500-650	-
Egg-Laying Ducks (per head)	11,000-12,000	-
Duck finishing eggs (per head)	6,000-7,000	-
Broiler ducks (per head)	6,000-6,500	7,000
Muscovy Ducks (per kg)	5,500	8,000

**Source:** Seng, 2007 (1 USD=4,000 Riels)

*Note:* Prices from survey in Kampot, Takeo, Kampong Cham, and Kampong Speu Provinces

### HPAI Experience

Kampot province has had the most severe problems with HPAI of any province in Cambodia. In addition to three confirmed outbreaks in poultry, there have been four human deaths from HPAI since 2004. Poultry outbreaks have occurred in chickens, ducks, and wild birds in several districts. In each case, outbreaks in birds have occurred in March or April, likely related to duck and rice production cycles. All of the human deaths also occurred within a four month period from February-May, 2005. The one village in Cambodia with confirmed poultry and human cases of HPAI is located in Banteay Meas district, Kampot province.

**Table 16: HPAI Cases in Poultry in Kampot Province, 2004-2007**

Year	Month	District	Bird Type	No. Affected
2004	Mar	Ta Khmau	Chickens/Ducks/Wild Birds	533

2005	Mar	Benteay Meas	Backyard Chickens	28
2006	April	Kampong Bay	Ducks	247

*Source:* WAHID, OIE, 2008

**Table 17: HPAI Cases in Humans in Kampot Province, 2004-2007**

Year	Month	Gender	Age	Death
2005	February	Female	25	Yes
2005	March	Male	28	Yes
2005	April	Female	8	Yes
2005	May	Female	20	Yes

*Source:* WHO, 2008; [http://www.who.int/csr/disease/avian\\_influenza/country/en/](http://www.who.int/csr/disease/avian_influenza/country/en/)

During the HPAI outbreaks, income from poultry decreased among smallholders of all income levels. However, case studies in Kampot villages suggest that since the HPAI outbreak the amount of income smallholders derived from poultry production has actually increased.

**Table 18: Percent of Household Income from Poultry in Kampot Village Case Study**

	Before HPAI Outbreak	During HPAI Outbreak	After HPAI Outbreak
Better-off Farmers	Chicken 7%	Chicken 5%	Chicken 15%
Medium Farmers	Chicken 10%	Chicken 5%	Chicken 15%
Poor Farmers	Chicken 12%	Chicken 5%	Chicken 25%
Poorest Farmers	Chicken 0%	Chicken 0%	Chicken 7%

*Source:* Seng et al, 2007

### Summary

The climate of Kampot province, in addition to its proximity to the Mekong Delta, are conducive to duck raising. Moreover, the high incidence of HPAI cases in the province, including four death, as well as the informal cross border trade that exists with Vietnam make Kampot province an excellent location for duck studies. The lack of commercial chicken farms mean that any study in Kampot will lack that component of analysis. However, it has also been suggested that informal seasonal chicken trade with Vietnam takes place in Kampot so this is another reason for study inclusion. Moreover, the province's proximity to Phnom Penh make it a large provider of chicken meat for the capital.

## Siem Reap Province

### Geography

Siem Reap province is located in the Tonle Sap region of northwestern Cambodia. The province covers 10,300 km<sup>2</sup> (5.7% of Cambodia). Of the land area, 5,570 km<sup>2</sup> is forested area (54.0%), 1,970 km<sup>2</sup> is agricultural land (19.2%), 1,098 km<sup>2</sup> is infrastructure or human settlements (11.7%), and 1,020 km<sup>2</sup> are water bodies (9.9%). The main streams in Siem Reap are Bang Tonlesab, Baray Tukthla, Stung Siem Ream, Stung Rulus, Stung Chikreng, and Stung Krolagn. The water average water level in the main rivers is 9.5 meters. During the dry season water covers 1,000 km<sup>2</sup>, however, during the wet season water covers 2,814 km<sup>2</sup> with the difference largely attributed to the change in Tonlesab Lake.

There are three primary zones in Siem Reap; urban, suburban, and terrace. The living and farming conditions of each zone are distinct. The urban zone is characterized by main roads and high population density. Agriculture is less important in this zone. The suburban zone tends to lie toward the flood plain of Tonle Sap Lake and is characterized by zones that were formerly primarily agricultural but have recently become more developed as the area urbanized. The terrace zone is removed from urban centers and characterized by a terrace ecosystem in the hills.

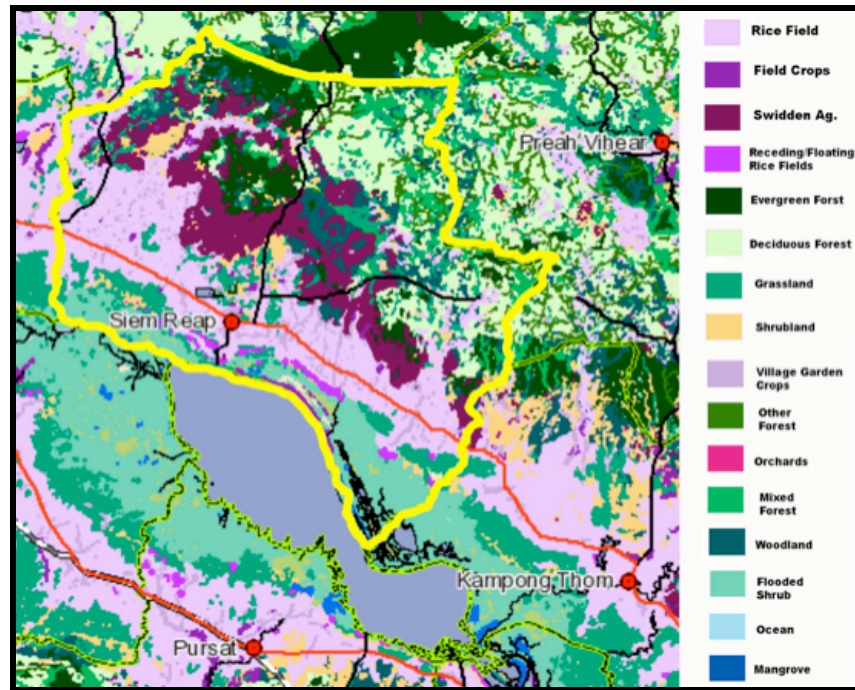
The average temperature in Siem Reap is 28°C with 73% humidity. The average rain fall is 1,250 mm/yr, compared to a national average of 1,993 mm/yr (FAO, 2005). The administrative units in Siem Reap consist of 12 districts, 100 communes, and 882 villages.

**Figure 14: Location of Siem Riam Province**



*Phnom Penh is highlighted in red*

Figure 15: Land Use Map of Siem Reap Province



*Source:* Atlas of Cambodia, available online at: <http://www.cambodiaatlas.com/>

### Population

The population of Siem Reap province in 2004 was 755,000 people for a population density of 75 people per km<sup>2</sup>. There were 125,385 households and an average household size of 5.4 people. Nearly 68% of households were male-headed (NIS, 2004a). Within the population 188,415 people migrated from their hometowns (27% of population). 83% of migrants came from other villages within the province while 14% came from other provinces and 3% from other countries (presumably Thailand). The province is made up of 12 villages, 100 communes, and 907 villages.

The age distribution in Siem Reap province is very close to the national average with close to 40% of people under the age of 15.

**Table 19: Age distribution of the population in Siem Reap Province**

Age Group	0-4	5-14	15-64	65+
Siem Reap Province	13	28	56	3

National Average	11	28	57	4
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**Source:** National Institute of Statistics, 2004a

### Economy

Like elsewhere in Cambodia, most employment in Siem Reap is based on agriculture. In fact, 76% of the population are farmers, 16% are traders, 5.5% are government officers, and 3% are fishermen. More generally, close to 90% of the population is either an own account worker or an unpaid family worker. Females are more twice as likely to be unpaid family workers while males are three times as likely to be paid employees.

**Table 20: Employment status by sex in Siem Reap (percent)**

Employment status	Both sexes	Males	Females
Employer	0.1	0.1	0.2
Paid Employee	10.4	15.3	5.7
Own Account Worker	41.8	52.7	31.4
Unpaid Family Worker	47.6	31.8	62.6
Other	0.1	0.1	0.1
Total	100	100	100

**Source:** NIS, 2004a

Yearly per capita food consumption in Siem Reap consists of 224 kg of paddy rice, 40 kg of fish, 35 kg of vegetables, and 4 kg of meat (NIS, 1998). Fuel for cooking consists primarily of firewood (96.1%), kerosene (2.1%), and charcoal (1.4%).

Economic activities in Siem Reap vary greatly depending on socioeconomic status and geographical region. A case study stratified by geographical zone found that urban households were more than twice as likely to be employed as salary workers than suburban or rural households (table 24). Rice farming is not practiced in urban zones, but is the main activity for most suburban and rural households and is undertaken by 70-90% of households. Poultry raising is practiced in all three regions, however, suburban households are more likely to operate medium or large scale farms.

**Table 21: Economic Activities by Region in Siem Reap Case Study (percent hh)**

Economic Activities	Urban case	Urban	Suburban	Suburban	Suburban	Rural	Rural
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	1	case 2	case 1	case 2	case 3	case 1	case 2
Rice Farming	0	2	80	70	82	74	98
Chicken Raising	27	25	80	58	92	68	91
Duck Raising	10	10	20	78	13	27	12
Smallscale	10	9	19	40	7	27	12
Mediumscale	0	0	0	8	3	0	0
Largescale	0	1	0	16	3	0	0
Salary Workers	49	31	20	10	5	7	3
Daily wage workers	32	6	40	30	59	40	39
Running a petty trade	19	31	12	5	7	3	4

**Source:** Seng et al, 2008

The same study also used focus group discussions to construct descriptions of households characteristics according to geographical region and poverty levels (table 25). Characteristics describe include amount of land utilized for rice production, number of livestock, transportation methods, and description of housing structure.

**Table 22: Description of households by poverty levels and region in Siem Reap**

	Characteristic	Urban areas	Sub-urban areas	Rural (Terrace) areas
<b>Poorest Households</b>	Proportion	19%	22%	13%
	Rice Land	none	0-0.2 ha	0-0.5 ha
	Type of house	3X4 m; leaf roof	3X4 m; leaf roof	3X4 m; palm or thatch leaf roof
	Number of Cattle	none	none	none
	Transportation	0-1 bicycle	0-1 bicycle	0-1 bicycle
	Chicken rearing	0-2 hens	0-1 hen	0-2 hens
	Duck rearing	none	none	4-5 head
<b>Poor Households</b>	Proportion	31%	33%	26%
	Rice Land	<0.5 ha	<0.5 ha	0.25-1.5 ha
	Type of house	4X5 m; leaf/zinc roof	4X5 m; leaf/zinc roof; bamboo wall	4X6 m; leaf/zinc roof; bamboo wall
	Number of Cattle	none	0-2 cows	1-2 cows
		1-2 bicycles, 0-1 motorbike	0-2 bicycles, 0-1 motorbike (for motor taxi driver)	1 bicycle and 1 motorbike
	Chicken rearing	1-3 hens	1-2 hens	1-4 hens
	Duck rearing	<10 ducks, 2-4 Muscovy ducks	1-5 ducks and 1-3 Muscovy ducks	0-5 ducks and 0-2 Muscovy duck hens
<b>Medium households</b>	Proportion	26%	28%	26%
	Rice Land	0.5-1.0 ha	0.5-1.5 ha	1-4 ha
	Type of house	6X7 m; wooden walls; concrete ground floor	5X7 m; wooden wall; concrete floor	6X8 m
	Number of Cattle	0-2 cows	1-5 cows	2-4 cows
	Transportation	1-2 motorbikes; 1 bicycle; 0-1 car	0-2 motorbikes; 1 bicycle; 0-1 car	1-2 bicycles; 1 motorbike
	Chicken rearing	2-6 hens	2-5 hens	3-6 hens
	Duck rearing	200-1,000 ducks; 2-4 Muscovy ducks	300-1,000 ducks; 2-5 Muscovy ducks	1-15 female duck; 1-4 Muscovy ducks
<b>Better-off households</b>	Proportion	24%	17%	13%
	Rice Land	1-1.5 ha	1-5 ha	3-10 ha
	Type of house	8X12 m; concrete ground floor; flat roof	7X10 m; concrete ground and flat roof	7X10m
	Number of Cattle	none	1-5 cows	2-5 cows
	Transportation	1-4 motorbike or bicycles	1-3 motorbikes or bicycles; 1 car	1-3 bicycles; 1-2 motorbikes, 0-1 car; 0-1 rice mill
	Chicken rearing	2-7 hens; 2-3 fighting cocks	3-10 hens; 2-3 fighting cocks	4-15 hens
	Duck rearing	1,100-3,000 ducks; 2-4 Muscovy ducks	500-3,000 ducks	5-20 ducks; 2-5 Muscovy ducks

*Source:* Seng et al, 2008

**Livestock**

Siem Reap has nearly 770,000 head of poultry, ranking 10th in the country. In addition, the province has a poultry density of 75 birds/km<sup>2</sup>, ranking 14th nationally. In its review of priorities, the provincial MAFF office ranked agronomy as the top priority for development followed by fisheries, second, and livestock, third.

Of the poultry raised in Siem Reap, more than 628,000 head are chickens and 141,000 head are ducks. In the 2004 poultry census Siem Reap also contained several large-scale commercial farms. In fact, the DAHP survey recorded 6 chicken layer farms, raising a total of 10,920 birds, 18 chicken broiler farms raising 30,780 birds, and 98 duck farms raising 178,755 birds (DAHP, 2004). Nationally, the province hosts the 2<sup>nd</sup> most commercial broiler farms, the 3<sup>rd</sup> most layer farms, and the 4<sup>th</sup> most duck farms.

The three zones (urban, sub-urban, and terrace) represented distinct farming practices. Duck farming occurred primarily in the sub-urban zone among medium and better off households while Duck production systems in Siem Reap vary according to zone (urban, suburban, terrace) and wealth. Recent years have seen the number of households in Siem Reap that raise ducks hold steady or increase, while most flock sizes have increased greatly. Medium and large scale production tends to take place in suburban regions while small-scale production is practiced in the terrace regions. Both the poorest and the richest households, for different reasons, do not participate in duck rearing. For the poorest households duck feed is too expensive and for the richest households the activity is too labor intensive. Suburban duck farms tend to be managed by medium well-off households (flock sizes ranging from 200-500 heads) and relatively better-off households (flock sizes ranging from 500-2,000 heads) while poor households in terrace regions keep small flocks (10-20 heads) [Seng et al, 2008].

The farm gate price for chickens tend to be around 11,500-12,500 riel/kg in the normal season and increased by about 1,000 riel during the high season (table 26). Market prices range from 14,500-15,000 riel/kg in the normal season and also increase by 1,000 riel in the high season. Middlemen and market vendors collectively extract about 3,000 riel per kg for their services (about 20% of market value).

Duck products sold in Siem Reap markets include eggs, ducklings, layer ducks, finishing eggs, broiler ducks, and muscovy ducks (table 27). Ducklings, layers, and broiler ducks tend not to increase in price during the high season. However, Eggs and muscovy ducks increase in price by about 5 and 10 percent, respectively, during the high season.

**Table 23: Price of Chicken Products in Siem Reap 2008 (Riel/kg)**

Chicken Commodity	Farm Gate Price		Market Retail Price	
	Normal Season	High Season	Normal Season	High Season
Hen over 1 kg	11,500-12,500	12,500-13,500	14,500-15,500	15,500-16,500
Hen under 1 kg	11,500-12,500	12,500-13,500	14,500-15,500	15,500-16,500
Cocks over 1 kg	11,500-12,500	12,500-13,500	14,500-15,500	15,500-16,500
Cock over 3 Kg	7,000-7,500	7,500-8,000	8,000-8,500	8,500-9,000

**Source:** Seng et al, 2008 (1 USD=4,000 Riels)

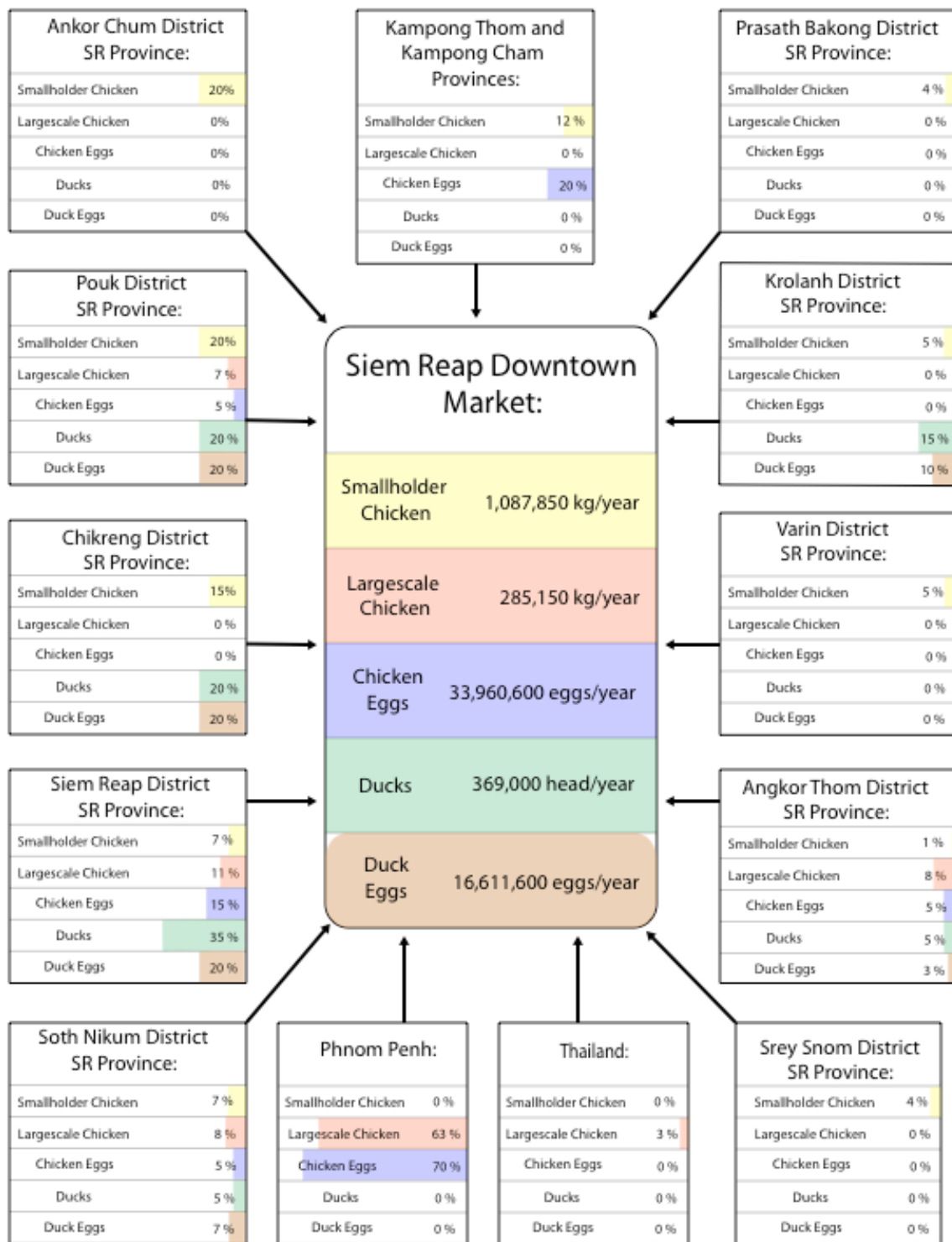
**Table 24: Farm Gate Price of Duck Products In Siem Reap 2008**

Duck Commodity	Normal Season	High Season
Duck eggs (Riel/egg)	420-430	440-450
Female ducklings (Riel/head)	1,000-1,100	1,000-1,100
Male Ducklings (Riel/head)	800-900	800-900
Egg-Laying Ducks (Riel/head)	11,000	11,000
Duck finishing eggs (Riel/head)	8,500-9,000	9,500-10,000
Broiler ducks (Riel/head)	7,500-8,000	7,500-8,000
Female Muscovy (Riel/head)	25,000-27,000	28,000-30,000
Male Muscovy (Riel/head)	40,000	40,000

**Source:** Seng et al, 2008 (1 USD=4,000 Riels)

Siem Reap district, population 140,000, is one of the largest areas of poultry consumption outside of Phnom Penh. The district is a major outlet for regional poultry products; 10 of the 12 provincial districts produce poultry products that are sold in this market. However, local supply is insufficient to meet this large demand. Consequently, producers from Phnom Penh, Kampong Thom, and Kampong Cham provinces as well as Thailand sell poultry products in the provincial market (figure 17). Most industrial chicken meat (63%) and chicken eggs (72%) sold in the market are produced in Phnom Penh while all duck products are produced within Siem Reap province. About 90% of local chickens are raised within the province.

Figure 16: Source of Poultry Products in Siem Reap Downtown Market



Source: Adapted from Seng et al, 2008

## HPAI Experience

Siem Reap province experienced two HPAI outbreaks in poultry, both in 2004, and no confirmed human cases. Prior to 2004 most people in Siem Reap had never heard of HPAI. Since the outbreaks began, most people are aware of its existence, however, many people continue to consume sick or dead birds. In fact, most household learned about HPAI on television and were unaware of the two outbreaks in the province. The exception is better-off households in urban/sub-urban areas. These households are aware of local outbreaks and are now hesitant to handle live poultry and more likely to purchased slaughtered birds and take meat safety into their purchasing decisions. Other households continue to eat sick or dead birds and do not believe this poses a threat (Seng et al, 2008).

**Table 25: HPAI Outbreaks in Poultry in Siem Reap Province, 2004-2007**

Year	Month	District	Bird Type	No. Affected
2004	Mar	Siem Reap	Chickens/Ducks/Wild Birds	533
2004	Mar	Siem Reap	Chickens/Ducks/Wild Birds	533

*Source:* WAHID, OIE, 2008

While household undertake distinct activities in each geographical region, this does not appear to have influenced how HPAI impacted poultry production. Instead, it appears that farm scale was the main determinant of how HPAI impacted households in Siem Reap. The impact of HPAI was felt mostly by commercial producers (medium and large-scale) who were hurt by the loss of a main source of income during the outbreaks. Some producers, with sufficient social capital to access loans, have restarted their commercial ventures. In fact, since 2003 16 of 20 commercial chicken farms have shut down (Seng et al, 2008).

## Recommendations for Study Inclusion

Based on the preceding overview, Kampot and Siem Reap provinces were selected as the best sites to conduct livelihood studies. The diversity of poultry production systems in Siem Reap, as well as the high levels of poverty and large market for poultry products make Siem Reap fitting for one chicken study. Moreover, Kampot's high incidence of HPAI, border trade with Vietnam, and extensive duck production systems make the province the best fit for complimentary chicken and duck studies. Building on previous studies carried out in these provinces, we will be able to construct calibrated supply chains and carry out lifecycle analysis at the household level in order to better understand the systems that poultry production operates within.

## 4. Methodology

### Consumer Surveys

#### Purpose:

The purpose of the Consumer Survey is to better understand poultry purchasing habits of households that acquire their poultry products through markets. A detailed survey will be carried out revolving around household tastes, price sensitivity, breed preference, and other aspects of shopping habits. In addition, this survey will be used to assess interest in paying for certified poultry.

#### Implementation:

The survey was implemented in both urban and semi-urban villages. However, most households, both urban and semi-urban, were found to raise a small amount of poultry. Consequently, the original strategy of only interviewing households that do not raise poultry was modified to include households that purchase a majority of their poultry through the market. The survey consists of two separate samples, one consisting of urban districts, and the other consisting of villages that are classified as rural, but are district centers where there are some (albeit limited) off-farm employment opportunities. The latter is henceforth referred to as semi-urban.

In total, 1,000 consumer questionnaires were planned to be implemented, 500 in Kampot province and 500 in Siem Reap province. Of the 500 observations in each province, 70% in Kampot and 85% in Siem Reap, were planned to come from urban districts with the remaining observations made up of semi-urban households. The distinct sample makeup is necessary because the number of urban villages in Kampot is significantly less than in Siem Reap.

**Table 26: Summary of Consumer Survey Observations**

Province	Expected Urban Observations	Actual Urban Observations	Expected Semi-Urban Observations	Actual Semi-urban Observations	Total Expected	Actual Total
Kampot	350	342	150	150	500	492
Siem Reap	500	483	0	0	500	483
Total	700	300	300	150	1,000	492

We expected a 75% response rate for consumer surveys. A 25% non-response rate (primarily because of refusal to participate or that the occupants could never be found at home) is

expected because the households included are urban and semi-urban and are thus less likely to participate than the rural households included in supply side surveys. All household visits are documented, regardless of whether an interview is conducted. Households that cannot be interviewed will not be replaced.

Villages were selected for sample inclusion with probability proportional to size (PPS). This will be carried out using the PPS.do command for STATA, published by the World Bank<sup>1</sup>. At the time of sampling, the most recent village level population data available was the 1998 Cambodian Census. While the 2008 Cambodian Census had been completed, release of village level population was pending. In each province, 25 villages will be selected for study inclusion, with 20 observations in each village.

The enumerators will choose the households to be interviewed based on the following procedure: Enumerators will be provided with a random number between 0 and 1. The enumerator then obtains an ordered list of households from the village chief and multiplies the random number by the total number of households in the village. The closest household to this number becomes the first household in the village. The enumerator will then visit the first household and list/number the first 40 households in the neighborhood. Subsequently, they will visit every 4th household. Including a fixed percentage of households allows us to account for varying blocks densities and keeps each households chance of being selected more approximately equal.

Households that are not home will be marked and revisited at different hours for up to five visits. If they are not home upon the fifth visit then the closest neighbor will be selected (with a coin used to determine which side) and clearly labeled.

### **Willingness to Pay for Certified Poultry Experiment**

One important facet of the consumer survey is evaluating households willingness to pay for certified poultry products. Consequently, an experiment was developed to evaluate this issue. The respondent was presented first with a detailed description of a proposed certification system and subsequently with a hypothetical market visit with three meat product alternatives;

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<sup>1</sup> PPS.do file & documentation can be found online: <http://www.worldbank.org/html/prdph/lms/manage/pps.html>



indigenous chicken, industrial chicken, and duck, only one of which has been certified. The respondent was asked to choose the most appealing product. This process was repeated 5 times for each household, with different prices for each scenario.

Prices were randomly selected from a list of seven prices ranging 25-30% above or below average prices for a given product (average prices were estimated from market visits). Which product would be certified for each repetition was also randomized. A certification premium of 4,000 Riels (~1 USD) was added to the item selected for certification in each repetition. In all, 50 unique sets of 5 scenarios were generated. Each set was copied 10 times (to be used for 10 households) in each province for a total of 500 observations per province. The data collected will be used to estimate the price premiums people are willing to pay for certification of each type of poultry meat product (indigenous chicken, industrial chicken, and duck).

**Products:**

The primary output of the consumer survey is a data set of 1,000 households' purchasing habits, pricing information, and safety concerns. An important component of the data set is the data set from the willingness to pay randomization experiment described above.

**Poultry Farmer Surveys****Purpose:**

The purposes of the farmer surveys are to better understand farmer cost structure, resource utilization, and assess the adjustment of poultry producers in response to HPAI control measures. The surveys will assess these issues by focusing questions on evaluating farmer inputs and outputs, production cost structure, access to markets, trading relationships, barriers to expansion, and HPAI experience. From the data collected we will be better able to estimate the cost to producers from shifts in policy or structural changes in the Cambodian poultry sector.

**Implementation:**

The farmer surveys consist of three distinct questionnaires;

1. Smallholder chicken and duck producers.
2. Largescale chicken (meat and egg) producers.

3. Largescale duck (meat and egg) producers.

**1. Smallholder Producer Surveys**

The smallholder producer sample consists of a two-stage random sample of villages and households within selected communes and districts. The choice to randomize household selection (as opposed to seeking out households involved in poultry production) was made based on the assumption that most rural households raise poultry. This assumption is supported by previous studies (Seng, 2007; VSF 2004) as well as practice surveys. Of the 35 households randomly selected for practice surveys, 34 households raised at least some poultry (97.5%).

The choice to select districts and communes strategically (as opposed to randomly) was based on feasibility and a desire to include areas with certain characteristics in our sample. Survey feasibility was an issue because restricted access to some areas meant that clustering communes was necessary in order to allow enumerators to complete surveys within the allotted time frame. In addition, social and institutional conditions are such that there is a high initial investment required for each additional district selected. It is necessary for us to seek approval from the district governor each time we wish to work in a new district. This is a time consuming, albeit straightforward, process. Moreover, most residents are unfamiliar with areas outside of their home district and are reluctant/unwilling/unable to work outside their home district on a daily basis. This meant that each district required a significant investment in human resources through training. Finally, overseeing survey implementation requires project managers to travel between work areas on a regular basis. Consequently, it is necessary to include districts that are within reasonable distance of each other.

While choosing communes and districts strategically is not an ideal sampling strategy, doing so was deemed necessary. Moreover, this approach does allow us to target groups of interest. In addition, we believe that randomizing villages and households, along with the large sample size and geographical diversity between the two provinces included in the sample compensate for this sampling insufficiency.

## 2. Largescale Chicken and Duck Producers (>100 birds)

Largescale producers will be included from the same areas as smallholder producers. However, enumerators are instructed to interview all largescale producers located, regardless of the village. This approach was intended to include as many largescale chicken and duck farmers as possible. Largescale producers are located by talking to government officials, market vendors, other producers, etc. We estimate that we will be able to collect approximately 250 largescale poultry producer observations in Kampot and 125 observations in Siem Reap. Large scale farmers in Kampot are expected to be primarily duck producers (~70%) while in Siem Reap we expect to collect more largescale observations from chicken producers (~60%). These estimations are based on practice surveys and past studies (Seng 2007; Seng 2008).

The planned sample size for all farmer surveys (smallholder, largescale chicken, largescale duck) is 1,500 observations. However, because we are collecting as many observations as possible from largescale farmers, we can only approximate how many smallholders will be included in the sample. Ideally, we would collect 500 observations from chicken producers (large and small) in Kampot province, 500 from chicken producers (large and small) in Siem Reap province, and 500 from duck producers (large and small) in Kampot province. However, this approach is complicated by the unknown numbers of largescale chicken and duck farmer and by the fact that many smallholders raise both chickens and ducks. Initially, 90 villages in Kampot and 45 villages in Siem Reap will be included in the sample. However, additional villages will be selected if necessary (i.e., if we are unable to locate enough largescale producers within the originally selected villages).

**Table 27: Smallholder Farmer Surveys (<100 birds)**

Province	Expected Observations	Actual Observations
Kampot	~ 775	700
Siem Reap	~400	0*

\* Data collection in progress

**Table 28: Largescale Chicken and Duck Farmer Surveys**

Province	Expected Chicken Observations	Actual Chicken Observations	Expected Duck Observations	Actual Duck Observations
Kampot	75	100	150	200
Siem Reap	50	0*	50	0*

\* Data collection in progress

**Products:**

The primary product will be a data set consisting of 1,500 farmer observations. From this data we will be able to construct detailed maps of both chicken and duck supply chains. In addition, the data will allow us to detail farmers' production practices and cost structures as well as trading relationship, HPAI experience, and attitudes towards bio-security and disease.

**Aggregator Surveys****Purpose:**

The purpose of the aggregator survey is to improve our understanding of the marketing network and trading relationships as well as to collect information on pricing, disease considerations, resource utilization and operation costs. The survey aims to include traders of all poultry products including chicken and duck eggs/meat, and chicks/ducklings for sourcing production.

**Implementation:**

Similar to largescale farmer surveys, aggregator surveys will consist of intercepting and interviewing as many aggregators as possible. Interception will occur in three ways. First, aggregators may be intercepted directly at markets or trading corners and interviewed. Secondly, aggregators may be reached through contact information provided by market vendors. Finally, aggregators may be reached through contact information provided by farmers. Consequently, the aggregator survey will be carried out in communes where any other surveys are being conducted. Collectively, these methods are expected to include a broad collection of aggregators in a timely and cost-effective manner.

One potential bias of this method is that it is more likely to omit traders who approach vendors and farmers in a way that does not require contacting the trader (these traders will only be interviewed if they are intercepted directly). This demographic is likely medium or large scale-traders who are looking to compliment other regular sources of chicken. Our anecdotal observations suggest that small-scale aggregators trade primarily with locals they know from their own or surrounding village. If this is indeed the case then it is likely we will still include these medium to large scale aggregators if we speak with their regular source farms or if they

have regular vendors that they sell to. Therefore we are confident that we are not omitting any major groups of aggregators. In addition, many aggregators raise chicken of their own and thus will be interviewed when they are visited during the farmer survey. While this method of intercepting traders is imperfect, it can be done at a reasonable cost most likely without excluding any major groups.

**Table 29: Aggregator Surveys**

Province	Expected Observations	Actual Observations
Kampot	100	126
Siem Reap	75	0*

\* Data collection in progress

Several groups of enumerators will be trained to conduct aggregator surveys including enumerators who interview market vendors and those who interview farmers. When they locate aggregators during other surveys they are instructed to conduct aggregator surveys at that time. We expect approximately 75% of traders contacted to participate in our survey. The number is expected to be higher for traders contacted at home than for traders contacted in the market or at a trading corner (as they may be conducting business). Another possible bias would arise from omitting large traders who work long hours and are not home during reasonable interview times. Some aggregators work long hours every day of the week. One possible solution is to interview them in the nighttime over the phone. Another possible solution is to interview their spouse, if they are at home, and are knowledgeable about details of the trading business.

#### **Products:**

Data set of approximately 150 aggregators will allow us to evaluate aggregators' role in local market chains and will be key to mapping poultry movements. Moreover, detailed information will be collected about the cost structures of trading business.

#### **Market Vendor Surveys**

##### **Purpose:**

The purpose of the market vendor survey is to better understand the sources of chicken sold in urban markets as well as to collect price and breed data. In addition, the market vendor survey will be the first survey carried out and will help determine which areas are included in the farmer survey as well as contribute to the list of local aggregators.

**Implementation:**

A map of markets in each urban center will be constructed primarily through local knowledge. All enumerators hired are locals. We will ask each local enumerator to locate all of the markets in their district.

**Table 30: Number of Market Vendor Survey Observations**

Province	Expected Urban Observations	Actual Urban Observations	Expected Semi-Urban* Observations	Actual Semi-urban Observations
Kampot	20	18	40	61
Siem Reap	65	0*	10	0*

\* Data collection in progress

Once the markets are mapped they are visited by teams of two enumerators at off market hours. They attempt to interview every vendor who sells chicken. In addition, they ask the vendors present whether there are other vendors who have not yet arrived or have already left the market. Enumerators revisit markets until all vendors have been interviewed. Vendors are approached at off hours to increase the number of responses. We expect approximately 90% of vendors to be included with this method and upwards of 75% of vendors to respond.

**Products:**

Data set from approximately 135 wet market vendors will provide detailed information about pricing, the volume and types of products, as well as trading relationships and biosecurity practices.

**Other Surveys**

In addition to the planned surveys, a limited number of hatcheries and slaughterhouses will be interviewed if they are found to operate within the selected areas. We expect approximately one duck hatchery to operate within selected areas in Kampot and one in Siem Reap. In addition, we expect to find 1-2 poultry slaughterhouses in Siem Reap. Questionnaires for these surveys will be adapted from existing surveys to apply to the market actors' role in the supply chain.

### **Enumeration Teams**

Data collection is being carried out by separate enumeration teams in each of the four districts. Enumerators are recruited through local high school principals. The projects Cambodian counterpart conducts 1-2 days of training for the students. Upon training completion, enumerators are asked to conduct five practice surveys in order to evaluate their capacity to conduct the questionnaires. Enumerators who meet minimum standards then begin to conduct project surveys.

Each enumerator team consists of approximately 8 people. Enumerators for the consumer, market vendor, and smallholder farmer surveys are paid \$2/survey in addition to \$3/day for gasoline and food. Enumerators are expected to complete at least 5 surveys/day. Enumerators for the aggregator, vendor, and large farmer surveys are paid \$3/survey in addition to \$4/day for gasoline and food. The latter are paid a higher wage because there are less observations and the observations are spread across greater distances. This group are expected to complete at least 3 surveys per day. Consequently every enumerator has an expected wage of \$13/day. In addition, two enumerators in each group will be selected to be employed as data checkers, ensuring survey consistency throughout the enumeration team. Data checkers are expected to spend an additional 2-3 hours per day checking all surveys for consistency and returning surveys with problems to the enumerators who conducted them. Data checkers are paid \$4/person/day.

### **Questionnaire Translation**

The questionnaires were originally written in English. The originals were translated into Khmer by Vibol Penh, the Cambodian counterpart for the project. The Khmer questionnaires were then back translated by an unaffiliated party in order to ensure consistency with the original questionnaires.

### **Data Entry**

All questionnaires were entered into a Microsoft Access database through an interface that was constructed to appear the same as the surveys in order to minimize data entry.

**Institutional Cooperation**

FAO – The Cambodian branch of FAO provided an official letter of support for the project. The letter was presented to local government officials in order to obtain approval for the project.

District Governors – A letter of approval is obtained from the District Governor prior to beginning data collection in each district.



## 5. Survey Findings

### Household / Consumer Survey

Consumer surveys were conducted in the urban district of each province, as well as selected semi-urban villages in Kampot.

**Table 31: Household sample sizes.**

	Kampot (urban)		Kampot (semi-urban)		Siem Reap		Total	
	Expected	Actual	Expected	Actual	Expected	Actual	Expected	Actual
Nr of Observations	350	344	150	149	500	490	1,000	983

The actual number of observations approached expected observations in both Kampot and Siem Reap. The response rates were higher than expected: Kampot urban- 98 Percent; Kampot semi-urban- 98 Percent, and Siem Reap-74 Percent. Selecting households at the village level by name meant that it was relatively straightforward to locate respondents. Refusal to participate was the primary reason that selected households were not included, however, these numbers were low.

We were hoping for a response rate of 75 percent, which was achieved in both Kampot samples, and was almost achieved in Siem Reap. Using updated village household lists with family names was one reason for the high rate of locating households, and the nature of urban and semi-urban areas in Kampot is such that non-response rates were very low.

### Household Characteristics

Enumerators asked to speak with household members most responsible for grocery shopping. More than 90 percent of respondents were female. Most respondents fell into the middle age groups between 30 and 45 years of age.

**Table 32: Gender of survey respondents.**

Gender	Kampot (urban)		Kampot (semi-urban)		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent
Male	27	7.9	13	8.8	58	11.6	98	9.9
Female	316	92.1	135	91.2	443	88.4	894	90.1

In both provinces the most common household size was between 5 and 6 people. Urban households average one-half more people per household than semi-urban households in Kampot province.

### Poultry Purchasing Habits

Respondents in Kampot visited the market more often than respondents in Siem Reap, however, 85 percent of overall respondents visited the market at least one time per day

**Table 33: Frequency of market visits in selected locations.**

Frequency of visit	Kampot (urban)		Kampot (semi-urban)		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent
< 1 time / day	2	0.6	9	6.0	54	10.8	65	6.6
1 time / day	246	71.9	135	92.0	403	80.4	786	79.2
> 1 time /day	94	27.5	3	2.0	44	8.8	141	14.2

Respondents were asked to report the amount of money spent in one week for the entire household on the following food categories: meats, eggs, poultry, and chicken. Categories only refer to raw products brought home and cooked. Fried chicken, for example, falls into ‘eat out’ category even if it was taken home for consumption. Respondents in Siem Reap has significantly higher weekly expenditures on eating outside the home, however, expenditure on groceries for home preparation were similar across all groups at around 100,000 Riels/week (~\$25/week). Chicken meat was the highest poultry expenditure, averaging 20,800 Riels/week (~\$5.20/week) followed by duck meat (12,500 Riels/week ~ \$3.10/week).

**Table 34: Household poultry expenditure (1000 Riels/week).**

poultry consumed	Kampot (urban)		Kampot (semi-urban)		Siem Reap		Total	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Eating Out	29.6	28.6	25.1	23.9	53.7	35.8	38.9	33.5
Eating In	105.8	48.8	94.8	30.1	110.5	63.6	110.9	78.0
All meats	80.4	48.0	73.7	58.0	67.7	68.4	74.7	72.4
Chicken Meat	21.7	11.9	23.8	8.8	18.9	21.4	20.8	16.6
Chicken Eggs	6.4	4.3	3.1	1.3	4.7	5.2	4.9	4.5
Duck Eggs	11.9	4.6	13.3	5.5	12.8	15.4	12.5	9.4
Duck Eggs	6.6	3.5	6.1	2.4	5.7	4.8	6.1	4.1

While the average expenditure was low, duck eggs were the most common poultry product purchased . One third of respondents reported purchasing duck eggs every day, while more than

80 percent reported purchasing duck eggs at least once per week. On average, respondents purchased about 10 duck eggs per market visit. Approximately half respondents purchase chicken meat at least once per week purchasing slightly over one kg per visit. Fifty percent of respondents reported never purchasing duck meat. Duck eggs were significantly more popular in semi-urban regions than in urban regions.

**Table 35: Frequency of poultry purchases (percent respondents).**

Item	Kampot (urban)					Kampot (semi-urban)					Siem Reap					Total				
	Daily	Weekly	Monthly	Spec. Occ.	Never	Daily	Weekly	Monthly	Spec. Occ.	Never	Daily	Weekly	Monthly	Spec. Occ.	Never	Daily	Weekly	Monthly	Spec. Occ.	Never
Chicken Meat	1	34	50	15	0	1	86	7	6	0	5	38	45	11	1	3	44	41	12	1
Chicken Eggs	7	29	7	1	55	11	2	52	1	34	1	10	29	11	49	1	20	34	12	33
Duck meat	1	16	51	13	19	1	60	16	11	12	11	25	10	4	50	10	23	15	3	49
Duck Eggs	20	59	12	7	2	85	11	3	1	0	27	61	7	1	3	33	53	8	3	3

**Table 36: Household poultry consumption.**

poultry consumed	Kampot (urban)		Kampot (semi-urban)		Siem Reap		Total	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Chicken Meat (kg/visit)	1.3	0.5	1.4	0.5	1.0	0.5	1.2	0.5
Chicken Eggs (eggs/visit)	10	3.1	6	2.3	7	3.4	8	3.5
Duck meat (kg/visit)	1.1	0.4	1.0	0.4	1.1	0.5	1.1	0.4
Duck Eggs (eggs/visit)	12	5.5	12	5.4	9	5.6	10	5.7

Semi-urban respondents in Kampot were most likely to purchase live birds, however, the practice was also common in Kampot's urban areas. However, in Siem Reap, the vast majority of consumer purchases slaughtered birds (>80 percent) while less than 5 percent of purchased birds were slaughtered in the market.

**Table 37: Form of poultry purchased (percent) in selected locations.**

	Kampot (urban)			Kampot (semi-urban)			Siem Reap			Total		
	Live	Slaughter in market	Slaughter	Live	Slaughter in market	Slaughter	Live	Slaughter in market	Slaughter	Live	Slaughter in market	Slaughter
Percent of birds purchased	47.2	39.9	12.9	62.5	6.1	31.4	13.7	4.5	81.8	32.7	17.0	50.3

\* Slaughtered in market = birds are selected live then slaughtered and prepared by vendor

Prices for poultry products in Cambodia vary greatly depending on the season. Survey respondents were asked about the prices they paid in high season (months of high season) and low season (months of low season). Average prices were highest for all products in urban Kampot during the high season. However, prices in urban Kampot and urban Siem Reap were very similar, with the exception of chicken eggs which were twenty percent cheaper in Siem Reap. Nearly all shopping (more than 90 percent) occurred at traditional wet markets.

**Table 38: Average price of poultry by breed and form purchased (Riels/kg; Riels/egg).**

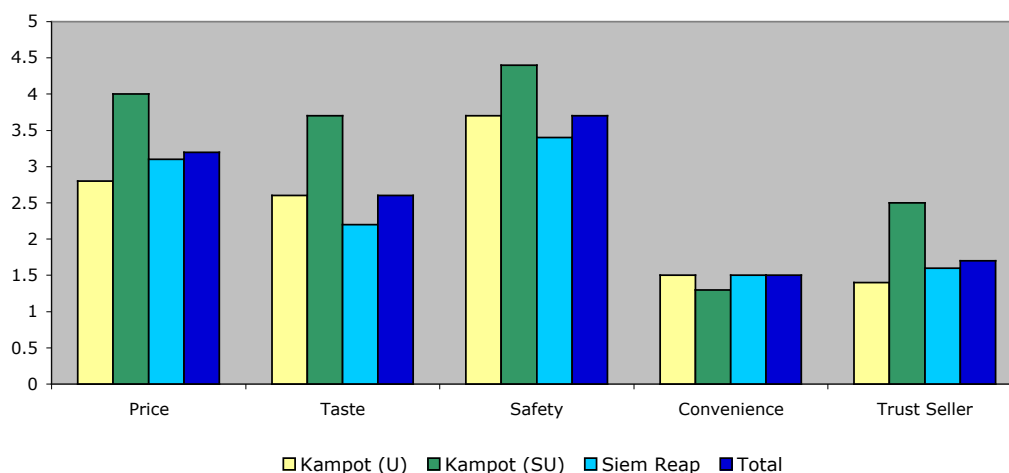
Reason	Kampot (urban)		Kampot (semi-urban)		Siem Reap		Total	
	High Season	Low Season	High Season	Low Season	High Season	Low Season	High Season	Low Season
Chicken Meat	15,800	13,800	14,200	12,200	15,700	13,900	15,500	13,500
Chicken Eggs	520	440	500	410	440	380	500	430
Duck Meat	10,300	8,600	9,600	7,800	8,700	7,600	9,900	8,200
Duck Eggs	530	460	450	340	520	450	520	440

Respondents were asked how far they traveled to visit the market. Average distances ranged from 3.5 km in urban Kampot to 1.4 km in Siem Reap and 1.0 km in semi-urban Kampot. In urban Kampot, there was one large market in the center of town that served the entire area.

### Concerns Related to Chicken Meat

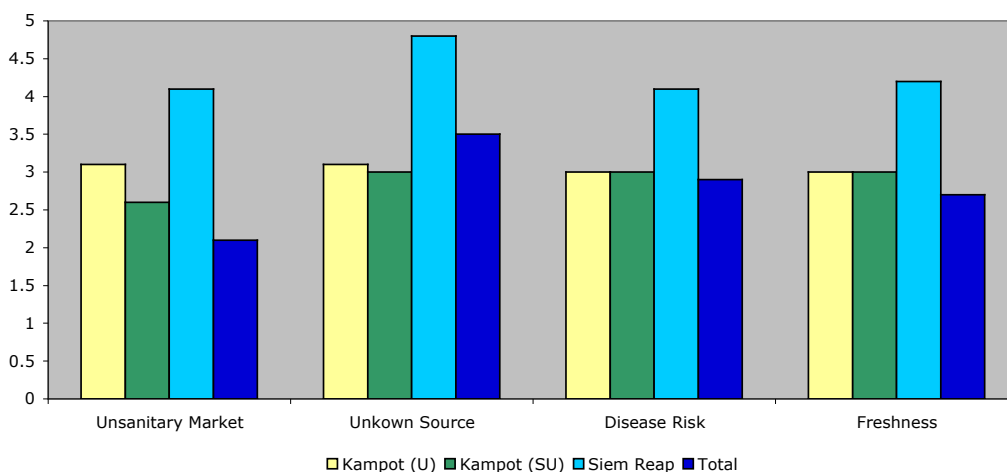
On a scale of 1 to 5 (not important to very important), households were asked to report how important different attributes of chicken meat were to them. Figure 17 displays the results.

**Figure 17: Ranking the importance of chicken meat attributes in selected locations.**



Safety was ranked the most important attribute of chicken meat in every region. Surprisingly, trusting the seller was ranked very low in every location, implying that consumer-vendor relationships do not play heavily in consumer decisions.

**Figure 18: Average ranking of safety concerns by location.**



Respondents in Siem Reap ranked every concern higher than their Kampot counterparts. Overall, the lack of knowledge of the farm source was the largest concern, followed closely by disease risk and freshness.

Respondents were asked about their methods for determining the quality of the chicken meat they purchase. More than three-quarters of respondents in Kampot reported using the live appearance of the bird to determine the quality of the product. However, in Siem Reap consumers were much more likely to judge the appearance of meat. This follows from the earlier finding that consumers in Siem Reap were much more likely to purchase slaughtered chickens.

**Table 39: Methods for determining quality of chicken and duck meat (percent respondents).**

Reason	Kampot (urban)		Kampot (semi-urban)		Siem Reap		Total	
	Freq	Perc	Freq	Perc	Freq	Perc	Freq	Perc
Live appearance	272	79.1	113	75.8	89	17.7	474	47.6
Meat appearance	26	7.6	49	32.9	392	78.1	467	46.9
Relationship with seller	168	48.8	21	14.1	94	18.7	283	28.4
Knowledge of source	75	21.8	7	4.7	12	2.4	94	9.5
Do not think about safety	7	2.0	1	0.7	1	0.2	9	0.9
Other	1	0.3	2	1.3	10	2.0	13	1.3

In addition, consumers were asked whether they felt the safety of the poultry products that they purchase could be improved. More than 8 in 10 respondents in Kampot felt that safety could be improved compared to 6 in 10 respondents in Siem Reap.

**Table 40: Could safety of poultry products be improved?**

	Kampot (urban)		Kampot (semi-urban)		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent
Responding Yes	273	80.3	144	96.6	314	63.8	731	74.5

#### **Willingness to Pay for Certified Chicken**

A proposed certification system was explained in detail and respondents were asked to if they would be interested in purchasing this type of meat. Overall, more than 85 percent of respondents reporting interest in purchasing safety certified chicken meat. The number was highest in the semi-urban areas of Kampot where all respondents reported some interest. In

Siem Reap 90 percent of respondents reported interest compared to 74 percent in urban Kampot.

**Table 41: Certification programme interest expressed by respondents.**

	Kampot (urban)		Kampot (semi-urban)		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent
Interested in buying certified poultry	249	73.7	149	100	450	90.0	848	85.9

Among those without interest in the proposed certification program, respondents were asked why. The most common answer was that not enough information had been provided about the program, followed by worries that the safety inspection would be unreliable.

**Table 42: Why people don't want to pay for safety certified chickens.**

Reason	Kampot (urban)		Kampot (semi-urban)		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent
Do not want to pay extra for a system like this	6	6.7	--	--	3	6.3	9	7.4
Worried system inspections will be unreliable	34	38.2	--	--	10	31.3	44	36.4
Not enough information about the programme	59	66.3	--	--	15	46.9	74	61.2
Satisfied with the level of safety of chicken purchased	23	25.8	--	--	10	31.3	33	27.3
Observations	89		0		32		121	

## Farmer Survey

Farmer surveys were conducted in the primary duck producing districts of Kampot province and chicken producing districts in Siem Reap which provide poultry products to the urban and semi-urban markets and consumer households included in our sample. Districts were chosen based on past market chain mapping activities (Seng 2007, Seng 2008).

**Table 43: Breakdown of Expected Farmer Survey Observations**

	Kampot	Siem Reap	Total
Small-Scale Producers	523	378	901
<i>Small-Scale Producers Raising Ducks*</i>	75	82	157
<i>Small-Scale Producers Raising Chickens*</i>	521	351	872
Largescale Duck Producers (<100 birds)	195	57	252
Largescale Chicken Producers (<100 birds)	93	23	115
All	811	458	1,269
**All farmer surveys	596	891	1,396

\* Many small-scale farmer raise both chicken and ducks

\*\* Accounting for the smallholders that produce ducks and chickens as separate observations

Enumerators asked to speak with the person(s) responsible for raising poultry. Often rearing chickens was a responsibility shared primarily between females and children, while men were responsible for larger livestock such as pigs and cows.

## Chicken Producers

### Smallscale Poultry Producers (<100 birds)

The following section discusses the household characteristics of smallholder producers as a group followed by a discussion of production practices for chicken and duck producers separately.

### Smallscale Farmer Household Characteristics

The majority of respondents were females in both provinces. This finding supports findings in earlier studies (Seng 2007, Seng 2008) that women often control the income from poultry production. Enumerators approached households in a manner similar to they way aggregators



approach households, seeking out the owners of chickens during the middle of the day. More than 60 percent of the time this meant interviewing women.

**Table 44: Gender of survey respondents.**

Gender	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Male	170	33.7	136	36.0	309	34.9
Female	335	66.3	242	64.0	576	65.1

Similarly to consumer surveys, the majority of respondents were in the mid age range of 30-45 years. However, in Siem Reap close to 30 percent of respondents were under 30 years old.

**Table 45: Age of survey respondents.**

Age class	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
<30	57	10.9	98	28.4	155	17.2
30-45	250	47.8	159	39.8	409	45.4
46-60	150	28.7	106	28.1	256	28.4
>60	66	12.6	15	3.7	81	9.0

The average years of experience raising poultry averaged about 10 years. The averages were slightly higher for Kampot farmers.

**Table 46: Years of poultry raising experience.**

Work experience	Kampot		Siem Reap		Total	
	Mean	SD	Mean	SD	Mean	SD
Chickens	12.0	11.0	9.3	7.1	10.9	9.7
Ducks	11.3	10.5	5.8	7.2	9.2	9.7

Like most Cambodians, the majority of survey respondents produced crops as their main economics activity. In Kampot rice was the most frequent crop produced (94.3 percent respondents) while in Siem Reap vegetables were the most common. In addition, nearly 90 percent of Kampot respondents and 68 percent of Siem Reap respondents also reared other livestock, most commonly pig and cattle. Off farmer employment was reported in 20 percent of Kampot households and 10 percent of Siem Reap households.

**Table 47: Other household Economic Activities.**

Age Range in Years	Kampot		Siem Reap		Total	
	Nr	Percent	Nr	Percent	Nr	Percent
Rice Production	493	94.3	228	60.3	721	80.0

Vegetables	156	38.6	268	70.9	424	47.1
Fruits and Nuts	57	10.9	113	29.9	170	18.9
Raise Livestock (other than poultry)	468	89.5	254	67.2	722	80.1
Off-Farm Employment	103	19.7	38	10.1	141	15.7

Among respondents cultivating rice, farmers were asked about duck grazing practices in their fields. Nearly half of the farmers in Kampot who cultivated rice reported other people's ducks had grazed in their field in the past 6 months. In Siem Reap, however, while 40 percent of farmers allowed their own ducks to graze in their rice field, less than 3 percent allowed other peoples' ducks to graze in their fields.

**Table 48: Duck grazing activities in households' rice fields in 2008.**

Age class	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Own ducks grazed in rice field	120	22.9	144	38.1	309	34.3
Other peoples ducks grazed in rice field	200	46.7	11	2.9	264	29.3
No ducks grazed in rice field	156	33.7	153	40.5	355	28.3

Personal savings are the main source of funding poultry raising in both locations. However, in Siem Reap more than half of respondents also reported receiving loans from family members (often in the form of the birds themselves). Ancillary income was also a common source of financing.

**Table 49: Financing of poultry production by location.**

Source of finance	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Family loan	199	38.1	201	53.2	400	44.4
Ancillary Income	153	29.4	154	40.7	308	34.2
Personal savings	430	82.2	211	55.8	641	71.1
Informal loan	8	1.5	4	1.1	12	1.3
Other	4	0.8	8	2.1	12	1.3

### Farmer Motivation for Raising Poultry

Respondents were asked about their primary purpose for raising chicken. Most respondents raise chickens for both consumption and sale. No respondents reported selling all of their birds. Respondents in Siem Reap were more likely to consume all of their birds.

### Farmer Income From Raising Poultry

Respondents were asked to report their cash income from raising poultry. Respondents in Kampot averaged higher income from poultry, however standard deviations were high in both provinces. This is a result of the high variation in roles that poultry production plays in household economies. Some households reported close to half of their cash income came from poultry production, however, it is important to keep in mind that these results are not attempting to measure total income (i.e., do not include home consumption nor trade value of products produced) but only cash generated by household economic activities.

**Table 50: Income from poultry production.**

Variable	Kampot		Siem Reap		Total	
	Mean	SD	Mean	SD	Mean	SD
HH income from poultry 2008 (10,000 Riels)	44.1	56.0	24.0	40.2	38.1	52.5
Percent of total cash income from poultry production	24.2	23.2	8.2	16.4	17.5	22.1

Respondents were also asked where they spent their cash income received from poultry production. The most common response was essential consumption. However, More than 20 percent of respondents reporting using the money for school fees and 15-20 percent reported saving money for emergencies. These findings underlie the importance of poultry production in low income households.

**Table 51: Use of cash income from poultry production.**

Barrier	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Save for emergency	113	21.6	59	15.6	172	19.1
School fees	111	21.2	81	21.4	192	21.3
Essential consumption (food, clothing, shelter)	335	64.1	160	42.3	495	55.0
Non-essential consumption	19	3.7	3	0.8	22	2.4

Invest in other economic activities	13	2.5	11	2.9	24	2.7
Other	19	3.7	55	14.6	76	8.4
Don't know	7	1.3	0	0	14	1.6

### Poultry Production

The subsequent section discusses the production practices of both duck and chicken producers.

While women are the primary managers of sale, labor division is divided up throughout the family. More than 70 percent of respondents reported that women participated in poultry keeping, with slightly less men, and more than 40 percent of children also contributing.

**Table 52: Labor division for participating in poultry keeping.**

Group	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Men	322	61.6	270	71.5	592	65.7
Women	394	75.4	157	68.2	651	72.3
Children	224	42.7	165	43.6	389	43.2
Employees (non-family)	7	1.4	5	0.3	12	0.8

However, while most family members contribute to poultry raising, the total amount of time allotted to tending to poultry was under 20 minutes per day in both provinces. This finding illustrates one of the facets of poultry keeping that is conducive to poverty alleviation; there is minimal investment in poultry with relatively high returns.

**Table 53: Average time devoted to poultry keeping.**

	Kampot		Siem Reap		Total	
	Mean	SD	Mean	SD	Mean	SD
Minutes per day	17.4	16.4	12.5	9.3	15.7	14.2

One of the reasons that there is such little time spent caring for chickens is that most birds scavenge for food. Consequently, the majority of birds are not kept in an enclosure during the day (enclosed birds must be provided with additional feed). However, more than 60 percent of respondents did keep their poultry inside enclosures at night. The main reason cited for keeping

birds enclosed at night was protecting them from predators, as opposed to biosecurity concerns.

**Table 54: Smallholder Chicken Flock sizes in selected locations.**

Farm Size	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
1-20 chickens	339	65.8	347	98.0	686	78.9
21-50 chickens	166	32.2	7	2.0	173	19.9
51-75 chickens	10	1.9	0	0	10	1.2
>76 chickens	0	0	0	0	0	0
Average Flock Size	19.0		5.6		13.5	

Most respondents in both provinces raised less than 20 chickens. However, flock sizes were larger, on average, in Kampot. Flock sizes were measured at the time of interview. Therefore, the numbers do not represent yearly production totals.

**Table 55: Percent of Smallscale Chicken Farmers that also raise ducks, by chicken flock size**

Farm Size	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
1-20 ducks	94	88.8	70	90.9	164	90.1
21-50 ducks	11	10.5	7	9.1	18	9.4
51-75 ducks	1	0.7	0	0	1	0.5
>76 ducks	0	0	0	0	0	0
Average Flock Size	11.0		8.1		9.7	

Duck flock sizes were slightly smaller. Most smallholders who kept ducks raised about 10 birds. Respondents who raised more than 100 ducks were included in the largescale duck survey, however, there were no duck farmer encountered that raised between 75 and 100 birds.

**Table 56: Are birds kept in an enclosure?**

	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Yes, always	12	2.4	113	32.8	125	14.7
Yes, only at night	385	76.5	164	47.5	549	64.7
No, never	106	21.2	68	19.7	174	20.5

Farmers were asked what type of feed their birds consumed on a daily basis, whether scavenged or provided. The most common feed was paddy rice in both provinces. However, there was

some variation between locations. In Siem Reap, human food scraps were a common source of feed, with more than 70 percent of respondents reporting using this type of feed. Contrarily, in Kampot only 30 percent of respondents fed human food scraps to their birds.

**Table 57: Food provided to chickens in selected locations.**

Feed type	Kampot				Siem Reap				Total			
	chicken		duck		chicken		duck		chicken		duck	
	Freq	Per	Freq	Per	Freq	Per	Freq	Per	Freq	Per	Freq	Per
Paddy rice	509	97.7	93	93.9	302	79.9	57	77.0	813	90.2	152	86.9
Rice bran	132	25.3	50	50.5	38	10.1	27	36.5	173	19.2	79	45.1
Broken rice	436	83.7	78	78.8	251	66.4	34	46.0	689	76.5	113	64.6
White rice	142	27.3	23	23.2	97	25.7	8	10.8	239	26.5	31	17.7
Human food scraps	93	17.9	30	30.3	281	74.3	52	70.3	375	41.6	83	47.4
Insects and worms	285	54.7	49	49.5	174	46.0	27	36.5	461	51.2	78	44.6
Grass and leaves	277	53.2	39	38.4	188	49.7	23	31.1	465	51.6	63	36.0
Commercial feed	85	16.3	1	1.0	18	4.8	7	9.5	103	11.4	8	4.6
Other	6	1.2	0	0	10	2.7	9	12.2	26	3.0	9	5.1
Observations	519		99		378		74		897		175	

For water, most farmers use a well to provide some water to their birds and allow them to drink water from crops to supplement the provided water. Ponds were another common source of water.

**Table 58: Source of water provided to poultry in selected locations.**

Feed type	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Crops run-off	216	41.5	237	62.7	453	50.3
Well	384	73.7	301	79.6	684	76.0
Pond	116	22.3	88	23.3	207	23.0
River or stream	25	4.8	58	15.3	83	9.2
Other	8	1.5	2	0.5	10	1.1

Approximately half of all respondents reported providing pharmaceuticals to their birds. The most common source of medicine was a Village Animal Health Worker in Kampot (34 percent) and a pharmacy that sells human medicines in Siem Reap (10.1 percent). Farmers in Kampot were more likely to use veterinary services.

**Table 59: Source of pharmaceuticals and veterinary services.**

	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
VAHW	179	34.4	32	8.5	212	25.5

State Vet	21	4.0	3	0.8	24	2.7
Private vet	74	14.2	17	4.5	91	10.1
Friend/relative	15	2.9	1	0.3	16	1.8
Pharmacy	60	11.5	38	10.1	98	10.9
Do not use any	217	41.7	237	62.7	455	50.5

### Poultry Marketing

As noted above, most respondents sell a portion of their flock. Average price received for poultry products is reported below. The prices were higher for meat products in Siem Reap and higher for eggs in Kampot. Prices for slaughtered birds were higher in both provinces with a premium of 800-1,000 Riels charged for slaughtering.

**Table 60: Poultry product farmer sale price by location (Riels/kg; Riels/egg).**

Price	Kampot		Siem Reap		Total	
	High season	Low season	High season	Low season	High season	Low season
Live chicken	13,600	11,100	14,700	13,000	13,000	10,700
Slaughtered chicken	14,500	11,900	15,400	12,200	14,600	11,900
Chicken eggs	360	250	250	230	360	250
Live ducks	9,700	7,800	11,600	9,700	11,400	9,500
Slaughtered ducks	11,800	10,200	--	--	11,800	10,100
Duck eggs	490	340	420	370	480	350

Aggregators were the most common purchaser of poultry products among all respondents. Vendors were the next most common outlet. Less than 20 percent of respondents sold birds to their friends and neighbors.

**Table 61: Buyer of products in selected locations (percent).**

Agreement	Kampot	Siem Reap	Total
Aggregator	50.0	45.8	48.6
Vendor	30.7	39.0	33.4
End-user	15.2	13.4	14.9
Food vendor	1.7	1.1	1.5
Other	2.4	0.3	1.0

While aggregators bought close to half of the birds sold, there were a variety of sales locations reported by farmers. In Kampot, most sales took place at the farm, however, roadside sales and

bringing birds to market were also common. In Siem Reap, bringing birds to market was most common with only 15 percent of sales taking place at the farm.

**Table 62: Location of transaction.**

Agreement	Kampot	Siem Reap	Total
Farm gate	45.2	15.0	35.7
Side of the road	21.6	11.0	18.2
At the market	29.1	38.2	32.0
Other in village	2.1	26.0	16.0
Other	1.0	10.0	4.6

Farmers were asked whether they had any pre-existing agreements with people that they sold chickens to. Vendors were most likely to have verbal agreements with farmers, followed by aggregators. Most end users did not have any type of agreements (formal or informal). Respondents in all provinces with verbal agreements tended to have stipulations for time, price and quantity of purchase. Farmers did not report offering discounts to buyers for regular purchases.

**Table 63: Buyer-seller relationships (percent).**

Buyer	Kampot			Siem Reap			Total		
	None	Verbal	Formal	None	Verbal	Formal	None	Verbal	Formal
Aggregator	84.9	15.1	0	79.8	14.0	6.1	83.3	15.0	1.7
Vendors	71.6	28.4	0	83.3	12.8	3.9	75.2	23.6	1.2
End users	71.1	28.9	0	85.3	14.8	0	74.5	25.5	0
Food vendor	60.0	40.0	0	77.8	22.2	0	62.5	37.5	0
Other	92.9	7.1	0	92.3	7.7	0	92.7	7.3	0

Most respondents did not have prior agreement for purchase with aggregators. Food vendors were most likely to have verbal agreements with respondents in Kampot.

**Table 64: Items covered by verbal agreements (In percentages).**

Agreement	Kampot	Siem Reap	Total
Price	34.2	84.6	64.9
Quantity	29.9	3.2	18.7
Time	33.0	0.8	19.4
Credit	23.6	0	13.5
Other	22.5	14.5	14.8



Among respondents with informal arrangements for purchase, price and quantity were the most common types of informal agreements in place.

In addition to questions about trade agreements, farmers were asked about the type of relationships they maintained with buyers. Respondents in Siem Reap were more likely to maintain personal relationships, outside of business, with the people whom they traded with. Close to half of farmer-vendor traders in Siem Reap took place between people whom also interact regularly outside of the poultry trade.

**Table 65: Nature of buyer-seller relationships prior to transaction.**

Buyer	Kampot			Siem Reap			Total		
	Business	Personal	None	Business	Personal	None	Business	Personal	None
Aggregator	79.9	6.0	14.1	55.5	32.1	12.4	71.8	20.0	8.3
Vendors	50.4	4.8	44.8	46.6	49.1	4.3	49.2	46.2	4.6
End users	39.4	11.8	48.8	44.6	28.4	27.0	40.7	43.2	16.2
Food vendor	46.0	4.8	49.2	53.3	20.0	26.7	47.4	43.6	9.0
Other	35.3	17.7	47.1	60.0	26.7	13.3	45.5	39.4	15.2

### HPAI Culling Experience, Sanitary Measures, and Inspections

Despite the occurrence of at least four reported HPAI outbreaks in chicken, and four reported human deaths from HPAI in Kampot, zero respondents reported having their birds culled. At least two villages reported HPAI outbreaks in their villages, however, none of the respondents had experienced culling. It is possible that respondents whose flocks were culled did not return to producing poultry, and hence were excluded from our sample, however these seems improbable given the low cost of restarting a flock and the large sample size.

**Table 66: Number of farmers whose poultry were culled.**

Flock culled	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Yes	0	0	0	0	0	0

### Poultry Farmer Concerns

Farmers were asked about their risk perception of HPAI and other diseases to their flocks and to their families. Respondents were asked to rank the level of risk they perceived for each issue on a scale of 0 to 5, 0 being no risk and 5 being very risky. As expected, the risk to families was ranked much higher than risk to flocks.

Farmers were asked which issues facing smallholders concerned them most. Respondents were asked to rate their level of concern for each issue on a scale of zero to five with zero meaning the respondent does not worry at all and three meaning respondent worries about this issue every day.

**Table 67: Importance of factors in deciding whom to trade with (Average ranking, 0 to 5).**

Agreement	Kampot	Siem Reap	Total
Price	3.0	2.3	2.7
Quantity	1.8	1.2	1.5
Timing	1.8	1.1	1.5
Fairness	3.6	0.9	2.8
Relationship	2.7	1.7	2.0
Other	1.0	0.9	0.8

**Table 68: Risk Perception (Average ranking, 0 to 5).**

Risk of:	Kampot	Siem Reap	Total
HPAI to birds	1.9	2.1	2.0
HPAI to family	1.8	1.9	1.8
Other disease to birds	2.2	2.2	2.2
Other disease to family	2.1	2.2	2.1

**Table 69: Importance of factors in deciding whom to trade with (Average ranking, 0 to 5).**

	Kampot	Siem Reap	Total
Demand for poultry	1.1	1.0	1.0
Government culling your flock	0.9	0.6	0.8
Lack of capital to finance poultry raising	1.9	1.7	1.8
Predator will kill birds	1.5	1.0	1.2
Theft of birds	1.6	0.7	1.3

In general, farmers were most worried about price and fairness in Kampot, and price alone in Siem Reap. Risk perceptions were very low among farmers with HPAI risk perceived to be less of a threat than other disease to both family and flock. Finally, lack of capital was seen as the biggest challenge facing farmers, however, the average ranking was less than 2 out of 5 on a scale of importance.

### Largescale Chicken and Duck Producers (<100 birds)

The largescale duck production survey was one of the most important facets of this study because, to this point in time, there is very limited quantitative information on how duck producers have adjusted to producing poultry post HPAI in Cambodia. The study included nearly 200 interviews with largescale duck producers across Kampot and Siem Reap.

Unlike with chicken, males are primarily responsible for duck production. Averaging over age 40, duck farmers invest significant resources into production, and ducks are one of their major economic activities.

### Largescale Duck Producer Survey

**Table 70: Gender of Producers.**

Gender	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Male	122	62.4	30	52.6	152	60.3
Female	73	37.6	27	47.4	100	39.7

**Table 71: Age of Producers.**

Age Range in Years	Kampot		Siem Reap		Total	
	Nr	Percent	Nr	Percent	Nr	Percent
20-29	10	5.5	13	24.0	23	9.7
31-39	60	32.8	12	22.2	72	30.4
40-49	83	45.4	21	38.9	104	43.9
50-59	26	14.2	7	13.0	33	13.9
60-69	4	2.1	1	1.9	5	2.1

Almost 90 percent of duck farmers in Kampot reported cultivating rice in conjunction with farming ducks. These activities are complimentary because ducks can extract feed from the rice field and the ducks can fertilize the rice and aerate the soil. Respondents in Siem Reap were much less likely to cultivate rice.

**Table 72: Other Economic Activities Undertaken by Producers.**

Crop Type	Kampot		Siem Reap		Total	
	Nr	Percent	Nr	Percent	Nr	Percent
Rice Production	192	88.5	23	40.4	215	85.3
Fruit, Vegetable, Nut Production	93	47.7	12	0.2	109	43.3
Livestock Activities (other than trading)	177	90.1	22	38.6	199	79.0
Off-Farm Employment	58	29.7	1	2.0	59	23.4

In Kampot, more than 60 percent of respondents allowed their duck flocks to graze in their rice fields. Furthermore, nearly three-quarters allowed other peoples ducks to graze in their fields. This practice was highly uncommon in Siem Reap, were there was less rice cultivation and less than 10 percent of respondents reported duck grazing in their rice fields.

**Table 73: Rice Production and Duck Grazing (Nr, Percent of Rice Cultivators)**

Crop Type	Kampot		Siem Reap		Total	
	Nr	Percent	Nr	Percent	Nr	Percent
Own ducks graze in rice field	123	63.1	0	0	123	57.2
Other peoples' ducks graze in rice field	143	73.3	1	4.3	144	66.9
No ducks graze in rice field	26	14.4	22	95.7	48	22.3

Duck production is a major economic activity. Consequently, income from duck production is significant and farmers spend more than 7 hours per day attending to their flocks.

**Table 74: Income from Poultry in 2008 (1000 Riels).**

Work experience	Kampot		Siem Reap		Total	
	Mean	SD	Mean	SD	Mean	SD
Total Income (2008)	4,800	3,030	6,900	3,200	5,200	3,900
Income from Poultry (2008)	3,030	1,750	6,000	2,770	4,500	3,000
Percent Income from Poultry (2008)	62.7	15.8	87.2	18.9	68.1	19.4

**Table 75: Work hours attending to ducks per day (all workers).**

	Kampot	Siem Reap	Total
Average hours per day	7.9	7.1	7.7

When asked about the major barriers to expanding duck production, special constraints and the cost of feed were the two most common answers with 75 percent and 56 percent of respondents replying in this manner.

**Table 76: Barriers to production expansion.**

Source of finance	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Space	174	89.2	54	75.4	188	74.6
Feed Cost	117	60.0	24	42.1	141	56.0
Time	33	16.9	0	0	33	13.1
Water availability	3	1.5	0	0	3	1.2
Feed Availability	2	1.0	3	5.3	5	2.0
Other	14	25.6	28	49.1	29	11.5

Among duck producers, there are several production structures. In both provinces the most common structure was to purchase layer ducks and keep them for egg production. This is profitable because of the high demand for duck eggs as a consumption item. In Siem Reap it was also common for farmers to hatch layers from ducklings and then raise them to produce eggs.

**Table 77: Primary economic duck production activity. (Percent producers)**

Breeds	Kampot		Siem Reap		Total	
	Ave	SD	Ave	SD	Ave	SD
Purchase layer ducks, keep for egg production	142	82.8	37	64.9	179	71.0
Hatch ducklings, raise layer ducks for egg production	14	7.2	20	35.1	34	13.5
Raise mixed ducks from ducklings, sell male ducks for meat, sell female ducks to egg producers	35	18.0	0	0	35	13.9
Purchase male ducklings, fatten then sell for meat	4	2.1	0	0	4	1.6

Average flock size also varied greatly, however, most farmers maintained flocks of a few hundred birds. Layer producers averaged about 400 birds kept at one time.

**Table 78: Average flock size by production structure and location. (Percent producers)**

Breeds	Kampot			Siem Reap			Total		
	Egg producers	Meat producers	Mixed producers	Egg producers	Meat producers	Mixed producers	Egg producers	Meat producers	Mixed producers
Male ducks	27	60	80	28	--	--	27	60	80
Female ducks	391	190	420	409	--	--	405	190	420
Muscovy ducks	1	2	2	1	--	--	2	2	2
Chickens	12	5	10	11	--	--	11	5	4

Paddy Rice is the main source of feed. In addition, 75 percent of respondents in Kampot, and more than 90 percent of respondents in Siem Reap, provided additional commercial feed to supplement paddy rice as duck feed.

**Table 79: Type of feed provided. (Percent of producers)**

Buyer	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Paddy Rice	194	99.5	45	79.0	239	94.8
Commercial Feed	145	74.4	53	92.3	198	78.6
Rice Bran	3	1.5	42	73.7	45	17.9
Broken Rice	42	21.5	19	33.3	61	24.2
White Rice	15	7.7	4	7.0	19	7.5
Earthworms	15	7.7	0	0	15	6.0
Other	79	40.5	20	35.1	99	39.3

An additional requirement for ducks is that they have water access. In Kampot streams and creeks were the most common water body that ducks had access to while in Siem Reap there were other types of water access.

**Table 80: Water Access. (Percent of producers)**

Buyer	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Stream/Creek	155	79.5	4	7.0	159	63.1
Pond	101	51.8	26	45.6	127	50.4
Lake	68	34.9	12	21.1	80	31.8
Other	64	32.8	44	77.2	108	42.9
River	2	1.0	2	3.5	4	1.6
None	1	0.5	0	0	1	0.4

More than three-quarters of respondents provided their ducks with some form of pharmaceutical. The most common source were private vets in both provinces.

**Table 81: Source of veterinary services and pharmaceuticals. (Percent of producers)**

Buyer	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Private Vet.	89	45.6	30	52.6	119	47.2
VAHW <sup>1</sup>	53	27.2	0	0	53	21.0
State Vet.	29	14.9	0	0	29	11.5
Friend/Relative	2	1.0	0	0	2	0.8
Pharmacy	0	0	16	28.1	16	6.4
None	27	13.9	14	24.6	41	16.3

1. Village Animal Health Worker

Duck producers were asked what symptoms were common in their duck prior to early death. The most common symptom in Kampot was paralysis (70 percent respondents) while the most common symptom in Siem Reap was diarrhea (60 percent of respondents).

**Table 82: Common symptoms in ducks prior to death from disease.**

Symptom	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Diarrhea	51	26.3	36	63.2	87	34.7
Cough/Sneezing	29	15.0	25	43.9	54	21.5
Loss of appetite	65	33.5	9	15.8	74	29.5
Paralysis	134	69.1	5	8.8	139	55.4
Other	38	19.6	23	40.4	61	24.3

Farmers were asked what they did when their birds died unnaturally from disease. While most respondents reported destroying birds that died from disease, more than 40 percent of respondents in Kampot reported consuming the birds themselves.

**Table 83: Actions taken with birds that die from disease.**

Buyer	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Destroy	108	55.4	51	89.5	159	63.1
Consume	83	42.6	1	1.8	84	33.3
Sell	25	12.8	5	8.8	30	11.9
Give away	7	3.6	0	0	7	2.8
Other	0	0	2	3.5	2	0.8

Another feature of duck production is that it produces significant amounts of manure. The majority of respondents use duck manure to fertilize rice or other crops. In addition, nearly 40 percent of duck farmers in Siem Reap sold duck manure for additional cash income.

**Table 84: Use of duck manure.**

Buyer	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Fertilizing Vegetables	111	56.9	22	38.6	133	52.8
Fertilizing other crops	186	95.4	22	38.6	208	82.5
Fish Feed	19	9.7	0	0	19	7.5
Destroy	1	0.5	9	15.8	10	4.0
Discard	0	0	3	5.3	3	1.2
Sell	2	1.0	22	38.6	24	9.5
Other	7	12.3	14	24.5	21	8.3



**Table 85: Biosecurity measures undertaken.**

Buyer	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Enclosure	191	98.5	28	49.1	219	87.3
Clean holding facility regularly	150	77.3	55	96.5	205	81.7
Use gloves	30	15.5	1	1.8	31	12.4
Separate ducks from chickens	117	60.3	0	0	117	46.6
Other	9	4.6	1	1.8	10	4.0

In addition to pharmaceuticals, it was common for respondents to report keeping their birds in an enclosure that was cleaned regularly. In addition, most respondents in Kampot kept their ducks separate from their chickens.

### **Production Structure**

Respondents were asked detailed questions about all of their inputs and outputs of production. The results are summarized in the following tables. The tables include the author's calculation of monthly operating costs as well as profits. These estimates are compared to the respondents self-reported monthly profits.

**Table 86: Largescale Chicken Farmer Cost Structure – Average Values**

Inputs				Outputs			
Item	Percent Respondents Using Inputs	Cost (Riels per month)	Item	Percent Respondents Using Inputs	Quantity/month	Total Cost	
Eggs/Chicks	58.1	28,000	Chickens	100	26 birds		
Feed	100	235,000	Chicken Eggs	23.7	23 Eggs		
Water	4.3	13,900	Animal Waste	100	43.3 Kg		
Employees	5.4	79,000	Waste Water	100	65.5 Liters		
Pharmaceuticals	78.5	16,600	Manure	100	71.1 Kg		
Veterinary Services	64.5	46,000					
Electricity	8.6	13,100					
Gasoline (animal transport)	67.7	25,000					
Gasoline (feed transport)	50.5	21,000					
<b>Item</b>	<b>Percent Respondents Using Inputs</b>	<b>Total Cost</b>					
Enclosure Materials	94.6	555,000					
Enclosure Construction	94.6	64 Hours					
Cooling System	3.3	50,000					
Feeding Trays	90.3	44,000					
Electrical Infrastructure	12.9	58,000					
Other 1	9.7	1,250,000					
Other 2	8.6	9,000					
Automated Watering System	72.0	30,500					

**Table 87: Medium-scale Duck Egg Producer Cost Structure in Kampot (100-500 Layer Ducks\*) – Average Values**

Inputs			Outputs			
Item	Percent Respondents Using Inputs	Cost Riels/month	Item	Percent Respondents with Outputs	Quantity/month	Value Riels/month
Layer Ducks	100	200,000	Duck Eggs Sold	100	3,900 eggs	1,500,000
Feed	100	995,000	Spent Layers Sold	39.0	12 birds	100,000
Water	1.0	20,000	Animal Waste	100	32.0 Kg	--
Employees	2.0	100,000	Waste Water	100	42.0 L	0
Pharmaceuticals	59.0	16,000	Manure	100	64.1 Kg	13,000
Veterinary Services	31.3	2,000	<b>Total**</b>		<b>1,540,000</b>	
Gasoline (egg transport)	29.1	20,000	<b>***Monthly profit = Cash Income - Variable Costs</b> = 1,540,000 – 1,230,000 = 310,000 Riels/month ~ 78 USD/month <b>Reported Income = 360,000 Riels/month ~ 90 USD/month</b>			
Gasoline (feed transport)	76.9	20,000				
<b>Total**</b>		<b>1,230,000 Riels/month</b>				
<b>Fixed Costs</b>						
Enclosure Materials	100	205,000				
Enclosure Construction (work hours)	100	19 hours				

\* 134 Respondents

\*\* Weighted averages according to percentage of respondents utilizing input/output

\*\*\* Author's calculation

**Table 88: Medium-scale Mixed Duck Producer Cost Structure in Siem Reap (300-900 Ducks\*) – Average Values**

Inputs			Outputs			
Item	Percent Respondents Using Inputs	Cost Riels/month	Item	Percent Respondents with Outputs	Quantity/month	Value Riels/month
Fertilized Eggs/Ducklings	100	365,000	Duck Eggs Sold	100	2,260 eggs/month	938,000
Feed	100	337,000	Broiler Ducks Sold	100	7 birds/month	65,000
Water	0	0	Spent Layers Sold	97.8	11 birds/month	113,000
Employees	2.3	35,000	Animal Waste	100		--
Pharmaceuticals	88.4	12,000	Waste Water	100		0
Veterinary Services	40.0	2,000	Manure	2.0**	115.0 Kg/month	23,000
Gasoline (bird transport)	59.1	13,000	Total**		1,114,000 Riels/month	
Gasoline (feed transport)	42.9	14,000				
Total**	778,000 Riels/month					
<b>Fixed Costs</b>			<p>***<b>Monthly profit</b> = Cash Income - Variable Costs                      = 1,140,000 – 778,000                      = 362,000 Riels/month ~ 90 USD/month  <b>Reported Income</b> = 343,500 Riels/month ~ 86 USD/month</p>			
Item	Percent Respondents Using Inputs	Cost (total)				
Enclosure Materials	100	189,000				
Enclosure Construction (work hours)	100	45 hours				

\* 43 Respondents: Raise ducks from ducklings; sell male ducks for meat, keep females for egg production.

\*\* Percent reporting sale of manure.

\*\*\* Author's calculation

**Table 89: Medium-scale Duck Egg Producer Cost Structure in Kampot (100-500 Layer Ducks\*) – Average Values**

Inputs			Outputs			
Item	Percent Respondents Using Inputs	Cost Riels/month	Item	Percent Respondents with Outputs	Quantity/month	Value Riels/month
Layer Ducks	100	200,000	Duck Eggs Sold	100	3,900 eggs	1,500,000
Feed	100	995,000	Spent Layers Sold	39.0	12 birds	100,000
Water	1.0	20,000	Animal Waste	100	32.0 Kg	--
Employees	2.0	100,000	Waste Water	100	42.0 L	0
Pharmaceuticals	59.0	16,000	Manure	100	64.1 Kg	13,000
Veterinary Services	31.3	2,000	Total**		1,540,000	
Gasoline (egg transport)	29.1	20,000	<b>***Monthly profit = Cash Income - Variable Costs</b> = 1,540,000 – 1,230,000 = 310,000 Riels/month ~ 78 USD/month <b>Reported Income = 360,000 Riels/month ~ 90 USD/month</b>			
Gasoline (feed transport)	76.9	20,000				
Total**	1,230,000 Riels/month					
<b>Fixed Costs</b>						
Item	Percent Respondents Using Inputs	Cost (total)				
Enclosure Materials	100	205,000				
Enclosure Construction (work hours)	100	19 hours				

\* 134 Respondents

\*\* Weighted averages according to percentage of respondents utilizing input/output

\*\*\* Author's calculation

**Table 90: Medium-scale Mixed Duck Producer Cost Structure in Siem Reap (300-900 Ducks\*) – Average Values**

Inputs				Outputs			
Item	Percent Respondents Using Inputs	Cost Riels/month	Item	Percent Respondents with Outputs	Quantity/month	Value Riels/month	
Fertilized Eggs/Ducklings	100	365,000	Duck Eggs Sold	100	2,260 eggs/month	938,000	
Feed	100	337,000	Broiler Ducks Sold	100	7 birds/month	65,000	
Water	0	0	Spent Layers Sold	97.8	11 birds/month	113,000	
Employees	2.3	35,000	Animal Waste	100		--	
Pharmaceuticals	88.4	12,000	Waste Water	100		0	
Veterinary Services	40.0	2,000	Manure	2.0**	115.0 Kg/month	23,000	
Gasoline (bird transport)	59.1	13,000	Total**		1,114,000 Riels/month		
Gasoline (feed transport)	42.9	14,000					
Total**	778,000 Riels/month						
				*** <b>Monthly profit</b> = Cash Income - Variable Costs = 1,140,000 – 778,000 = 362,000 Riels/month ~ 90 USD/month <b>Reported Income</b> = 343,500 Riels/month ~ 86 USD/month			
<b>Fixed Costs</b>		<b>Item</b>	<b>Percent Respondents Using Inputs</b>	<b>Cost (total)</b>			
		Enclosure Materials	100	189,000			
		Enclosure Construction (work hours)	100	45 hours			

\* 43 Respondents: Raise ducks from ducklings; sell male ducks for meat, keep females for egg production.

\*\* Percent reporting sale of manure.

\*\*\* Author's calculation

### Aggregator Survey

Expected numbers of traders were based on the number of estimated farmers and the population in each province. Consequently, these expectations were meant to be general approximations of the actual numbers.

**Table 91: Sample of aggregators in selected locations.**

	Kampot		Siem Reap		Total	
	Expected	Actual	Expected	Actual	Expected	Actual
Nr of Observations	100	116	50	11	150	127

In Kampot the desired number of observations was surpassed. However, in Siem Reap, where there were few non-responses, there were very few traders located. In the end, only a few aggregators were included in the sample from Siem Reap.

### Aggregator Household Characteristics

Aggregators in Kampot were a slight majority male, 55 percent, to 45 percent female. Aggregators in Kampot had an average age of 42 years and had been trading for an average of 9.6 years. Respondents were slightly younger in Siem Reap but had slightly more experience.

**Table 92: Gender of traders.**

Gender	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Male	64	55.2	6	54.6	116	55.2
Female	52	44.8	5	45.5	110	44.8

**Table 93: Age of traders.**

	Kampot		Siem Reap		Total	
	Mean	SD	Mean	SD	Mean	SD
Average age	41.2	9.6	38.8	7.9	41.0	9.6

**Table 94: Years of experience of traders.**

Work experience	Kampot		Siem Reap		Total	
	Mean	SD	Mean	SD	Mean	SD
Years	7.8	4.4	10.1	9.5	8.4	6.6

### Poultry Income and Trade Patterns of Aggregator Households

Income among traders was relatively high. Likewise, the trading activities contributed more than 60 percent of cash income among respondents.

**Table 95: Aggregator monthly household income from poultry by location (percent)**

	Kampot		Siem Reap		Total	
	Mean	SD	Mean	SD	Mean	SD
Monthly income from poultry trade	950,000 Riels/month	1,020,000	--	--	950,000 Riels/month	1,020,000
Percent of total income	60.5 percent	23.9	--	--	60.5 percent	23.9

4,100 Riels ~1 USD

Respondents were most likely to trade chicken for meat or layer ducks. Interestingly, in Siem Reap nearly all respondents who traded chicken also traded layer ducks. However, in Kampot, the people trading layer ducks tended not to also be trading chicken for meat.

**Table 96: Number of people trading poultry products.**

	Kampot		Siem Reap		Total	
	Nr	Percent	Nr	Percent	Nr	Percent
Chicken Eggs (for consumption)	2	1.6	0	0	2	0.7
Chicks	5	4.3	0	0	5	4.0
Chickens for Meat	99	85.3	11	100	110	87.2
Duck Eggs (for consumption)	12	10.3	0	0	12	8.0
Duck Eggs (fertilized)	10	8.6	0	0	10	7.3
Ducklings	1	0.9	0	0	18	8.0
Male Ducks for Meat	7	6.0	0	0	15	6.6
Active Layer Ducks for Egg Production	6	5.2	9	81.8	10	4.4
Spent Layer Ducks for Meat	4	3.5	9	81.8	38	16.8
Muscovy Ducks	18	15.5	0	0	18	8.0

Chicken trading volumes were higher in Kampot (per trader) but duck trading volumes were slightly higher in Siem Reap.



**Table 97: Average monthly trading volume by product**

Item	Kampot	Siem Reap	Total
Chicken Meat (head/month)	334	310	320
Chicken Eggs (eggs/month)	18,800	--	18,800
Duck Meat (head/month)	203	240	224
Duck Eggs (eggs/month)	11,500	--	11,500

Detailed pricing information was collected from aggregators on all poultry products. However, the prices provided by aggregators were very close to the prices stated by vendors. One possible explanation is that traders are overstating the prices they trade at. Another possibility would be that traders are price differentiating and may sell directly to end users at a higher price, thereby selling at a price similar to market vendors.

**Table 98: Average purchase price for poultry products in selected locations**

	Kampot		Siem Reap		Total	
	High Season	Low Season	High Season	Low Season	High Season	Low Season
Chickens for Meat [Riels/Kg]	14,700	12,600	--	--	14,700	12,600
Duck Eggs - unfertilized [Riels/Egg]	385	325	--	--	385	325
Duck Eggs - fertilized [Riels/Egg]	390	330	--	--	390	330
Ducklings [Riels/Head]	800	600	--	--	800	600
Male Ducks for Meat [Riels/Kg]	8,900	7,600	--	--	8,900	7,600
Spent Layer Ducks for Meat [Riels/Kg]	8,400	7,500	--	--	8,400	7,500
Muscovy Ducks [Riels/Kg]	9,300	7,400	--	--	9,300	7,400

**Table 99: Average sale price for poultry products in selected locations**

	Kampot		Siem Reap		Total	
	High Season	Low Season	High Season	Low Season	High Season	Low Season
Chickens for Meat [Riels/Kg]	16,300	14,500	--	--	16,300	14,500
Duck Eggs - unfertilized [Riels/Egg]	410	370	--	--	410	370
Duck Eggs - fertilized [Riels/Egg]	470	410	--	--	470	410
Ducklings [Riels/Head]	5,400	5,300	--	--	5,400	5,300
Male Ducks for Meat [Riels/Kg]	10,300	8,800	--	--	10,300	8,800
Spent Layer Ducks for Meat [Riels/Kg]	11,300	10,000	--	--	11,300	10,000
Muscovy Ducks [Riels/Kg]	10,700	8.500	--	--	10,700	8.500

### **Operating Structure**

The following table summarized the operating structure of the average aggregator interviewed in this study. Aggregators were asked all operating costs as well as values and quantities of inputs and outputs in order that we might better understand how they operate.

In addition, Figure 20 displays the seasonality of poultry trading with monthly trading volumes plotted by product.

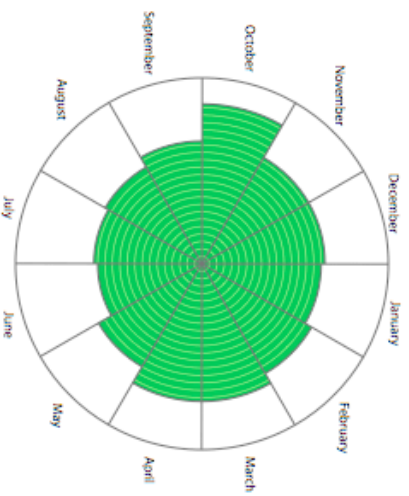
**Table 100: Chicken Meat Aggregator Cost Structure – Average Weekly Values in Kampot Province**

Average Inputs			Outputs				
Item	Quantity/week	Unit price	Total Cost	Item	Quantity/week	Unit price	Total Value
Chickens	140 kg/week*	13,640 Riels/kg	1,909,600 Riels/wk	Chickens	140 kg/week*	15,300 Riels/kg	2,142,000 Riels/week
	4.7 Liters/week	3,860 Riels/L	17,500 Riels/wk				
Poultry feed	4.2 kg/week	2,500 Riels/kg	8,400 Riels/wk				
Road Fees**	15 fees/week	1,000 Riels/fee	15,000 Riels/wk				
<b>Item</b>	<b>Quantity</b>	<b>Percent traders utilizing input</b>	<b>Approximate Cost***</b>	<b>Author's Calculation of Monthly Trader Profit</b>			
Bicycle	1	23	\$25	2,142,000 - (1,909,600+17,500+8,400) = 206,500 Riels/week			
Motorbike	1	70	\$550	206,500 Riels per week* 4.35 weeks per month~ 898,275 Riels/month			
Cars	1	3	\$2,750	898,275 Riels per month/4,100 Riels per dollar ~ 219.00 USD/month Average self-reported income from trading ~ 230.00 USD/month			

\* Assumes an average weight of 1.75 kg/bird  
 \*\* Road fees only apply to the 5-10Percent of traders who leave Kampot province traveling towards Phnom Penh on National Road 3, otherwise road fees=0  
 \*\*\* Author's own estimation based on inquiries, however, cost of transportation vehicle was not included in the questionnaires

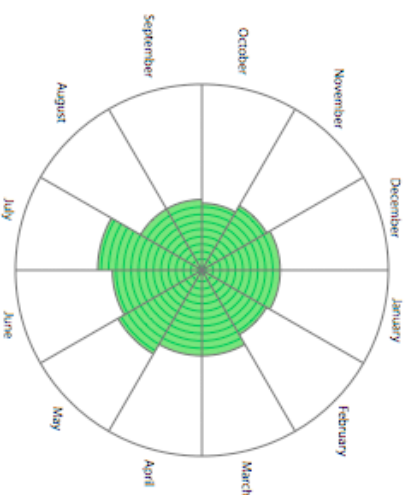
Figure 19: Seasonality of Trading (Average number of products traded by an aggregator in one month)

### 1. Chicken Meat

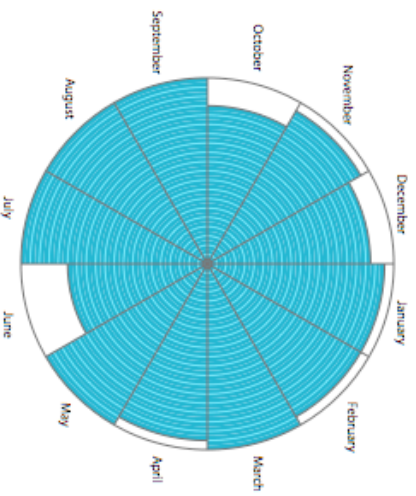


1 Radial Unit = 20 Birds

### 2. Duck Meat



### 3. Chicken Eggs



1 Radial Unit = 1,000 Eggs

### 4. Duck Eggs



### Market Vendor Survey

Enumerators visited wet markets inside the urban district of each province as well as several districts in Kampot. In Kampot, there is one large market that serves the majority of the center, and then several peripheral markets that serve local neighborhoods. In Siem Reap there are a few central markets and relatively large markets throughout the district.

**Table 101: Vendor sample by location.**

	Kampot (urban)		Kampot (semi-urban)		Siem Reap		Expected
	Expected	Actual	Expected	Actual	Expected	Actual	
Nr of Observations	50	13	100	135			

Our largest problem with non-response arose in Kampot urban markets. While there were approximately 30 vendors that served the central market, only 13 vendors agreed to participate in the survey. It is unclear why the reaction was different in other markets. One explanation is that enumerators in Kampot's urban district were not persuasive enough. Non-respondents were offered compensation for participating in the survey.

In all locations the majority of vendors were women. The age distribution was similar to other market chain actors with a majority of respondents falling between the ages of 30 and 45. A limited number of respondents in Kampot were, on average, slightly older, but this was likely a result of response bias rather than a trend (i.e., elder vendors may be more likely to participate in the survey).

### Vendor Household Characteristics

**Table 102: Gender of respondents by location.**

Gender	Kampot (urban)		Kampot (semi-urban)		Siem Reap		Freq.
	Freq.	Percent	Freq.	Percent	Freq.	Percent	
Male	3	21.4	16	11.9	6	13.7	25
Female	11	78.6	118	88.1	38	86.4	169

**Table 103: Age of respondents by location.**

Age class	Kampot (urban)		Kampot (semi-urban)		Siem Reap		Freq.
	Freq.	Percent	Freq.	Percent	Freq.	Percent	
<30	1	7.1	11	8.3	15	34.9	27
30-45	5	35.5	88	66.7	19	38.8	112
46-60	7	49.7	31	23.5	7	14.2	45
>60	1	7.1	2	1.5	2	4.1	5

**Table 104: Years of experience as market vendor.**

	Kampot (urban)		Kampot (semi-urban)		Siem Reap		Total	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Work experience Years	8.9	5.9	5.9	4.5	6.5	8.0	6.3	5.6

Vendors tended to have slightly less experience than other market actors with between 5 and 10 years experience selling poultry. Many vendors reported selling other products prior to their entrance into the poultry market chain.

**Table 105: Type of market space in selected locations.**

Market space	Kampot (urban)		Kampot (semi-urban)		Siem Reap		Total	
	Freq.	Perc	Freq.	Perc	Freq.	Perc	Freq.	Perc
Temporary (daily rental)	7	53.9	107	79.9	15	34.1	129	66.5
Temporary (monthly rental)	5	35.5	15	11.1	18	40.9	38	19.6
Permanent	1	7.7	12	9.0	9	20.5	22	11.3

In most instances, vendors have the option of paying daily rent, monthly rent, or purchasing their own market spaces. Respondents in Kampot were more likely to have daily rental spaces while respondents in Siem Reap were more likely to have monthly rental spaces.

**Table 106: Types of poultry products sold (percent of vendors).**

Breed	Kampot (urban)		Kampot (semi-urban)		Siem Reap		Total	
	Freq	Perc	Freq	Perc	Freq	Perc	Freq	Perc
Chicken meat	14	100	81	60.5	19	43.2	114	58.8
Chicken eggs	0	0	12	9.0	20	45.5	32	16.5
Duck meat	8	42.9	39	29.1	2	4.6	47	24.2
Duck eggs	0	0	72	53.7	24	54.6	98	50.5

Duck eggs were the most commonly sold product in both Siem Reap and the semi-urban area in Kampot. This coincides with our findings in the consumer survey that duck eggs are the most commonly purchased poultry products. The prices for poultry products were higher in Siem Reap than in Kampot for all poultry products except chicken eggs. This finding also coincides with observations from different market actors.

**Table 107: Average market vendor sale price in selected locations.**

	Kampot		Siem Reap		Total	
	High Season	Low Season	High Season	Low Season	High Season	Low Season
Chicken Meat (Riels/kg)	15,400	12,300	16,100	13,200	15,700	12,600
Chicken Eggs (Riels/egg)	410	410	380	390	410	410
Duck Meat (Riels/kg)	12,100	8,300	12,500	10,000	10,300	8,600
Duck Eggs (Riels/egg)	420	410	460	430	480	410

The average price of chicken meat in the market was found to be approximately \$4.00 per kilogram during the high season and \$3.20 per kilogram during the low season. Duck meat is significantly cheaper at \$2.50/kilogram during the high season and only \$2.15 per kilogram during the low season.

**Table 108: Average daily trading volume of poultry products in selected location.**

Breed	Kampot (urban)		Kampot (semi-urban)		Siem Reap		Total	
	High Season	Low Season	High Season	Low Season	High Season	Low Season	High Season	Low Season
Chicken meat (kg/day)	22.9	16.8	32.7	23.7	65.9	64.3	37.5	28.2
Chicken eggs (eggs/day)	--	--	25	13	260	160	200	50
Duck meat (kg/day)	12.8	8.8	20.3	14.3	40.0	20.0	20.4	13.9
Duck eggs (eggs/day)	--	--	208	160	840	560	360	190

Daily trading volumes varied greatly across vendors. On average vendors reported selling more than 35 kg of chicken meat per day, more than 20 kg of duck meat, and a few hundred eggs (though, as noted above, not all vendors sell all products). Vendors were most likely to have agreements with traders who delivered birds to their home, with 35 percent of respondents reporting a verbal arrangement for this type of purchase.

**Table 109: Pre-purchase contractual agreements by source and location.**

Source	Kampot (urban)			Kampot (urban)			Kampot (semi-urban)		
	None	Verbal	Formal	None	Verbal	Formal	None	Verbal	Formal
Trader – market delivered	70.0	30.0	0	37.3	62.7	0	9.6	6.4	0
Trader – home delivered	100	0	0	27.7	72.3	0	65.0	35.0	0
Farmer	83.3	16.7	0	86.2	17.8	0	88.9	11.1	0
Market vendor	50.0	50.0	0	43.4	56.6	0	94.0	6.0	0

## 6. Policy Recommendations

The following policy recommendations follow from the findings of our survey.

- Most smallscale chicken and duck producers have not adopted biosecurity measures on their farms. In addition, most farmers invest minimal resources into production and expect high mortality rates. Average survey participants spent less than 20 minutes per day attending to chickens and only sometimes provided additional feed to supplement scavenging. For these reasons, poultry production is seen as an ancillary activity that does not warrant additional investments. In addition, farmers believe HPAI poses little risk to their own flocks. On a scale of 0 to 3, respondents ranked HPAI risk to their flocks and to their families close to 1. Risks from other livestock diseases were ranked significantly higher. Consequently, while significant resources have been invested into HPAI public awareness campaigns, farmers are unlikely to adopt biosecurity measures to combat HPAI in the future. Policies that address other livestock diseases, such as Newcastle disease, in coordination with HPAI are more likely to be adopted. Nonetheless, measures that require additional investments from farmers, whether it be in the form of time or other resources, are unlikely to be adopted unless there are additional incentives provided to do so.
- Despite its low standing in the household economic hierarchy, poultry production serves an important role in rural livelihoods. Every survey respondent used poultry production to supplement household diets. More than half of all respondents received cash income from the sale of birds. Moreover, women were often in control of the income from poultry sales and tended to put the money towards essential consumption goods, school fees, and to save for use in emergencies. Consequently, policies seeking to combat HPAI should not hinder the production and sale of bird by smallholders. Moreover, as Cambodia continues to urbanize, poultry production could potentially be used as a tool for rural poverty alleviation.
- Poultry marketing is based largely on trading relationships with friends and acquaintances. More than half of respondents in Siem Reap reported trading with people whom they interacted with regularly outside of the poultry trade. Therefore, any policies that seek to



regulate poultry trade need to take into account the importance of pre-existing relationships. Moreover, attempts to create alternative trading networks, in order to improve regulation, would need to incorporate existing relationships in order to prevent a breakdown of the system.

- The most common form of Duck production encountered in our surveys was largescale duck egg production. The number of duck hatcheries is very few (it requires specializes skills to identify the sex of ducklings) and most producers source eggs from the same suppliers. Consequently, the duck product supply chain may be vulnerable to disease outbreaks. Moreover, hatcheries in Kampot province reported significant, albeit illegal, sourcing of duck eggs from Vietnam. This practice proposes a potential introduction of livestock disease. However, duck production is a primary economic activity for producers, so they invest significant resources in biosecurity measure in order to protect their flock. Most duck producers seek advice from private veterinarians, however, any outreach programs seeking to promote safe poultry production practices should consider including largescale duck producers.
- Duck eggs are the most commonly consumed poultry products, however, urban households tend to purchase chicken meat every wee. Moreover, consumers are knowledgeable about the products they buy. Safety is judged by appearance, either of the live bird or of the meat, however, consumers place a high value on safety. Most respondents felt that the safety of the chicken meat they buy could be improved, and the vast majority said that they were interested in paying a premium for a proposed “safety guaranteed chicken”. These findings are in line with similar findings in Vietnam and Thailand, suggesting that households value safety over price. Consequently, there is potential for farmers to market “safe chicken” at a higher price if consumers believe the safety guarantee. The potential for demand side approaches to improving production techniques, and rural livelihoods, should be further investigated.

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## 8. Annex: Summary Statistics

### Annex 1: Household / Consumer Survey

**Table A1.1. Gender of survey respondents.**

Gender	Kampot (urban)		Kampot (semi-urban)		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent
Male	27	7.9	13	8.8	58	11.6	98	9.9
Female	316	92.1	135	91.2	443	88.4	894	90.1

**Table A1.2. Age of survey respondents.**

Age class	Kampot (urban)		Kampot (semi-urban)		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent
<30	41	11.9	15	10.0	136	27.1	192	19.3
30-45	165	48.0	89	59.7	227	45.2	481	48.3
46-60	124	36.0	42	28.2	121	24.1	287	28.8
>60	14	4.1	3	2.1	18	3.6	35	3.6

**Table A1.3. Household sizes in selected locations.**

Household size	Kampot (urban)		Kampot (semi-urban)		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent
1	1	0.3	0	0	3	0.6	4	0.4
2	11	3.2	4	2.8	23	4.6	38	3.8
3	31	9.0	9	6.1	52	10.4	92	9.3
4	61	17.7	23	15.5	102	20.4	186	18.8
5	56	16.3	40	27.0	95	19.0	191	19.3
6	61	17.7	41	27.7	59	11.8	161	16.3
7	49	14.2	22	14.9	64	12.8	135	13.6
8	28	8.1	5	3.4	36	7.2	69	7.0
>8	46	13.5	4	2.8	65	13.2	115	11.5
Mean	6.0		5.5		5.8		5.8	

**Table A1.4. Self reported literacy of survey respondents.**

Gender	Kampot (urban)		Kampot (semi-urban)		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent
Literate	297	86.3	147	98.7	413	83.6	857	86.8
Illiterate	47	13.7	2	1.3	81	16.4	130	13.2

**Table A1.5. Household Socio-Economic Ranking in selected locations.**

Monthly income	Kampot (urban)		Kampot (semi-urban)		Siem Reap		Total*	
	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent
Poorest	13	3.8	1	0.6	20	4.0	23	3.7
Poor	149	43.3	5	3.4	147	29.3	218	35.2
Middle	166	48.3	118	80.3	281	56.1	324	52.3
Better-off	16	4.7	23	15.7	53	10.6	54	8.7

**Table A1.6. Frequency of market visits in selected locations.**

Frequency of visit	Kampot (urban)		Kampot (semi-urban)		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent
< 1 time / day	2	0.6	9	6.0	54	10.8	65	6.6
1 time / day	246	71.9	135	92.0	403	80.4	786	79.2
> 1 time / day	94	27.5	3	2.0	44	8.8	141	14.2

**Table A1.7. Frequency of poultry purchases (percent respondents).**

Item	Kampot (urban)					Kampot (semi-urban)					Siem Reap					Total				
	Daily	Weekly	Monthly	Spec. Occ.	Never	Daily	Weekly	Monthly	Spec. Occ.	Never	Daily	Weekly	Monthly	Spec. Occ.	Never	Daily	Weekly	Monthly	Spec. Occ.	Never
Chicken Meat	1	34	50	15	0	1	86	7	6	0	5	38	45	11	1	3	44	41	12	1
Chicken Eggs	7	29	7	1	55	11	2	52	1	34	1	10	29	11	49	1	20	34	12	33
Duck meat	1	16	51	13	19	1	60	16	11	12	11	25	10	4	50	10	23	15	3	49
Duck Eggs	20	59	12	7	2	85	11	3	1	0	27	61	7	1	3	33	53	8	3	3

**Table A1.8. Household poultry consumption.**

poultry consumed	Kampot (urban)		Kampot (semi-urban)		Siem Reap		Total	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Chicken Meat (kg/visit)	1.3	0.5	1.4	0.5	1.0	0.5	1.2	0.5
Chicken Eggs (eggs/visit)	10	3.1	6	2.3	7	3.4	8	3.5
Duck meat (kg/visit)	1.1	0.4	1.0	0.4	1.1	0.5	1.1	0.4
Duck Eggs (eggs/visit)	12	5.5	12	5.4	9	5.6	10	5.7

**Table A1.9. Household poultry expenditure (1000 Riels/week).**

poultry consumed	Kampot (urban)		Kampot (semi-urban)		Siem Reap		Total	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Eating Out	29.6	28.6	25.1	23.9	53.7	35.8	38.9	33.5
Eating In	105.8	48.8	94.8	30.1	110.5	63.6	110.9	78.0
All meats	80.4	48.0	73.7	58.0	67.7	68.4	74.7	72.4
Chicken Meat	21.7	11.9	23.8	8.8	18.9	21.4	20.8	16.6
Chicken Eggs	6.4	4.3	3.1	1.3	4.7	5.2	4.9	4.5
Duck meat	11.9	4.6	13.3	5.5	12.8	15.4	12.5	9.4
Duck Eggs	6.6	3.5	6.1	2.4	5.7	4.8	6.1	4.1

**Table A1.10. Form of poultry purchased (percent) in selected locations.**

	Kampot (urban)			Kampot (semi-urban)			Siem Reap			Total		
	Live	Slaughter in market	Slaughter	Live	Slaughter in market	Slaughter	Live	Slaughter in market	Slaughter	Live	Slaughter in market	Slaughter
Percent of birds purchased	47.2	39.9	12.9	62.5	6.1	31.4	13.7	4.5	81.8	32.7	17.0	50.3

\* Slaughtered in market = birds are selected live then slaughtered and prepared by vendor

**Table A1.11. Distance to market where poultry products are purchased (km)**

	Kampot (urban)		Kampot (semi-urban)		Siem Reap		Total	
	Mean	sd	Mean	sd	Mean	sd	Mean	sd
Km from home to market	2.5	1.6	1.0	0.7	1.4	1.7	1.7	1.6

**Table A1.12. Average price of poultry by breed and form purchased (Riels/kg; Riels/egg).**

Reason	Kampot (urban)		Kampot (semi-urban)		Siem Reap		Total	
	High Season	Low Season	High Season	Low Season	High Season	Low Season	High Season	Low Season
Chicken Meat	15,800	13,800	14,200	12,200	15,700	13,900	15,500	13,500
Chicken Eggs	520	440	500	410	440	380	500	430
Duck Meat	10,300	8,600	9,600	7,800	8,700	7,600	9,900	8,200
Duck Eggs	530	460	450	340	520	450	520	440

**Table A1.13. Concerns about attributes of poultry meat (Ranking 1 to 5).**

Reason	Kampot (urban)	Kampot (semi-urban)	Siem Reap	Total
Price	2.8	4.0	3.1	3.2
Taste	2.6	3.7	2.2	2.6
Safety	3.7	4.4	3.4	3.7
Convenience	1.5	1.3	1.5	1.5
Relationship with seller	1.4	2.5	1.6	1.7

**Table A1.14. Methods for determining quality of chicken and duck meat (percent respondents).**

Reason	Kampot (urban)		Kampot (semi-urban)		Siem Reap		Total	
	Freq	Perc	Freq	Perc	Freq	Perc	Freq	Perc
Live appearance	272	79.1	113	75.8	89	17.7	474	47.6
Meat appearance	26	7.6	49	32.9	392	78.1	467	46.9
Relationship with seller	168	48.8	21	14.1	94	18.7	283	28.4
Knowledge of source	75	21.8	7	4.7	12	2.4	94	9.5
Do not think about safety	7	2.0	1	0.7	1	0.2	9	0.9
Other	1	0.3	2	1.3	10	2.0	13	1.3

**Table A1.15. Reason for safety concern (Ranking 1 to 5).**

Reason	Kampot (urban)	Kampot (semi-urban)	Siem Reap	Total
Unsanitary market conditions	3.1	3.1	3.0	3.0
Poultry comes from unknown source	2.6	3.0	3.0	3.0
Disease Risk	4.1	4.8	4.1	4.2
Freshness	2.1	3.5	2.9	2.7

**Table A1.16. How respondents have changed their behavior because of HPAI.**

Reason	Kampot (urban)		Kampot (semi-urban)		Siem Reap		Total	
	Freq	Perc	Freq	Perc	Freq	Perc	Freq	Perc
No change	28	8.1	15	10.1	51	10.2	94	9.5
Purchase less poultry products	237	68.9	32	21.5	220	43.8	489	49.2
More careful about which products to buy	284	82.6	102	68.5	239	47.6	625	62.8
Other	1	0.3	0	0	119	23.7	120	12.1

**Table A1.17. Respondents knowledge of poultry origin.**

Knowledge of source	Kampot (urban)		Kampot (semi-urban)		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent
Farm	78	22.9	49	32.9	73	14.7	200	20.2
Village	60	17.6	90	60.4	47	9.4	197	19.9
District	23	6.7	3	2.0	33	6.6	59	6.0
No knowledge	180	52.8	7	4.7	345	69.3	532	53.8



**Table A1.18. Certification programme interest expressed by respondents.**

	Kampot (urban)		Kampot (semi-urban)		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent
Interested in buying certified poultry	249	73.7	149	100	450	90.0	848	85.9

**Table A1.19. Could safety of poultry products be improved?**

	Kampot (urban)		Kampot (semi-urban)		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent
Responding Yes	273	80.3	144	96.6	314	63.8	731	74.5

**Table A1.20. Why people don't want to pay for safety certified chickens.**

Reason	Kampot (urban)		Kampot (semi-urban)		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent
Do not want to pay extra for a system like this	6	6.7	NA	NA	3	6.3	9	7.4
Worried system inspections will be unreliable	34	38.2	NA	NA	10	31.3	44	36.4
Not enough information about the programme	59	66.3	NA	NA	15	46.9	74	61.2
Satisfied with the level of safety of chicken purchased	23	25.8	NA	NA	10	31.3	33	27.3
Observations	89		0		32		121	

## Annex 2: Farmer Survey

Table A2. 1: Gender of survey respondents.

Gender	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Male	170	33.7	136	36.0	309	34.9
Female	335	66.3	242	64.0	576	65.1

Table A2. 2: Age of survey respondents.

Age class	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
<30	57	10.9	98	28.4	155	17.2
30-45	250	47.8	159	39.8	409	45.4
46-60	150	28.7	106	28.1	256	28.4
>60	66	12.6	15	3.7	81	9.0

Table A2. 3: Farming household sizes in selected locations.

Household size	Kampot		Siem Reap		Total	
	Mean	SD	Mean	SD	Mean	SD
Nr. of people	5.1	1.7	5.8	2.2	5.4	2.0

Table A2. 4: Other household Economic Activities.

Age Range in Years	Kampot		Siem Reap		Total	
	Nr	Percent	Nr	Percent	Nr	Percent
Rice Production	493	94.3	228	60.3	721	80.0
Vegetables	156	38.6	268	70.9	424	47.1
Fruits and Nuts	57	10.9	113	29.9	170	18.9
Raise Livestock (other than poultry)	468	89.5	254	67.2	722	80.1
Off-Farm Employment	103	19.7	38	10.1	141	15.7

Table A2. 5: Seasonality of household crop production.

Age class	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Wet Season (only)	298	57.2	166	51.7	464	55.1
Dry Season (only)	71	13.6	19	5.9	90	10.7
Both	96	18.4	115	35.9	211	25.1
Do not raise crops	56	10.8	21	6.5	77	9.1

**Table A2. 6: Average size of rice crop (hectares).**

Hectares of rice	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
<0.1	1	0.2	54	16.0	55	6.5
0.1-1	286	56.3	76	22.5	362	42.7
1.1-2	148	29.1	169	50.0	317	37.4
2.1-5	39	7.7	24	7.1	63	7.4
5.1-10	7	1.4	1	0.3	8	9.4
10.1-100	27	5.3	8	2.4	35	4.1
100.1-200	0	0	6	1.8	6	0.7

**Table A2. 7: Duck grazing activities in households' rice fields in 2008.**

Age class	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Own ducks grazed in rice field	120	22.9	144	38.1	309	34.3
Other peoples ducks grazed in rice field	200	46.7	11	2.9	264	29.3
No ducks grazed in rice field	156	33.7	153	40.5	355	28.3

**Table A2. 8: Years of poultry raising experience.**

Work experience	Kampot		Siem Reap		Total	
	Mean	SD	Mean	SD	Mean	SD
Chickens	12.0	11.0	9.3	7.1	10.9	9.7
Ducks	11.3	10.5	5.8	7.2	9.2	9.7

**Table A2. 9: Financing of poultry production by location.**

Source of finance	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Family loan	199	38.1	201	53.2	400	44.4
Ancillary Income	153	29.4	154	40.7	308	34.2
Personal savings	430	82.2	211	55.8	641	71.1
Informal loan	8	1.5	4	1.1	12	1.3
Other	4	0.8	8	2.1	12	1.3

**Table A2. 10: Motivation for raising poultry.**

Barrier	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Sell only	0	0	0	0	0	0
Consume only	99	19.5	169	47.7	268	31.0
Sell and consume	403	79.0	184	52.0	587	67.9
Raise for consumption, but may also sell some <sup>1</sup>	9	1.8	1	0.3	10	1.2

**Table A2. 11: Barriers to expanding poultry production.**

Barrier	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Space	244	46.7	123	32.5	367	40.7
Feed availability	42	8.0	23	6.1	65	7.2
Feed cost	114	21.8	2	0.5	116	12.9
Time	92	17.6	25	6.6	117	13.0
Water availability	75	14.3	1	0.3	76	8.4
Other	90	17.2	178	47.1	268	29.7

**Table A2. 12: Are birds kept in an enclosure?**

	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Yes, always	12	2.4	113	32.8	174	20.5
Yes, only at night	385	76.5	164	47.5	125	14.7
No, never	106	21.2	68	19.7	549	64.7

**Table A2. 13: Materials used to build enclosure.**

Material	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Bamboo	284	68.1	237	76.5	521	71.7
Other woods	319	76.5	75	24.2	394	54.2
Chicken wire	119	28.5	10	3.2	129	17.7
Net	37	8.9	21	6.8	58	8.0
Other	27	6.5	51	16.5	78	10.7

**Table A2. 14: Number of farmers buying chicks and ducklings.**

		Kampot		Siem Reap		Total	
Chickens	Source chicks on farm	77.3		51.4			
	Purchase chicks	5.0		23.2			
		4.7		7.2		5.7	
		8.4		1.0		5.3	
	Other	4.6		17.2		9.9	
Ducks	Source some ducklings on farm	27.3		2.0		16.6	
	Purchase some ducklings	9.0		41.2		22.6	
		7.6		11.3		9.1	
		23.8		21.6		22.7	
		33.2		23.9		29.0	

**Table A2. 15: Use of cash income from poultry production.**

Barrier	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Save for emergency	113	21.6	59	15.6	172	19.1
School fees	111	21.2	81	21.4	192	21.3
Essential consumption (food, clothing, shelter)	335	64.1	160	42.3	495	55.0
Non-essential consumption	19	3.7	3	0.8	22	2.4
Invest in other economic activities	13	2.5	11	2.9	24	2.7
Other	19	3.7	55	14.6	76	8.4
Don't know	7	1.3	0	0	14	1.6

**Table A2. 16: Food provided to chickens in selected locations.**

Feed type	Kampot				Siem Reap				Total			
	chicken		duck		chicken		duck		chicken		duck	
	Freq	Per	Freq	Per	Freq	Per	Freq	Per	Freq	Per	Freq	Per
Paddy rice	509	97.7	93	93.9	302	79.9	57	77.0	813	90.2	152	86.9
Rice bran	132	25.3	50	50.5	38	10.1	27	36.5	173	19.2	79	45.1
Broken rice	436	83.7	78	78.8	251	66.4	34	46.0	689	76.5	113	64.6
White rice	142	27.3	23	23.2	97	25.7	8	10.8	239	26.5	31	17.7
Human food scraps	93	17.9	30	30.3	281	74.3	52	70.3	375	41.6	83	47.4
Insects and worms	285	54.7	49	49.5	174	46.0	27	36.5	461	51.2	78	44.6
Grass and leaves	277	53.2	39	38.4	188	49.7	23	31.1	465	51.6	63	36.0
Commercial feed	85	16.3	1	1.0	18	4.8	7	9.5	103	11.4	8	4.6
Other	6	1.2	0	0	10	2.7	9	12.2	26	3.0	9	5.1
Observations	519		99		378		74		897		175	

**Table A2. 17: Source of water provided to poultry in selected locations.**

Feed type	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Crops run-off	216	41.5	237	62.7	453	50.3
Well	384	73.7	301	79.6	684	76.0
Pond	116	22.3	88	23.3	207	23.0
River or stream	25	4.8	58	15.3	83	9.2
Other	8	1.5	2	0.5	10	1.1

**Table A2. 18: Source of pharmaceuticals and veterinary services.**

	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
VAHW	179	34.4	32	8.5	212	25.5
State Vet	21	4.0	3	0.8	24	2.7
Private vet	74	14.2	17	4.5	91	10.1
Friend/relative	15	2.9	1	0.3	16	1.8
Pharmacy	60	11.5	38	10.1	98	10.9
Do not use any	217	41.7	237	62.7	455	50.5

**Table A2. 19: Labor division for participating in poultry keeping.**

Group	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Men	322	61.6	270	71.5	592	65.7
Women	394	75.4	157	68.2	651	72.3
Children	224	42.7	165	43.6	389	43.2
Employees (non-family)	7	1.4	5	0.3	12	0.8

**Table A2. 20: Average time devoted to poultry keeping.**

	Kampot		Siem Reap		Total	
	Mean	SD	Mean	SD	Mean	SD
Minutes per day	17.4	16.4	12.5	9.3	15.7	14.2

**Table A2. 21: Poultry product farm-gate price by location (Riels/kg; Riels/egg).**

Price	Kampot		Siem Reap		Total	
	High season	Low season	High season	Low season	High season	Low season
Live chicken	13,600	11,100	11,600	9,700	13,000	10,700
Slaughtered chicken	14,500	11,900	15,400	12,200	14,600	11,900
Chicken eggs	360	250	250	230	360	250
Live ducks	9,700	7,800	14,700	13,000	11,400	9,500
Slaughtered ducks	11,800	10,200	--	--	11,800	10,100
Duck eggs	490	340	420	370	480	350

**Table A2. 22: Buyers of poultry products from farmers.**

Agreement	Kampot	Siem Reap	Total
Aggregator	50.0	45.8	48.6
Vendor	30.7	39.0	33.4
End-user	15.2	13.4	14.9
Food vendor	1.7	1.1	1.5
Other	2.4	0.3	1.0

**Table A2. 23: Location of transaction.**

Agreement	Kampot	Siem Reap	Total
Farm gate	45.2	15.0	35.7
Side of the road	21.6	11.0	18.2
At the market	29.1	38.2	32.0
Other in village	2.1	10.0	8.2
Other	1.0	26.0	13.5

**Table A2. 24: Buyer-seller relationships (percent).**

Buyer	Kampot			Siem Reap			Total		
	None	Verbal	Formal	None	Verbal	Formal	None	Verbal	Formal
Aggregator	84.9	15.1	0	79.8	14.0	6.1	83.3	15.0	1.7
Vendors	71.6	28.4	0	83.3	12.8	3.9	75.2	23.6	1.2
End users	71.1	28.9	0	85.3	14.8	0	74.5	25.5	0
Food vendor	60.0	40.0	0	77.8	22.2	0	62.5	37.5	0
Other	92.9	7.1	0	92.3	7.7	0	92.7	7.3	0

**Table A2. 25: Items covered by verbal agreements (In percentages).**

Agreement	Kampot	Siem Reap	Total
Price	34.2	14.6	25.9
Quantity	29.9	3.2	18.7
Time	33.0	0.8	19.4
Credit	23.6	0	13.5
Other	22.5	14.5	14.8

**Table A2. 26: Nature of buyer-seller relationships prior to transaction.**

Buyer	Kampot			Siem Reap			Total		
	Business	Personal	None	Business	Personal	None	Business	Personal	None
Aggregator	79.9	6.0	14.1	55.5	32.1	12.4	71.8	20.0	8.3
Vendors	50.4	4.8	44.8	46.6	49.1	4.3	49.2	46.2	4.6
End users	39.4	11.8	48.8	44.6	28.4	27.0	40.7	43.2	16.2
Food vendor	46.0	4.8	49.2	53.3	20.0	26.7	47.4	43.6	9.0
Other	35.3	17.7	47.1	60.0	26.7	13.3	45.5	39.4	15.2

**Table A2. 27: Importance of factors in deciding whom to trade with (Average ranking, 0 to 5).**

Agreement	Kampot	Siem Reap	Total
Price	3.0	2.3	2.7
Quantity	1.8	1.2	1.5
Timing	1.8	1.1	1.5
Fairness	3.6	0.9	2.8
Relationship	2.7	1.7	2.0
Other	1.0	0.9	0.8

**Table A2. 28: Risk Perception (Average ranking, 0 to 3).**

Risk of:	Kampot	Siem Reap	Total
HPAI to birds	0.9	1.1	1.0
HPAI to family	0.8	0.9	0.8
Other disease to birds	1.2	1.2	1.2
Other disease to family	1.1	1.2	1.1

**Table A2. 29: Importance of factors in deciding whom to trade with (Average ranking, 0 to 5).**

	Kampot	Siem Reap	Total
Demand for poultry	1.1	1.0	1.0
Government culling your flock	0.9	0.6	0.8
Lack of capital to finance poultry raising	1.9	1.7	1.8
Predator will kill birds	1.5	1.0	1.2
Theft of birds	1.6	0.7	1.3



**Annex 3:****Largescale Chicken Producer Survey****Table A3.1: Gender of Producers.**

Gender	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Male	76	81.7	--	--	76	81.7
Female	17	18.3	--	--	17	18.3

**Table A3.2: Age of Producers.**

Age Range in Years	Kampot		Siem Reap		Total	
	Nr	Percent	Nr	Percent	Nr	Percent
20-29	2	2.2	--	--	2	2.2
31-39	28	30.1	--	--	28	30.1
40-49	45	48.3	--	--	45	48.3
50-59	16	17.2	--	--	16	17.2
60-69	2	2.2	--	--	2	2.2

**Table A3.3: Years of experience of Producers.**

Work experience	Kampot		Siem Reap		Total	
	Mean	SD	Mean	SD	Mean	SD
Years	3.6	2.6	--	--	3.6	2.6

**Table A3.4: Other Economic Activities Undertaken by Producers**

Age Range in Years	Kampot		Siem Reap		Total	
	Nr	Percent	Nr	Percent	Nr	Percent
Rice Production	91	97.9	--	--	91	97.9
Fruit, Vegetable, Nut Production	46	49.5	--	--	46	49.5
Other Crop Production	8	8.6	--	--	8	8.6
Livestock Activities (other than trading)	83	89.3	--	--	83	89.3
Off-Farm Employment	31	33.3	--	--	31	33.3

**Table A3.5: Years of experience of Producers (Thousands of Riels, Percent).**

Work experience	Kampot		Siem Reap		Total	
	Mean	SD	Mean	SD	Mean	SD
Total Income (2008)	4,220	2,240	--	--	4,220	2,240
Income from Poultry (2008)	2,750	3,000	--	--	2,750	3,000
Percent Income from Poultry (2008)	54.3	17.4	--	--	54.3	17.4

**Table A3.6: People attending to chicken.**

Gender	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Men	90	96.8	--	--	90	96.8
Women	77	82.8	--	--	77	82.8
Children	75	80.6	--	--	75	80.6
Employees (non-family)	13	14.0	--	--	13	14.0

**Table A3.7: Time spent attending to chickens per day.**

Time Range	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
< 1 hour	49	52.7	--	--	49	52.7
1-2 hours	24	25.8	--	--	24	25.8
>2 hours	20	21.5	--	--	20	21.5

**Table A3.8: Barriers to production expansion.**

Source of finance	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Space	67	72.0	--	--	67	72.0
Feed cost	80	86.0	--	--	80	86.0
Time	6	6.5	--	--	6	6.5
Feed availability	0	0	--	--	0	0
Water availability	0	0	--	--	0	0
Other	12	12.9	--	--	12	12.9

**Table A3.9: Financing of poultry production by location.**

Source of finance	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Formal bank loan	0	0	--	--	0	0
Family loan	15	16.1	--	--	15	16.1
Informal Loan	0	0	--	--	0	0
Microfinance/NGO Loan	0	0	--	--	0	0
Ancillary Income	45	48.4	--	--	45	48.4
Personal savings	90	96.8	--	--	90	96.8
Other	0	0	--	--	0	0

**Table A3.10: Breeds of chickens raised by location. (Percent producers)**

Breeds	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Indigenous	88	94.6	--	--	88	94.6
Crossbred	30	32.3	--	--	30	32.3
Broilers	60	64.6	--	--	60	64.6
Layers	92	98.9	--	--	92	98.9
Ducks	25	26.9	--	--	25	26.9

**Table A3.11: Average number of chickens raised by breed and location. (Head)**

Breeds	Kampot		Siem Reap		Total	
	Ave	SD	Ave	SD	Ave	SD
Indigenous	139	220	--	--	139	220
Crossbred	12	7	--	--	12	7
Broilers	62	46	--	--	62	46
Layers	23	16	--	--	23	16
Ducks	9	7	--	--	9	7

**Table A3.12: Buyers of chicken from farmers.**

Buyer	Kampot		Siem Reap		Total	
	Ave	SD	Ave	SD	Ave	SD
Aggregator	63.2	20.8	--	--	63.2	20.8
Market vendor	12.3	11.1	--	--	12.3	11.1
End user	13.9	13.6	--	--	13.9	13.6
Food vendors	9.7	14.5	--	--	9.7	14.5

**Table A3.13: What to do with disease birds**

Buyer	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Sell	2	2.2	--	--	2	2.2
Consume	13.	14.0	--	--	13.	14.0
Destroy	79	85.0	--	--	79	85.0
Give away	2	2.2	--	--	2	2.2
Other	2	2.2	--	--	2	2.2

**Table A3.14: Waste Generated (Kg;Liters)**

Waste Item	Kampot		Siem Reap		Total	
	Ave	SD	Ave	SD	Ave	SD
Manure	71.1	62.8	--	--	71.1	62.8
Animal Waste	43.3	50.1	--	--	43.3	50.1
Waste Water	65.5	180.8	--	--	65.5	180.8

**Table A3.15: Where Manure goes**

Buyer	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Fertilizing Vegetables	74	79.6	--	--	74	79.6
Fertilizing other crops	73	78.5	--	--	73	78.5
Sell	35	37.6	--	--	35	37.6
Feed other animals	35	37.6	--	--	35	37.6
Destroy	0	0	--	--	0	0
Discard	0	0	--	--	0	0
Other	1	1.1	--	--	1	1.1

**Table A3.16: Where Animal Waste goes**

Buyer	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Feed other animals	5	5.4	--	--	5	5.4
Destroy	43	46.2	--	--	43	46.2
Discard	1	1.1	--	--	1	1.1
Recycle	21	22.6	--	--	21	22.6
Other	0	0	--	--	0	0

**Table A3.17: Where Waste Water goes**

Buyer	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Discard	43	46.2	--	--	43	46.2
Recycle	5	5.4	--	--	5	5.4
Other	0	0	--	--	0	0

## Annex 4: Largescale Duck Producer Survey

Table A4.1. Gender of Producers.

Gender	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Male	122	62.4	30	52.6	152	60.3
Female	73	37.6	27	47.4	100	39.7

Table A4.2. Age of Producers.

Age Range in Years	Kampot		Siem Reap		Total	
	Nr	Percent	Nr	Percent	Nr	Percent
20-29	10	5.5	13	24.0	23	9.7
31-39	60	32.8	12	22.2	72	30.4
40-49	83	45.4	21	38.9	104	43.9
50-59	26	14.2	7	13.0	33	13.9
60-69	4	2.1	1	1.9	5	2.1

Table A4.3. Years of experience of Producers (Thousands of Riels, Percent).

Work experience	Kampot		Siem Reap		Total	
	Nr	Percent	Nr	Percent	Nr	Percent
< 5 years	156	75.8	26	39.4	182	67.7
5-10 years	39	19.2	31	47.0	70	26.0
> 10 years	8	4.0	9	13.6	17	6.3
Mean	3.7		7.3		4.5	

Table A4.4. Other Economic Activities Undertaken by Producers.

Crop Type	Kampot		Siem Reap		Total	
	Nr	Percent	Nr	Percent	Nr	Percent
Rice Production	192	88.5	23	40.4	215	85.3
Fruit, Vegetable, Nut Production	93	47.7	12	0.2	109	43.3
Livestock Activities (other than trading)	177	90.1	22	38.6	199	79.0
Off-Farm Employment	58	29.7	1	2.0	59	23.4

Table A4.5. Seasonality of Rice Production.

Season of Rice Production	Kampot		Siem Reap		Total	
	Nr	Percent	Nr	Percent	Nr	Percent
Rainy Season (only)	157	80.5	10	17.5	167	66.3
Dry Season (only)	0	0	6	10.5	6	2.4
Both Rainy and Dry season	36	18.5	8	14.0	44	17.5
Do not cultivate rice	2	1.0	33	57.9	35	13.9

**Table A4.6. Size of Rice Crop.**

Size	Kampot		Siem Reap		Total	
	Mean	SD	Mean	SD	Mean	SD
Hectares of Rice	1.6	1.1	1.2	1.0	1.5	1.1

**Table A4.7. Rice Production and Duck Grazing (Nr, Percent of Rice Cultivators)**

Crop Type	Kampot		Siem Reap		Total	
	Nr	Percent	Nr	Percent	Nr	Percent
Own ducks graze in rice field	123	63.1	0	0	123	57.2
Other peoples' ducks graze in rice field	143	73.3	1	4.3	144	66.9
No ducks graze in rice field	26	14.4	22	95.7	48	22.3

**Table A4.8. Income from Poultry in 2008 (1000 Riels).**

Work experience	Kampot		Siem Reap		Total	
	Mean	SD	Mean	SD	Mean	SD
Total Income (2008)	4,800	3,030	6,900	3,200	5,200	3,900
Income from Poultry (2008)	3,030	1,750	6,000	2,770	4,500	3,000
Percent Income from Poultry (2008)	62.7	15.8	87.2	18.9	68.1	19.4

**Table A4.9. People attending to ducks (at least one person in group)**

Group	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Men	190	97.4	49	87.5	239	95.2
Women	157	80.5	46	80.7	203	80.6
Children	156	80.0	38	54.4	187	74.2
Employees (non-family)	7	3.6	3	5.25	10	4.0

**Table A4.10. Work hours attending to ducks per day (all workers).**

	Kampot	Siem Reap	Total
Average hours per day	7.9	7.1	7.7

**Table A4.11. Barriers to production expansion.**

Source of finance	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Space	174	89.2	54	75.4	188	74.6
Feed Cost	117	60.0	24	42.1	141	56.0
Time	33	16.9	0	0	33	13.1
Water availability	3	1.5	0	0	3	1.2
Feed Availability	2	1.0	3	5.3	5	2.0
Other	14	25.6	28	49.1	29	11.5

**Table A4.12. Financing of poultry production by location.**

Source of finance	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Formal bank loan	13	6.7	11	19.3	24	9.5
Family loan	65	33.3	5	8.8	70	27.8
Informal Loan	9	4.6	2	3.5	11	4.4
Microfinance/NGO Loan	18	9.2	15	26.3	33	13.1
Personal savings	141	72.3	34	59.7	175	69.4
Ancillary Income	55	28.2	8	14.0	63	25.0

**Table A4.13. Primary economic duck production activity. (Percent producers)**

Breeds	Kampot		Siem Reap		Total	
	Ave	SD	Ave	SD	Ave	SD
Purchase layer ducks, keep for egg production	142	82.8	37	64.9	179	71.0
Hatch ducklings, raise layer ducks for egg production	14	7.2	20	35.1	34	13.5
Raise mixed ducks from ducklings, sell male ducks for meat, sell female ducks to egg producers	35	18.0	0	0	35	13.9
Purchase male ducklings, fatten then sell for meat	4	2.1	0	0	4	1.6

**Table A4.14. Average flock size by production structure and location. (Percent producers)**

Breeds	Kampot			Siem Reap			Total		
	Egg producers	Meat producers	Mixed producers	Egg producers	Meat producers	Mixed producers	Egg producers	Meat producers	Mixed producers
Male ducks	27	60	80	28	--	--	27	60	80
Female ducks	391	190	420	409	--	--	405	190	420
Muscovy ducks	1	2	2	1	--	--	2	2	2
Chickens	12	5	10	11	--	--	11	5	4

**Table A4.15. Source of ducklings. (Percentage of respondents purchasing from source)**

Source of ducklings	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Purchase from trader	157	80.5	36	63.2	193	76.6
Purchase from hatchery	57	29.2	13	22.8	70	27.8
Purchase at market	0	0	7	12.2	7	2.8
Source from own farm	1	0.5	2	3.5	3	1.2
Other	1	0.5	4	7.0	5	2.0

**Table A4.16. Age distribution of purchased ducklings. (Percent of respondents purchasing)**

Age distribution of ducklings	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
1-100 days	89	46.1	26	45.6	115	46.0
101-200 days	40	20.5	27	48.2	67	26.4
>200 days	66	33.8	4	7.2	70	27.6

**Table A4.17. Type of feed provided. (Percent of producers)**

Buyer	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Paddy Rice	194	99.5	45	79.0	239	94.8
Commercial Feed	145	74.4	53	92.3	198	78.6
Rice Bran	3	1.5	42	73.7	45	17.9
Broken Rice	42	21.5	19	33.3	61	24.2
White Rice	15	7.7	4	7.0	19	7.5
Earthworms	15	7.7	0	0	15	6.0
Other	79	40.5	20	35.1	99	39.3

**Table A4.18. Feeding practices.**

	Kampot		Siem Reap		Total	
	Ave	SD	Ave	SD	Ave	SD
Average age in weeks when additional feedings begin	18.8	32.0	2.4	4.8	15.1	29.0
Average number of feedings per day (adult ducks)	2.6	1.6	2.4	1.6	2.6	1.6

**Table A4.19. Water Access. (Percent of producers)**

Buyer	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Stream/Creek	155	79.5	4	7.0	159	63.1
Pond	101	51.8	26	45.6	127	50.4
Lake	68	34.9	12	21.1	80	31.8
Other	64	32.8	44	77.2	108	42.9
River	2	1.0	2	3.5	4	1.6
None	1	0.5	0	0	1	0.4

**Table A4.20. Age distribution of ducks**

	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
All same age	156	80.0	44	77.2	200	79.4
Mixed ages	38	19.5	12	21.1	50	19.8
Multiple distinct ages	1	0.5	1	1.7	2	0.8



**Table A4.21. Source of veterinary services and pharmaceuticals. (Percent of producers)**

Buyer	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Private Vet.	89	45.6	30	52.6	119	47.2
VAHW <sup>1</sup>	53	27.2	0	0	53	21.0
State Vet.	29	14.9	0	0	29	11.5
Friend/Relative	2	1.0	0	0	2	0.8
Pharmacy	0	0	16	28.1	16	6.4
None	27	13.9	14	24.6	41	16.3

1. Village Animal Health Worker

**Table A4.22. Buyers of duck meat from farmers (percent).**

	Kampot	Siem Reap	Total
Aggregator	65.3	95.1	72.4
Market vendor	16.4	4.9	13.7
End user	13.1	0.1	10.0
Food vendors	4.7	0	3.6
Other	0.4	0	0.3

**Table A4.23. Buyers of duck eggs from farmers (percent).**

	Kampot	Siem Reap	Total
Aggregator	58.9	86.3	67.1
Market vendor	12.1	11.8	12.0
End user	13.5	0.4	9.5
Food vendors	4.1	0.6	3.0
Hatchery	11.5	1.3	8.5
Other	0	0	0

**Table A4.24. Type of buyer-seller agreement for regular purchase (percent).**

Buyer	Kampot			Siem Reap			Total		
	None	Verbal	Formal	None	Verbal	Formal	None	Verbal	Formal
Hatchery	33.9	66.1	0	54.5	45.5	0	35.6	64.4	0
Aggregator	39.8	58.6	1.6	63.0	37.0	0	44.9	53.9	1.2
Vendors	85.4	14.6	0	66.7	33.3	0	83.9	16.1	0
End users	92.9	5.4	1.8	70.0	30.0	0	91.6	6.7	1.7
Food vendors	96.6	3.4	0	100	0	0	96.7	3.3	0

**Table A4.25. Items covered by verbal agreements (percent).**

Agreement	Kampot	Siem Reap	Total
Price	77.3	27.3	66.3
Quantity	17.5	18.2	17.7
Time	24.7	5.5	20.5
Credit	23.7	0	18.5
Other	9.3	10.9	9.6

**Table A4.26. Extent of buyer-seller relationships (percent).**

Buyer	Kampot			Siem Reap			Total		
	Business	None	Personal	Business	None	Personal	Business	None	Personal
Hatchery	54.5	2.4	43.1	33.3	50.0	16.7	52.6	6.7	40.7
Aggregator	58.3	10.4	31.3	51.0	29.4	19.6	56.8	14.4	28.8
Vendors	66.7	33.3	0	50.0	50.0	0	65.1	34.9	0
End users	55.3	23.5	21.2	81.8	18.2	0	56.9	23.2	19.9
Food vendors	100	0	0	50.0	50.0	0	98.3	1.7	0

1. Do not regularly trade with the same people

2. Business = Regularly trade with the same people, do not interact outside of poultry trading

3. Personal = Interact with people outside of poultry trading

**Table A4.27. Importance of factors determining whom to trade with (Percent respondents).**

Rank*	Price		Quantity		Time		Fairness		Relationship		Other	
	Freq.	Per.	Freq.	Per.	Freq.	Per.	Freq.	Per.	Freq.	Per.	Freq.	Per.
<b>Kampot</b>												
0	1	0.5	12	6.2	2	1.0	1	0.5	2	1.0	69	35.6
1	10	5.2	38	19.6	27	13.9	0	0	31	16.0	88	45.4
2	6	3.1	57	29.4	77	39.7	2	1.0	73	37.6	23	11.9
3	0	0	49	25.3	46	23.7	9	4.6	22	11.3	12	6.2
4	14	7.2	26	13.4	10	5.2	22	11.3	18	9.3	1	0.5
5	163	84.0	12	6.2	32	16.5	160	82.5	48	24.7	1	0.5
<b>Siem Reap</b>												
0	3	5.3	9	15.8	11	19.3	6	10.5	6	10.5	35	61.4
1	0	0	5	8.8	10	17.5	10	17.5	29	50.9	19	33.3
2	0	0	18	31.6	18	31.6	4	7.0	14	24.6	2	3.5
3	3	5.3	8	14.0	8	14.0	5	8.8	5	8.8	0	0
4	3	5.3	9	15.8	9	15.8	6	10.5	1	1.8	0	0
5	48	84.2	8	14.0	1	1.8	26	45.6	2	3.5	1	1.8
<b>Total</b>												
0	4	1.6	21	8.4	13	5.2	7	2.8	8	3.2	104	41.4
1	10	4.0	43	17.1	37	14.7	10	4.0	60	23.9	107	42.6
2	6	2.4	75	29.9	95	37.9	6	2.4	87	34.7	25	10.0
3	3	1.2	57	22.7	54	21.5	14	5.6	27	10.8	12	4.8
4	17	6.8	35	13.9	19	7.6	28	11.2	19	7.6	1	0.4
5	211	84.1	20	8.0	33	13.2	186	74.1	50	19.9	2	0.8

\* Respondents were asked to rank the importance of each factor on a scale of 0=not important to 5=most important.

**Table A4.28. Common symptoms in ducks prior to death from disease.**

Symptom	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Diarrhea	51	26.3	36	63.2	87	34.7
Cough/Sneezing	29	15.0	25	43.9	54	21.5
Loss of appetite	65	33.5	9	15.8	74	29.5
Paralysis	134	69.1	5	8.8	139	55.4
Other	38	19.6	23	40.4	61	24.3

**Table A4.29. Actions taken with birds that die from disease.**

Buyer	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Destroy	108	55.4	51	89.5	159	63.1
Consume	83	42.6	1	1.8	84	33.3
Sell	25	12.8	5	8.8	30	11.9
Give away	7	3.6	0	0	7	2.8
Other	0	0	2	3.5	2	0.8

**Table A4.30. Use of duck manure.**

Buyer	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Fertilizing Vegetables	111	56.9	22	38.6	133	52.8
Fertilizing other crops	186	95.4	22	38.6	208	82.5
Fish Feed	19	9.7	0	0	19	7.5
Destroy	1	0.5	9	15.8	10	4.0
Discard	0	0	3	5.3	3	1.2
Sell	2	1.0	22	38.6	24	9.5
Other	7	12.3	14	24.5	21	8.3

**Table A4.31. Biosecurity measures undertaken.**

Buyer	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Enclosure	191	98.5	28	49.1	219	87.3
Clean holding facility regularly	150	77.3	55	96.5	205	81.7
Use gloves	30	15.5	1	1.8	31	12.4
Separate ducks from chickens	117	60.3	0	0	117	46.6
Other	9	4.6	1	1.8	10	4.0

**Table A4.32. Culling Experience**

	Kampot		Siem Reap		Total	
Experienced culling (percent respondents)	0	0	0	0	0	0
Percent flock culled	--	--	--	--	--	--
Number of birds culled	--	--	--	--	--	--
Infrastructure destroyed (percent respondents)	--	--	--	--	--	--
	--	--	--	--	--	--

## Annex 5: Aggregator Survey

Table A5.1: Gender of traders.

Gender	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Male	64	55.2	6	54.6	116	51.3
Female	52	44.8	5	45.5	110	48.7

Table A5.2: Age of traders.

	Kampot		Siem Reap		Total	
	Mean	SD	Mean	SD	Mean	SD
Average age	41.2	9.6	38.8	7.9	41.0	9.5

Table A5.3: Years of experience of traders.

Work experience	Kampot		Siem Reap		Total	
	Mean	SD	Mean	SD	Mean	SD
Years	7.8	4.4	10.1	9.5	8.4	6.3

Table A5.4: Number of people trading poultry products.

	Kampot		Siem Reap		Total	
	Nr	Percent	Nr	Percent	Nr	Percent
Chicken Eggs (for consumption)	2	1.6	0	0	2	0.7
Chicks	5	4.3	0	0	5	4.0
Chickens for Meat	99	85.3	11	100	110	87.2
Duck Eggs (for consumption)	12	10.3	0	0	12	8.0
Duck Eggs (fertilized)	10	8.6	0	0	10	7.3
Ducklings	1	0.9	0	0	18	8.0
Male Ducks for Meat	7	6.0	0	0	15	6.6
Active Layer Ducks for Egg Production	6	5.2	9	81.8	10	4.4
Spent Layer Ducks for Meat	4	3.5	9	81.8	38	16.8
Muscovy Ducks	18	15.5	0	0	18	8.0

Table A5.5: Average monthly trading volume by product

Item	Kampot	Siem Reap	Total
Chicken Meat (head/month)	334	310	320
Chicken Eggs (eggs/month)	18,800	--	18,800
Duck Meat (head/month)	203	240	224
Duck Eggs (eggs/month)	11,500	--	11,500

**Table A5.6: Average purchase price for poultry products in selected locations**

	Kampot		Siem Reap		Total	
	High Season	Low Season	High Season	Low Season	High Season	Low Season
Chickens for Meat [Riels/Kg]	14,700	12,600	--	--	14,700	12,600
Duck Eggs - unfertilized [Riels/Egg]	385	325	--	--	385	325
Duck Eggs - fertilized [Riels/Egg]	390	330	--	--	390	330
Ducklings [Riels/Head]	800	600	--	--	800	600
Male Ducks for Meat [Riels/Kg]	8,900	7,600	--	--	8,900	7,600
Spent Layer Ducks for Meat [Riels/Kg]	8,400	7,500	--	--	8,400	7,500
Muscovy Ducks [Riels/Kg]	9,300	7,400	--	--	9,300	7,400

**Table A5.7: Average sale price for poultry products in selected locations**

	Kampot		Siem Reap		Total	
	High Season	Low Season	High Season	Low Season	High Season	Low Season
Chickens for Meat [Riels/Kg]	16,300	14,500	--	--	16,300	14,500
Duck Eggs - unfertilized [Riels/Egg]	410	370	--	--	410	370
Duck Eggs - fertilized [Riels/Egg]	470	410	--	--	470	410
Ducklings [Riels/Head]	5,400	5,300	--	--	5,400	5,300
Male Ducks for Meat [Riels/Kg]	10,300	8,800	--	--	10,300	8,800
Spent Layer Ducks for Meat [Riels/Kg]	11,300	10,000	--	--	11,300	10,000
Muscovy Ducks [Riels/Kg]	10,700	8,500	--	--	10,700	8,500

**Table A5.8: Source of purchase by location (Percent).**

Source	Kampot				Siem Reap				Total			
	Chicken Meat	Chicken Eggs	Duck Meat	Duck Eggs	Chicken Meat	Chicken Eggs	Duck Meat	Duck Eggs	Chicken Meat	Chicken Eggs	Duck Meat	Duck Eggs
Backyard Farm (<50 birds)	28	16	42	12	--	--	--	--	28	16	42	12
Small Farm (50-100 birds)	18	34	11	23	--	--	--	--	18	34	11	23
Medium Farm (101-500 birds)	9	46	5	42	--	--	--	--	9	46	5	42
Large Farm (>500 birds)	9	0	3	0	--	--	--	--	9	0	3	0
Traders	34	0	33	23	--	--	--	--	34	0	33	23
Other	2	4	6	0	--	--	--	--	2	4	6	0

**Table A5.9: Type of agreement for aggregators purchasing chicken and duck meat.**

Seller		Kampot			Siem Reap			Total		
		None	Verbal	Formal	None	Verbal	Formal	None	Verbal	Formal
Meat	Farmer	95	5	0	--	--	--	95	5	0
	Trader	78	22	0	--	--	--	78	22	0
	Other	83	17	0	--	--	--	83	17	0
Eggs	Farmer	67	33	0	--	--	--	67	33	0
	Trader	0	100	0	--	--	--	0	100	0
	Other	NA	NA	NA	--	--	--	NA	NA	NA

**Table A5.10: Type of agreement for aggregators selling chicken and duck meat.**

Buyer		Kampot			Siem Reap			Total		
		None	Verbal	Formal	None	Verbal	Formal	None	Verbal	Formal
Meat	End users	79	11	0	--	--	--	79	11	0
	Vendors	33	67	0	--	--	--	33	67	0
	Restaurant/Shop	50	50	0	--	--	--	50	50	0
	Trader	64	36	0	--	--	--	64	36	0
	Other	100	0	0	--	--	--	100	0	0
Eggs	End users	100	0	0	--	--	--	100	0	0
	Vendors	75	25	0	--	--	--	75	25	0
	Restaurant/Shop	0	100	0	--	--	--	0	100	0
	Trader	25	75	0	--	--	--	25	75	0

**Table A5.11: What do verbal agreements entail? (Percent).**

Agreement		Kampot		Siem Reap		Total	
Meat	Time	0		--		0	
	Price	90		--		90	
	Quantity	89		--		89	
	Discount <sup>1</sup>	11		--		11	
Eggs	Time	0		--		0	
	Price	85		--		85	
	Quantity	33		--		33	
	Discount <sup>1</sup>	12		--		12	

<sup>1</sup> for regular purchases**Table A5.12: Sanitary measures taken by poultry meat aggregators.**

Measure	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Regular cleaning of holding pen	66	64.0	--	--	--	--
Destroy sick birds	75	72.8	--	--	--	--
Use gloves when handling birds	48	46.6	--	--	--	--
Provide vaccines/ medicine to birds traded	5	5.0	--	--	--	--

**Table A5.13: Other Economic Activities Undertaken by Aggregators**

Age Range in Years	Kampot		Siem Reap		Total	
	Nr	Percent	Nr	Percent	Nr	Percent
Rice Production	98	84.5	--	--	98	84.5
Fruit, Vegetable, Nut Production	15	12.9	--	--	15	12.9
Other Crop Production	38	32.7	--	--	38	32.7
Livestock Activities (other than trading)	78	67.2	--	--	78	67.2
Off-Farm Employment	32	27.6	--	--	32	27.6

**Table A5.14: Other Economic Activities Undertaken by Aggregators**

Age Range in Years	Kampot				Siem Reap				Total			
	0	1	2	3	0	1	2	3	0	1	2	3
Birds traded will contract HPAI	23	32	32	29	--	--	--	--	23	32	32	29
Me or my family will contract HPAI	17	22	35	42	--	--	--	--	17	22	35	42
Birds traded will contract other disease	30	23	35	28	--	--	--	--	30	23	35	28
Level of demand for birds that I trade	46	51	16	3	--	--	--	--	46	51	16	3
Other	95	19	2	0	--	--	--	--	95	19	2	0

**Table A5.15: Products traded by aggregators**

	Kampot		Siem Reap		Total	
	Nr	Percent	Nr	Percent	Nr	Percent
Chicken Eggs (for consumption)	2	1.6	--	--	2	1.6
Chicks	5	4.3	--	--	5	4.3
Chickens for Meat	99	85.3	--	--	99	85.3
Duck Eggs (for consumption)	12	10.3	--	--	12	10.3
Duck Eggs (fertilized)	10	8.6	--	--	10	8.6
Ducklings	1	0.9	--	--	1	0.9
Male Ducks for Meat	7	6.0	--	--	7	6.0
Active Layer Ducks for Egg Production	6	5.2	--	--	6	5.2
Spent Layer Ducks for Meat	4	3.5	--	--	4	3.5
Muscovy Ducks	18	15.5	--	--	18	15.5

**Table A5.16: Aggregator monthly household income from poultry by location (percent)**

	Kampot		Siem Reap		Total	
	Mean	SD	Mean	SD	Mean	SD
Monthly income from poultry trade	950,000 Riels/month	1,020,000	--	--	950,000 Riels/month	1,020,000
Percent of total income	60.5 percent	23.9	--	--	60.5 percent	23.9

4,100 Riels ~1 USD

**Table A5.17: Average purchase price for poultry products in selected locations**

	Kampot		Siem Reap		Total	
	High Season	Low Season	High Season	Low Season	High Season	Low Season
Chickens for Meat [Riels/Kg]	14,700	12,600	--	--	14,700	12,600
Duck Eggs - unfertilized [Riels/Egg]	385	325	--	--	385	325
Duck Eggs - fertilized [Riels/Egg]	390	330	--	--	390	330
Ducklings [Riels/Head]	800	600	--	--	800	600
Male Ducks for Meat [Riels/Kg]	8,900	7,600	--	--	8,900	7,600
Spent Layer Ducks for Meat [Riels/Kg]	8,400	7,500	--	--	8,400	7,500
Muscovy Ducks [Riels/Kg]	9,300	7,400	--	--	9,300	7,400



**Table A5.18: Average sale price for poultry products in selected locations**

	Kampot		Siem Reap		Total	
	High Season	Low Season	High Season	Low Season	High Season	Low Season
Chickens for Meat [Riels/Kg]	16,300	14,500	--	--	16,300	14,500
Duck Eggs - unfertilized [Riels/Egg]	410	370	--	--	410	370
Duck Eggs - fertilized [Riels/Egg]	470	410	--	--	470	410
Ducklings [Riels/Head]	5,400	5,300	--	--	5,400	5,300
Male Ducks for Meat [Riels/Kg]	10,300	8,800	--	--	10,300	8,800
Spent Layer Ducks for Meat [Riels/Kg]	11,300	10,000	--	--	11,300	10,000
Muscovy Ducks [Riels/Kg]	10,700	8,500	--	--	10,700	8,500

**Table A5.19: Average price mark-up for poultry products in selected locations**

	Kampot		Siem Reap		Total	
	High Season	Low Season	High Season	Low Season	High Season	Low Season
Chickens for Meat [Riels/Kg]	1,700	1,900	--	--	1,700	1,900
Duck Eggs - unfertilized [Riels/Egg]	29	23	--	--	29	23
Duck Eggs - fertilized [Riels/Egg]	82	79	--	--	82	79
Ducklings [Riels/Head]	900	1,000	--	--	900	1,000
Male Ducks for Meat [Riels/Kg]	1,400	1,000	--	--	1,400	1,000
Spent Layer Ducks for Meat [Riels/Kg]	2,700	2,200	--	--	2,700	2,200
Muscovy Ducks [Riels/Kg]	1,400	1,300	--	--	1,400	1,300

**Table A5.20: Sanitary measures taken by poultry meat aggregators.**

Measure	Kampot		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Regular cleaning of holding pen	66	64.0	--	--	66	64.0
Destroy sick birds	75	72.8	--	--	75	72.8
Use gloves when handling birds	48	46.6	--	--	48	46.6
Provide vaccines/medicine to birds traded	5	5.0	--	--	5	5.0

**Table A5.21: Other Economic Activities Undertaken by Aggregators**

Age Range in Years	Kampot		Siem Reap		Total	
	Nr	Percent	Nr	Percent	Nr	Percent
Rice Production	98	84.5	--	--	98	84.5
Fruit, Vegetable, Nut Production	15	12.9	--	--	15	12.9
Other Crop Production	38	32.7	--	--	38	32.7
Livestock Activities (other than trading)	78	67.2	--	--	78	67.2
Off-Farm Employment	32	27.6	--	--	32	27.6

## Annex 6: Vendor Survey

Table A6.1: Gender of respondents by location.

Gender	Kampot (urban)		Kampot (semi-urban)		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent
Male	3	21.4	16	11.9	6	13.7	25	12.9
Female	11	78.6	118	88.1	38	86.4	169	87.1

Table A6.2: Age of respondents by location.

Age class	Kampot (urban)		Kampot (semi-urban)		Siem Reap		Total	
	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent
<30	1	7.1	11	8.3	15	34.9	27	14.3
30-45	5	35.5	88	66.7	19	38.8	112	59.3
46-60	7	49.7	31	23.5	7	14.2	45	23.8
>60	1	7.1	2	1.5	2	4.1	5	2.6

Table A6.3: Years of experience as market vendor.

Work experience	Kampot (urban)		Kampot (semi-urban)		Siem Reap		Total	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Years	8.9	5.9	5.9	4.5	6.5	8.0	6.3	5.6

Table A6.4: Type of market space in selected locations.

Market space	Kampot (urban)		Kampot (semi-urban)		Siem Reap		Total	
	Freq.	Perc	Freq.	Perc	Freq.	Perc	Freq.	Perc
Temporary (daily rental)	7	53.9	107	79.9	15	34.1	129	66.5
Temporary (monthly rental)	5	35.5	15	11.1	18	40.9	38	19.6
Permanent	1	7.7	12	9.0	9	20.5	22	11.3

Table A6.5: Types of poultry products sold (percent of vendors).

Breed	Kampot (urban)		Kampot (semi-urban)		Siem Reap		Total	
	Freq	Perc	Freq	Perc	Freq	Perc	Freq	Perc
Chicken meat	14	100	81	60.5	19	43.2	114	58.8
Chicken eggs	0	0	12	9.0	20	45.5	32	16.5
Duck meat	8	42.9	39	29.1	2	4.6	47	24.2
Duck eggs	0	0	72	53.7	24	54.6	98	50.5

**Table A6.6: Average daily trading volume of poultry products in selected location.**

Breed	Kampot (urban)		Kampot (semi-urban)		Siem Reap		Total	
	High Season	Low Season	High Season	Low Season	High Season	Low Season	High Season	Low Season
Chicken meat (kg/day)	22.9	16.8	32.7	23.7	65.9	64.3	37.5	28.2
Chicken eggs (eggs/day)	--	--	25	13	260	160	200	50
Duck meat (kg/day)	12.8	8.8	20.3	14.3	40.0	20.0	20.4	13.9
Duck eggs (eggs/day)	--	--	208	160	840	560	360	190

**Table A6.7: Pre-purchase contractual agreements by source and location.**

Source	Kampot (urban)			Kampot (semi-urban)			Kampot (urban)			Kampot (semi-urban)		
	None	Verbal	Formal	None	Verbal	Formal	None	Verbal	Formal	None	Verbal	Formal
Trader – market delivered	70.0	30.0	0	70.0	30.0	0	100	0	0	9.6	6.4	0
Trader – home delivered	100	0	0	100	0	0	100	0	0	65.0	35.0	0
Farmer	83.3	16.7	0	83.3	16.7	0	100	0	0	88.9	11.1	0
Market vendor	50.0	50.0	0	50.0	50.0	0	100	0	0	94.0	6.0	0

**Table A6.8: Average market vendor sale price in selected locations.**

	Kampot		Siem Reap		Total	
	High Season	Low Season	High Season	Low Season	High Season	Low Season
Chicken Meat (Riels/kg)	15,400	12,300	16,100	13,200	14,700	12,600
Chicken Eggs (Riels/egg)	410	410	380	390	410	410
Duck Meat (Riels/kg)	12,100	8,300	12,500	10,000	10,300	8,600
Duck Eggs (Riels/egg)	420	410	460	430	480	410