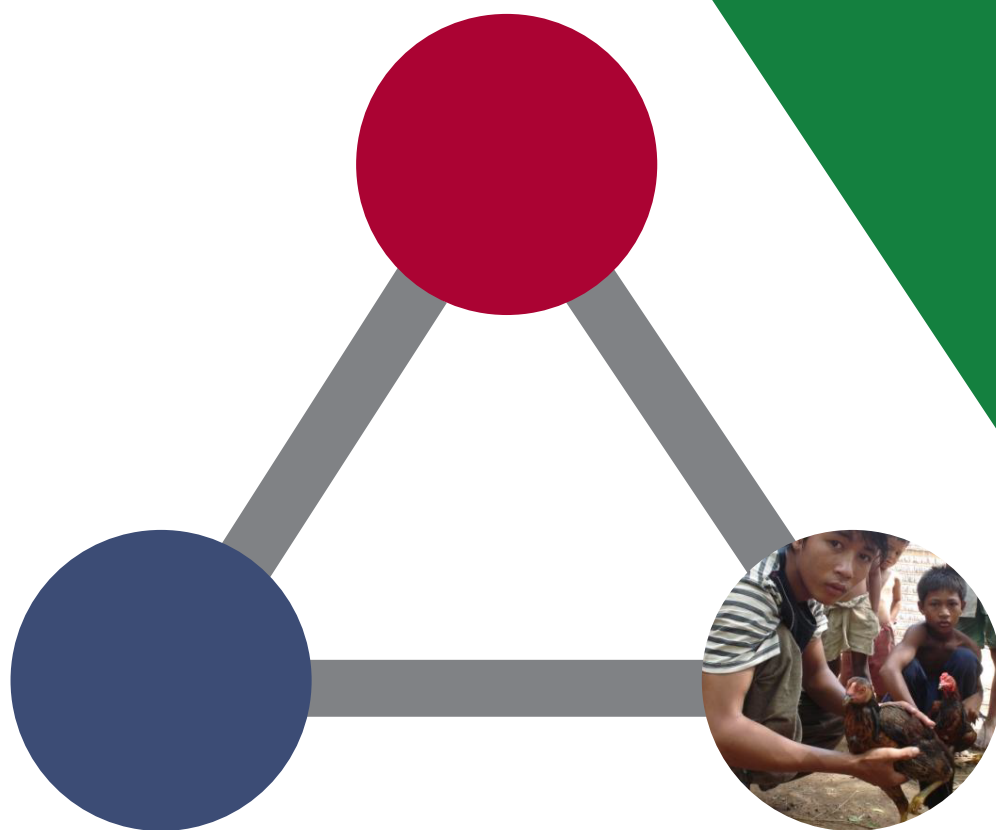


Characterization of indigenous chicken production systems in Cambodia



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Abstract

A survey was conducted on 402 chicken farmers in Kampong Cham, Kampot, Odar Meanchey, Rattanakiri and Siem Reap provinces in Cambodia to determine the different production systems and to differentiate the phenotypic characteristics of chickens from different provinces. The majority of farmers interviewed were men aged between 41 and 50 years. The illiteracy rate among these farmers was less than the national average of 26.4 percent. Rice is the main agricultural crop in all five provinces. As well as their chickens, 71 percent of the farmers rear cattle/buffaloes and 43 percent keep pigs. The average flock size is highest in Kampot province (40.2 birds/flock) and lowest in Rattanakiri (23.3 birds/flock). Across all the survey provinces, 35 percent of the farmers stated that chicken numbers have decreased over the last five years. Only one-third of the farmers purchase birds from outside, mainly from neighbours. Although the production systems vary in many aspects, selection criteria are similar in all provinces. Body weight is the most important criterion, followed by number of eggs laid. About 80 percent of the farmers provide their birds with at least night housing, constructed mainly from simple materials available on-farm. The birds depend on scavenging, but 95 percent of farmers also provide some extra feed. Only a small number of farmers use the available veterinary facilities, and disease is reported as the main cause of mortality.

In general, management of birds is carried out by both men and women, whereas marketing is done mainly by male members of the family.

Results of a multivariate analysis of the phenotypic characteristics of the bird populations in the five provinces indicate that the populations are well separated and none of them are very similar to any other. The populations of Kampong Cham and Odar Meanchey have similar size characteristics but are very different in other traits. Overall, despite the distance between them, the populations of Kampot and Siem Reap seem to be the most similar.



Introduction

Backyard chicken production is important for many rural households. Although it is a small and sometimes unorganized sector, it makes a substantial contribution to meeting the protein requirements of the majority of Cambodia's population.

Backyard chicken production is a subsistence activity providing eggs and meat for home consumption and, to some extent, cash income for families. Birds are usually reared in the traditional way, which is based on scavenging.

They receive few inputs such as feed supplementation and health care for their survival and productivity. These birds are less productive than commercial breeds; they have a lower growth rate and produce fewer eggs. However, the advantage of local breeds is that they are hardy and well adapted to low-input systems, where commercial breeds might not survive or might respond with a dramatic decline in productivity. Local breeds are considered a possible reservoir of important genes/traits that may not be found in many commercial breeds and that could be potentially utilized in current commercial breeding programmes.

Subsistence-level chicken production is now receiving attention because funding agencies recognize its contribution to poverty alleviation and food security. Programmes associated with backyard chickens – breed improvement, health improvement, credit schemes for the rural poor, housing schemes, etc. – are currently being undertaken in different parts of the world. If the introduction of appropriate indigenous poultry production and marketing technologies is to make livelihoods more sustainable, it is necessary to characterize production systems under traditional management conditions.

FAO's Animal Health, Breeding and Livelihood (AHBL) project on 'Promoting Strategies for Prevention and Control of Highly Pathogenic Avian Influenza (HPAI) that Focus on Smallholder Livelihoods and Biodiversity' was implemented in three countries – Cambodia, Egypt and Uganda. Its objective was to identify HPAI control methods that have neutral or positive impacts on the livelihoods of small-scale poultry keepers while helping to maintain chicken breed diversity. This study from Cambodia is part of this project. Its purpose is to identify and describe specific chicken genetic resources and production systems across five geographically and demographically different provinces of Cambodia. The aim is to find out whether and how backyard chickens and their production systems differ in different locations.



Materials and methods

Study area

This study was carried out in five provinces of Cambodia: Seam Reap, Rattanakiri, Kampong Cham, Kampot and Odar Meanchey. These provinces were selected in consultation with local FAO staff for the following reasons: 1) the different chicken production conditions in Cambodia are all represented; 2) they are locations where both chickens and ducks are important; and 3) they provide an opportunity to identify specific local genetic resources in the two remote provinces of Odar Meanchey and Rattanakiri.

FIGURE 1 MAP OF CAMBODIA SHOWING THE FIVE PROVINCES SELECTED FOR THE SURVEY



Ninety villages were selected from 13 districts within the five provinces. The numbers of districts per province and villages per district were decided according to the sizes of the human and chicken populations in each province. A stratified sampling technique was used first to select the districts and then to select villages from these districts. Numbers of districts, villages and selected household in each province are given in Table 1. The distribution of households per district is presented in Table 2.

TABLE 1 NUMBER OF SELECTED HOUSEHOLDS IN EACH PROVINCE

Province	Number of:		
	Districts	Villages	Households
Kampong Cham	3	40	170
Kampot	3	10	48
Odor Meanchey	2	10	48
Rattanakiri	3	10	48
Siem Reap	2	20	88
Total	13	90	402



TABLE 2 DISTRIBUTION OF HOUSEHOLDS PER DISTRICT

District	Kampong Cham	Kampot	Odor Meanchey	Rattanakiri	Siem Reap
Cheung Prey	73				
Kampong Seam	69				
Preychor	28				
Angkorchev		16			
Chuouck		16			
Kampong Trach		16			
Chongkal			24		
Samroung			24		
Ban Lung				16	
Koun Mom				16	
Lumphat				16	
Puok					48
Siem Reap					40
Total	170	48	48	48	88

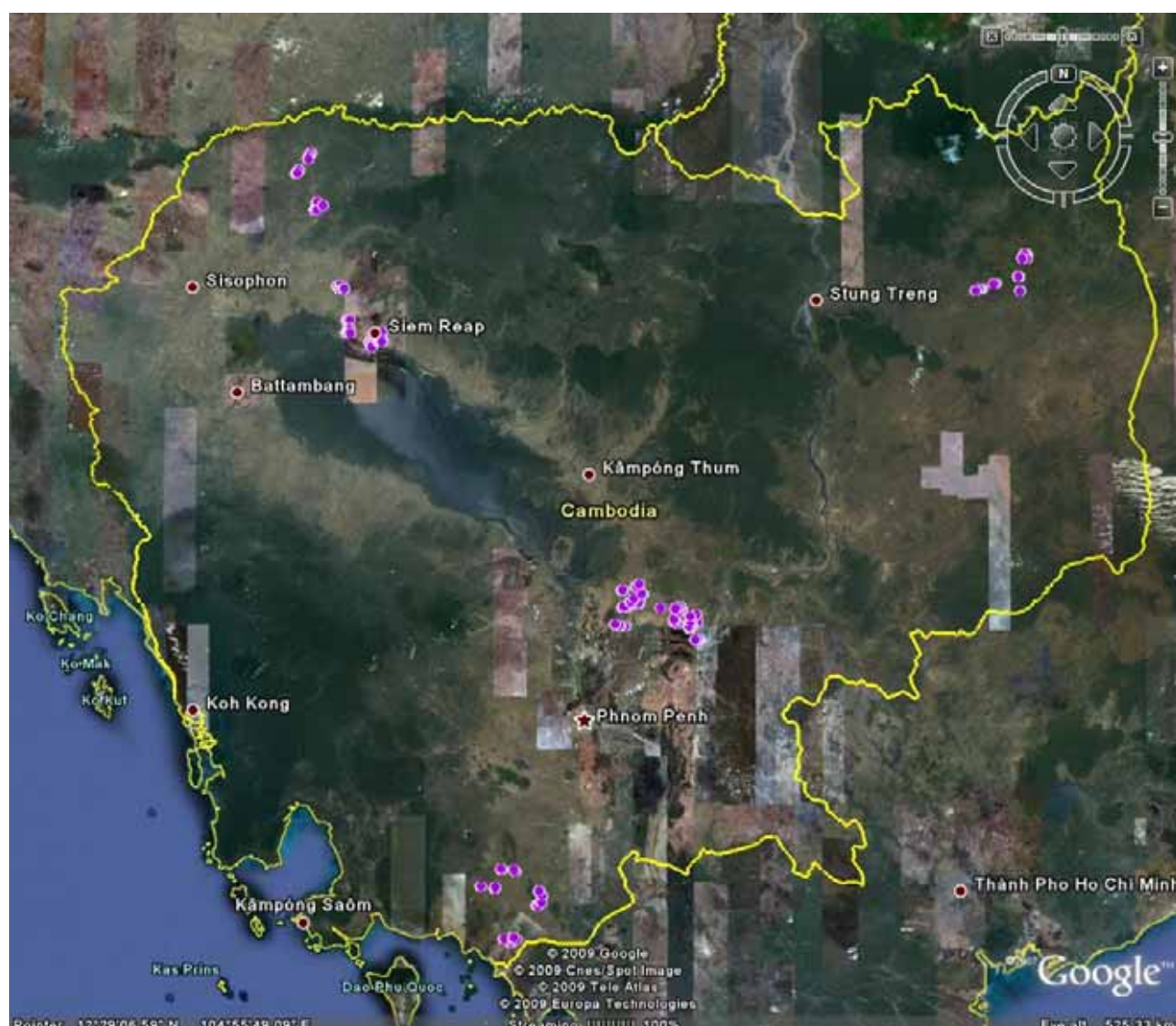
Data collection

Description of production systems

An on-farm survey was conducted during April and May 2008 in the five provinces. The study covered various aspects of chicken production: breeding, feeding, health and marketing. Data were collected in 402 households by means of personal interviews with either the household head or the main care taker of the birds. Information about the major crops and cropping systems, numbers and main uses of other livestock species, etc. was also collected. Information about the constraints faced by farmers in such aspects as housing and animal health was also gathered. The questionnaire used was developed by FAO and is presented in Annex 1.

Four to five households were randomly selected from each village, with the help of para-veterinary staff working with the Provincial Department of Animal Production and Animal Health, who first identified the households rearing chickens. Data were collected by 16 enumerators, who were staff of the non-governmental organization (NGO) Centre d'Etude et de Développement Agricole Cambodigien (CEDAC – Cambodian Centre for Study and Development in Agriculture). Data were collected from one province at a time for Kampong Cham, Kampot and Odor Meanchey, while data from Siem Reap and Rattanakiri were collected simultaneously. Each team of two enumerators covered one village a day, and was responsible for conducting the interviews in the local language and completing the questionnaire in English. On average, it took about 20 minutes for completion of each data sheet. Data are based entirely on interviewees' responses; enumerators did not carry out any independent assessment by means of observation. Most of the questions were of multiple-response type, and farmers could give more than one response. Enumerators were provided with global positioning systems (GPS) to record the position of each farm which is shown by Figure 2.



FIGURE 2 MAP SHOWING THE LOCATION OF THE SELECTED HOUSEHOLDS

Phenotypic characterization of chicken populations

Along with the survey the enumerators also conducted a physical assessment of four to five birds per household. The data collected were transferred to a checklist developed by FAO and provided in Annex 2. Body weight and shank length were measured for each bird, and the colours of shank, skin, eye and ear lobe were noted, along with type of comb. Other characteristics noted included naked neck, beard and muffs, polydactyl, frizzled or silky feathers.

In total, 1 943 birds were measured in the five provinces. The district breakdown of these birds is given in Table 3.

TABLE 3 BIRDS MEASURED PER DISTRICT

District	Kampong Cham	Kampot	Odor Meanchey	Rattanakiri	Siem Reap
Cheung Prey	355				
Kampong Seam	303				
Preychor	139				
Angkorchev		80			
Chuouck		80			
Kampong Trach		75			
Chongkal			115		
Samroung			119		
Ban Lung				80	
Koun Mom				80	
Lumphat				77	
Puok					240
Siem Reap					200
Total	797	235	234	237	440

The information collected by CEDAC was transferred to a database by the NGO Digital Divide Data (DDD).

Analysis of production systems by province

The data collected were analysed by province to identify how the production systems and birds differ from one province to another. The data were grouped into four categories: farmer households and life style, livestock numbers, management, and marketing. Productivity and phenotypic characteristics were also analysed.

Data analysis

Data were analysed using the statistical analysis software (SAS) computer package (SAS 2007). Frequency counts and means were calculated according to the type of dataset. To analyse traits such as body weight and shank length, the GLM procedure was used and pair-wise comparison was carried out using the Tukey method. Chi-square was used for the analysis of class variables, and the Bonferoni Holm test for multiple comparison.

Multivariate analysis was conducted to investigate how similar or different the chicken populations in the five provinces are. Canonical discriminant analysis was performed to obtain Mahalanobis distances of provinces based on all phenotypic characteristics. In addition, a step-wise discriminant analysis indicates which variates contribute most to differentiation among provinces. The Mahalanobis distances were submitted to cluster analysis to provide a graphical display of similarities/differences.



Results

Description of production system

Household and life style

The respondents of the survey are assumed to be the main care taker of the birds in each household. Sex was recorded for 400 of the 402 respondents: across all provinces, 55 percent of respondents (220) are male, but among provinces the sex ratio varies from 49 percent male in Kampot to 72 percent in Odar Meanchey.

TABLE 4 MALE AND FEMALE RESPONDENTS

Province	Male	Female	Total
Kampong Cham	89	81	170
Kampot	23	24	47
Odar Meanchey	34	13	47
Rattanakiri	27	21	48
Siem Reap	47	41	88
Total	220	180	400

The ages of 398 respondents were recorded in the response sheet. Age varies from 15 to 76 years, with 128 (32 percent) respondents in the 40 to 50 years age group. The highest frequency of any age is 28 years.

A large proportion of interviewees (73 percent) listen to the radio; this figure was similar in all provinces (Table 5).

The survey reveals high mobile phone coverage across the country, with 95 percent of respondents using mobile phones. More interesting figures can be observed at the province level, with 100 percent of the interviewed farmers in Kampot and Siem Reap having mobile phones (Table 5).

TABLE 5 RADIO LISTENERS AND MOBILE PHONE USERS

Province	Radio listeners			Mobile phone users		
	Yes	No	Total	Yes	No	Total
Kampong Cham	120	49	169	163	6	169
Kampot	32	16	48	48	0	48
Odar Meanchey	38	9	47	42	5	47
Rattanakiri	38	10	48	42	6	48
Siem Reap	65	23	88	88	0	88
Total	293	107	400	383	17	400

Education level of respondents

Regarding education level, 392 records were completed, which show that 66 (16.8 percent) respondents are illiterate, 170 (43.3 percent) have primary education, 123 (31.3 percent) have secondary education, and 33 (8.4 percent) have high school education. The percentage of illiterate respondents is highest in Odar Meanchey (28.89 percent) and lowest in Kampot (6.38 percent). Kampot also has the highest percentage (14.89 percent) of respondents with high school education. In Odar Meanchey, no respondents have high school education (Table 6).



TABLE 6 EDUCATION LEVEL OF RESPONDENTS

Province	No education	Primary	Secondary	High school	Total
Kampong Cham	23	74	56	15	168
Kampot	3	18	19	7	47
Odor Meanchey	13	24	8	0	45
Rattanakiri	9	24	7	4	44
Siem Reap	18	30	33	7	88
Total	66	170	123	33	392

Household size

Of the 397 interviewees who responded to the question about household size, 240 (60 percent) reported fewer than five members. All provinces except Rattanakiri show a similar trend, with more than 50 percent of households having fewer than five members. In Ratanakiri, only 46 percent of households have fewer than five members, and 12.77 percent have more than nine members. The corresponding figures for other provinces are 1.19 percent for Kampong Cham, 4.17 percent for Kampot, 8.7 percent for Odor Meanchey and 5.68 percent for Siem Reap (Table 7).

TABLE 7 HOUSEHOLD SIZE

Province	< 5	6 to 7	8 to 9	> 9	Total
Kampong Cham	107	43	16	2	168
Kampot	32	11	3	2	48
Odor Meanchey	29	9	4	4	46
Rattanakiri	22	11	8	6	47
Siem Reap	50	21	12	5	88
Total	240	95	43	19	397

Agriculture and its importance

Paddy is the main crop in all provinces, with more than 95 percent of respondents cultivating rice in all provinces but Rattanakiri. In Odor Meanchey, all the farmers grow rice as the main crop. Regarding use of the main crop, Kampong Cham and Kampot follow the same pattern, with 42 percent of respondents in both provinces using it for household consumption and 57 percent for both sale and household consumption. Odor Meanchey and Siem Reap show a different trend, with more than 55 percent of interviewees using rice for home consumption and only 36 to 44 percent using it for both home use and sale. The figures from Rattanakiri are entirely different, with only 20 percent of respondents using rice for home consumption alone, and 68 percent using it for both sale and home use. A large proportion (11 percent) of farmers reported that all rice is sold. Very low percentages of farmers also cultivate crops such as rubber and vegetables. Details regarding the main purpose of rice cultivation are given in Table 8.



TABLE 8 MAIN PURPOSE OF RICE CULTIVATION

Province	For sale	For home use	Both	Total
Kampong Cham	2	66	91	159
Kampot	0	20	27	47
Odor Meanchey	0	25	20	45
Rattanakiri	4	7	24	35
Siem Reap	0	46	26	72
Total	6	164	188	358

Use of livestock and their importance

Of the 402 households, 283 responded to the question regarding large ruminants, including cattle and buffaloes. Of these households, 164 (57.9 percent) said that cows/bullocks/buffaloes are used for home use only. All the provinces except Kampong Cham follow a similar pattern, with the majority of households (60.8 to 81.2 percent) using these animals for own use only. In Kampong Cham, only 45.4 percent of respondents use them exclusively for household purpose, while 48.4 percent reported using them for both home and rental purposes. Of the 283 respondents, 222 (78 percent) said that large ruminants play a very important role for their families' income. This figures ranges from 60 to 81.2 percent among provinces. Across the surveyed households, small ruminants are reared by only five farmers in Siem Reap.

Some 168 respondents reported rearing pigs. The main purpose of pig keeping is to generate income by selling fattened animals, and 93 percent of farmers said that all their pigs are sold. Nevertheless, respondents reported that pigs make only a moderate contribution to the family income. In a scale of 1 to 5 (with 5 being the most important), 41 respondents awarded 3, and 79 awarded 4.

Regarding chickens, 325 respondents (83.5 percent) said they use their chickens for both home consumption and sale in markets or the neighbourhood. The majority awarded scores of 3 or 4 (289 respondents, 75 percent), indicating that chickens' importance to the family income is only moderate. About 35 percent (143) of the farmers also rear ducks, which they rank as being of low to medium importance for the family.

Chicken flock size

Of the 402 households, 393 rear local chicken breeds, with an average of 33.7 birds per household across all provinces: 23.3 per household in Rattanakiri, 26.7 in Odor Meanchey, 33.3 in Siem Reap, 37.9 in Kampong Cham, and 40.1 in Kampot. The adult female to male ratio is highest in Odor Meanchey, with an average of 2.9 females per male, and lowest in Rattanakiri with 1.7 females per male. Figures for the other provinces are 2.6 for Kampong Cham, 2.8 for Kampot and 2.4 for Siem Reap. The average number of chicks per household ranges from 10.4 in Rattanakiri to 20.3 in Kampot.

Improved chicken breeds are reared in only seven households, with the highest number of improved birds per household recorded in Rattanakiri, with about 19, although only three of the surveyed households in this province rear them. The average figures for households in other provinces range from 1.50 improved birds in Kampong Cham to 3.00 in Siem Reap.



TABLE 9 AVERAGE FLOCK SIZES OF LOCAL CHICKENS

Province	Chicks	Pullets	Hens	Cockerels	Cocks	Total*
Kampong Cham	19.9	9.7	5.7	9.5	2.2	37.0
Kampot	20.3	9.9	7.1	9.9	2.5	40.1
Odor Meanchey	15.0	5.8	4.5	4.3	2.0	26.7
Rattanakiri	10.4	8.8	5.0	5.6	2.9	23.3
Siem Reap	16.6	8.7	5.8	8.3	2.3	33.3

*The averages for the different categories are calculated only for owners who had such birds. The figures in the total column are therefore not the totals of all the birds in the other columns.

Herd / flock size of livestock species reared

Data were collected for cattle, buffaloes, goats and ducks from households that keep those species (Tables 10 and 11). The figures show that households from Rattanakiri have the highest number of adult cattle per household, with 7.7 head, and Siem Reap the lowest, with 3.1 head. However, only 50 percent of the households in Rattanakiri rear cattle, compared with 87.2 percent of those in Siem Reap. In other provinces average herd sizes range from 3.5 in Kampot to 4.3 in Kampong Cham. Buffaloes are reared by only 12.4 percent of households, and the highest average number of buffaloes per household is 3.1 in Siem Reap.

Sheep are not reared in the recording area and only 20 households keep goats, all in Siem Reap. Of the 402 households, 182 rear pigs, with average numbers per household ranging from 2.3 in Rattanakiri to 6.6 in Siem Reap.

TABLE 10 AVERAGE HERD SIZES OF LOCAL CATTLE

Province	Newborns	Young females	Adult females	Young males	Adult males	Total*
Kampong Cham	1.8	1.5	1.8	1.7	2.1	4.3
Kampot	1.7	1.0	1.8	1.4	2.1	3.5
Odor Meanchey	1.5	1.5	1.5	1.5	2.1	3.5
Rattanakiri	3.5	4.1	3.3	1.7	2.6	7.7
Siem Reap	1.7	1.0	1.6	1.8	2.0	3.1

*The averages for the different categories are calculated only for owners who had those cattle. The figures in the total column are therefore not the totals of all the cattle in the other columns.

TABLE 11 AVERAGE HERD SIZES OF LOCAL PIGS

Province	Newborns	Young females	Adult females	Young males	Adult males	Total*
Kampong Cham	6.3	2.0	1.8	2.2	1.0	5.2
Kampot	4.6	1.4	2.0	1.7	1.0	4.6
Odor Meanchey	2.0	2.1	1.2	3.6	1.0	2.3
Rattanakiri	2.5	2.2	1.2	1.5	0.0	2.3
Siem Reap	6.5	1.6	1.8	6.0	2.0	6.6

*The averages for the different categories are calculated only for owners who had those pigs. The figures in the total column are therefore not the totals of all the pigs in the other columns.

Fluctuation in chicken flock size

In this study, no clear pattern emerged regarding changes in the flock size over the last five years. Farmers were given three options for this question: increase, decrease or remained the same. Only 16 percent of respondents answered that their flock size remained the same, 47.6 percent answered that it increased and about 35 percent that it decreased. More than 50 percent of the farmers in Kampong Cham, Kampot and Siem Reap indicated that numbers increased, whereas the majority in Odor Meanchey and Rattanakiri said that flock size decreased during the last five years (Table 12).



TABLE 12 FLUCTUATION OF CHICKEN NUMBERS IN THE LAST FIVE YEARS

Province	Increase	Decrease	Remained same	Total
Kampong Cham	88	56	26	170
Kampot	35	11	2	48
Odor Meanchey	10	25	12	47
Rattanakiri	10	30	8	48
Siem Reap	48	21	19	88
Total	191	143	67	401

Most respondents (93.5 percent) reported a pattern of seasonal fluctuation in chicken numbers over the year, with the highest numbers in June, July, October and November, and the lowest in March and April.

TABLE 13 MONTHS WITH HIGHEST NUMBERS OF CHICKENS (NUMBER OF RESPONDENTS REPORTING)

Province	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Kampong Cham	43	27	13	16	35	45	46	37	44	45	47	44
Kampot	13	13	3	3	9	18	19	21	17	18	25	21
Odor Meanchey	16	12	9	3	6	18	20	20	25	23	19	24
Rattanakiri	12	10	8	5	9	20	18	14	14	18	15	16
Siem Reap	18	16	19	13	26	35	28	24	25	26	29	20
Total	102	78	52	40	85	136	131	116	125	130	135	125

TABLE 14 MONTHS WITH LOWEST NUMBERS OF CHICKENS (NUMBER OF RESPONDENTS REPORTING)

Province	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Kampong Cham	12	27	59	108	55	18	8	3	1	1	7	10
Kampot	3	16	23	30	14	0	0	1	1	1	1	1
Odor Meanchey	6	14	28	38	28	12	8	5	5	4	4	5
Rattanakiri	1	5	25	36	14	8	6	4	4	4	3	3
Siem Reap	4	9	28	49	33	6	2	4	4	3	4	3
Total	26	71	163	261	144	44	24	17	15	13	19	22

Breeding

67 percent of the farmers do not buy birds from outside to improve their flocks; replacement is exclusively with their own birds. Of the few farmers who purchase chickens from outside, 80 percent get them from neighbours. This pattern is common to all five provinces (Table 15).

Only eight of the 402 respondents (2 percent) said that they use improved birds in their flocks. All others use only local breeds of chicken. None of the interviewees in Kampot use improved chickens. Farmers usually prefer to purchase adult birds rather than young ones. High chick mortality may be the reason for this. In all provinces, the most important selection criteria for purchasing birds are body size/weight, followed by number of eggs laid and disease resistance.

More than 96 percent (386) of the farmers use their own hens for brooding; in Kampot and Siem Reap all farmers practise brooding. Of these 386 respondents, 325 declared that they try to obtain better birds for their flocks, but their main source is usually their own flock. Traits such as body weight, eggs laid and mothering ability are given importance during selection.



TABLE 15 PURCHASE OF BIRDS FOR THE FLOCK

Province	Yes	No	Total
Kampong Cham	61	109	170
Kampot	16	32	48
Odor Meanchey	12	36	48
Rattanakiri	16	32	48
Siem Reap	27	60	87
Total	132	269	401

TABLE 16 SOURCE OF PURCHASED BIRDS

Province	Market	Neighbour	Commercial farm	Other
Kampong Cham	1	57	0	6
Kampot	0	14	0	1
Odor Meanchey	0	7	0	4
Rattanakiri	0	8	0	8
Siem Reap	3	20	0	4

Housing and manure disposal

Most of the farmers in the study area provide some sort of housing for their birds, but the type of construction and period of housing vary. Only 65 farmers in all five provinces keep their chickens indoors during both day and night; about 257 reported housing them only at night. The percentage of farmers providing night housing varies from 62.5 percent in Odor Meanchey to 79.5 percent in Kampot. In all provinces except Kampot, simple farm materials are usually used to build the houses. In Kampot, simple farm materials and purchased materials are used in equal proportions. Two respondents, one in Kampong Cham and one in Rattanakiri, answered that they use improved construction methods (Table 17).

The farmers who do not provide any shelter for their birds gave different reasons for this. The majority (43.5 percent) of them are of the opinion that housing is not required, while 27.8 percent gave financial reasons, and 28.6 percent other reasons. An interesting observation is that none of the farmers in Rattanakiri gave financial reasons for their lack of housing, while 52.6 percent of those without chicken houses in Odor Meanchey said that lack of money is the reason.

Regarding manure disposal, 80 farmers said they do not dispose of manure, while 274 reported using it as fertilizer.

TABLE 17 MATERIALS USED FOR BUILDING CHICKEN HOUSES

Province	Simple farm materials	Simple purchased materials	Improved construction
Kampong Cham	86	57	1
Kampot	19	19	0
Odor Meanchey	28	4	0
Rattanakiri	21	13	1
Siem Reap	39	36	0

Feeding

More than 95 percent (382) of the respondents provide their birds with some kind of feed, including kitchen waste or purchased feedstuffs. Of these farmers, 118 (30.9 percent) purchase feed. In Odor Meanchey, only two farmers said that they buy feed. The highest percentage of farmers purchasing feed is in Kampong Cham, at 39.8 percent (or 65 farmers).



Nine farmers in Kampot, 12 in Rattanakiri and 30 in Siem Reap buy feed for their birds.

Among the feedstuffs fed to the birds, grains produced on respondents' own farmland is the most common, followed by miscellaneous sources. The main source of bought feed is the market, followed by other sources (Table 18).

TABLE 18 FARMS PURCHASING DIFFERENT FEED TYPES

Province	Concentrate	Grains from farms	Others
Kampong Cham	44	105	27
Kampot	5	40	2
Odor Meanchey	3	13	22
Rattanakiri	2	13	25
Siem Reap	11		8

Animal health and related aspects

In total, 153 respondents reported that they note and keep records of mortalities. Mortality data were divided into three periods: period 1 from one day to one month of age; period 2 from one to six months; and period 3 from six month onwards.

Across all provinces, an average of 9.8 chicks are hatched per hen per cycle: 7.4 survive period 1, and 6.1 survive period 2. A similar trend is observed at the province level. However, these figures are based on farmers' answers, which should be read cautiously. Figures for each province are given in Table 19.

TABLE 19 AVERAGE NUMBERS OF CHICKS PER CLUTCH HATCHED AND SURVIVING

Province	Hatched	Surviving until 1 month	Number surviving until 6 months
Kampong Cham	9.6	7.3	6.0
Kampot	10.2	7.8	6.7
Odor Meanchey	9.3	6.8	5.4
Rattanakiri	10.2	7.7	5.9
Siem Reap	10.1	7.4	6.3

It is very unusual for farmers in the study areas to buy day-old chicks. Therefore, only 41 farmers answered the question regarding the survival of day-old chicks. Of these respondents, 27 (65.8 percent) were in Kampong Cham. No farmers in Odor Meanchey reported buying day-old chicks. More respondents (81) answered the question regarding the percentage of purchased chicks to survive period 2, indicating that farmers prefer to purchase older birds. Of these 81 farmers, the highest number was again in Kampong Cham province, and there were no respondents in Odor Meanchey. Analysis of the data reveals that about 78.7 percent of chicks survive period 1 and 82.5 percent survive period 2.

In all provinces and at all stages of the life cycle, disease is the main cause of mortality, followed by predators, accidents and unknown reasons.



TABLE 20 RESPONDENTS REPORTING CAUSES OF CHICKEN LOSSES DURING DIFFERENT PERIODS

Province	Disease	Predator	Accident	Unknown
Losses until first month				
Kampong Cham	109	68	48	21
Kampot	26	9	8	4
Odor Meanchey	26	29	11	11
Rattanakiri	24	20	6	7
Siem Reap	47	16	28	14
Total	232	142	101	57
Losses after first until sixth month				
Kampong Cham	97	53	30	20
Kampot	20	4	2	3
Odor Meanchey	22	21	11	13
Rattanakiri	29	14	5	2
Siem Reap	36	13	15	10
Total	204	105	63	48
Losses after sixth month				
Kampong Cham	76	23	6	14
Kampot	13	5	1	4
Odor Meanchey	20	3	8	6
Rattanakiri	25	10	2	8
Siem Reap	28	5	1	6
Total	162	46	18	38

About two-thirds of the farmers (296) do not use any veterinary services for their birds. Results across the different provinces show a similar trend, except for in Kampot, where 54.1 percent of respondents use veterinary services. Fairly similar figures are observed in the case of preventive vaccination. Only 88 farmers reported vaccinating their animals, and vaccination coverage was minimal in Odor Meanchey and Rattanakiri provinces, with only one farmer in Odor Meanchey and three in Rattanakiri reporting any sort of vaccination. Results for each province are provided in Table 21. As only Newcastle disease vaccine is supplied by the Department of Animal Production, it can be assumed that all the farmers were vaccinating against this disease.

TABLE 21 USE OF VETERINARY SERVICES AND VACCINATION

Province	Veterinary services			Vaccination		
	Yes	No	Total	Yes	No	Total
Kampong Cham	35	134	169	40	128	168
Kampot	26	22	48	23	25	48
Odor Meanchey	12	36	48	1	46	47
Rattanakiri	7	40	47	3	43	46
Siem Reap	23	64	87	21	67	88
Total	103	296	399	88	309	397

Productivity of the birds

The birds have an average of 3.7 production cycles a year, and in each cycle farmers obtain 11.9 eggs. Among the provinces, productivity of the birds in Siem Reap is highest, at an average of 4.1 cycles a year with 12.3 eggs per cycle. Again, these figures could not be verified through observation, so should be taken with caution, as farmers might overestimate the productivity of their birds and tend to remember birds of exceptionally good productivity rather than average ones. The lowest number of cycles is observed in Rattanakiri (3.2), whereas the lowest egg production per cycle is in Kampong Cham (11.6) (Table 22).



TABLE 22 PRODUCTIVITY OF THE BIRDS

Province	Number of cycles per year	Number of eggs per cycle
Kampong Cham	3.7	11.6
Kampot	3.6	11.9
Odor Meanchey	3.6	11.8
Rattanakiri	3.2	12.2
Siem Reap	4.1	12.3

Marketing and labour division

Some 87 percent (351) of the respondents sell excess birds to generate income. In Kampong Cham and Kampot more than 95 percent of farmers sell their birds – only one respondent in Kampot reported not selling birds. Farmers sell birds mainly to local traders at the farmgate; others sell them at local markets within 10 km of their farms. The survey revealed that the chicken farmers do not sell eggs: in the entire survey, only one farmer—from Kampong Cham – reported selling eggs.

Regarding the division of labour in chicken management, only 85 respondents reported that both the husband and the wife are responsible for managing the birds, while 254 reported that only one is. Of these, men are in charge of caring for chickens in 127 households, and women in the other 127. Differences can be observed among provinces, with more men being responsible for chickens in Kampot and Odor Meanchey, and more women in Kampong Cham and Siem Reap (Table 23).

TABLE 23 LABOUR DIVISION IN CHICKEN MANAGEMENT

Province	Both partners	One partner	Men	Women
Kampong Cham	46	101	45	56
Kampot	0	35	23	12
Odor Meanchey	25	18	12	6
Rattanakiri	0	42	21	21
Siem Reap	14	58	26	32
Total	85	254	127	127

Marketing is usually the responsibility of men. Of 250 households marketing chickens, men are responsible for sales in 173. A similar trend is observed in all five provinces (Table 24).

TABLE 24 LABOUR DIVISION IN CHICKEN MARKETING

Province	Both partners	One partner	Men	Women
Kampong Cham	31	104	69	35
Kampot	0	37	28	9
Odor Meanchey	10	19	15	4
Rattanakiri	0	30	19	11
Siem Reap	6	60	42	18
Total	47	250	173	77

Phenotypic characterization of the birds

Of the 1 943 birds analysed, 1 937 had valid records of sex. Of these, 68.7 percent were female and 31.3 percent male. All the provinces had similar distributions, apart from Kampot, where 41.3 percent of the birds measured were male and 58.7 percent female (Table 25).



TABLE 25 NUMBERS OF FEMALE AND MALE BIRDS MEASURED

Province	Female	Male	Total
Kampong Cham	558	238	796
Kampot	135	95	230
Odor Meanchey	164	70	234
Rattanakiri	169	68	237
Siem Reap	304	136	440
Total	1330	607	1937

Body weight and shank length were analysed separately for each sex, while qualitative traits such as skin, shank, eye and earlobe colour, and comb type were analysed on both sexes combined.

Body weight

For all but one of the 1 943 birds, body weight was recorded. As there were many extreme figures beyond the natural limitation, a cut-off range was decided based on the distribution of the weights across different provinces. 800 g was selected as the lower limit because there were only 68 birds below this weight, and these were distributed unevenly across the different provinces. Only four birds weighted more than 3 500 g, and these records too were removed from the analysis. After removing these extreme figures, there were 1 776 valid records of weight and sex from the different provinces. The sex-wise distribution of these birds across the different provinces is provided in Table 26.

TABLE 26 NUMBERS OF FEMALE AND MALE BIRDS WITH VALID WEIGHT RECORDS

Province	Female	Male	Total
Kampong Cham	505	182	687
Kampot	135	95	230
Odor Meanchey	141	62	203
Rattanakiri	164	66	230
Siem Reap	297	129	426
Total	1 242	534	1 776

The analysis shows that the heaviest birds are in Siem Reap, where the average weights are 1 719 g for males and 1 494 g for females. The smallest birds are from Kampot province, where females weigh 1 315 g and males 1 322 g. In all five provinces, male birds are heavier than females, but in Kampot the difference between males and females is very small (6.3 g).

TABLE 27 COMPARISON OF BODY WEIGHTS ACROSS PROVINCES

Sex	Kampong Cham	Kampot	Odor Meanchey	Rattanakiri	Siem Reap
Males	1 479 a	1 322 a	1 428 ab	1 469 ab	1 719 a
Females	1 444 ac	1 315 b	1 342 ab	1 320 b	1 494 c

^{abc} Means with different superscripts in a row differ significantly ($p < 0.01$).

Shank length

The data for shank length were analysed separately for males and females, again using cut-off body weight limits of 800 and 3 500 g. After applying the restrictions, there were 1 763 birds with valid shank length and sex records (Table 28). Overall the shank length varied from 4 to 13.5 cm. The highest frequencies were for lengths of 8 cm among females and 10 cm among males.



TABLE 28 NUMBERS OF FEMALE AND MALE BIRDS WITH VALID SHANK LENGTH RECORDS

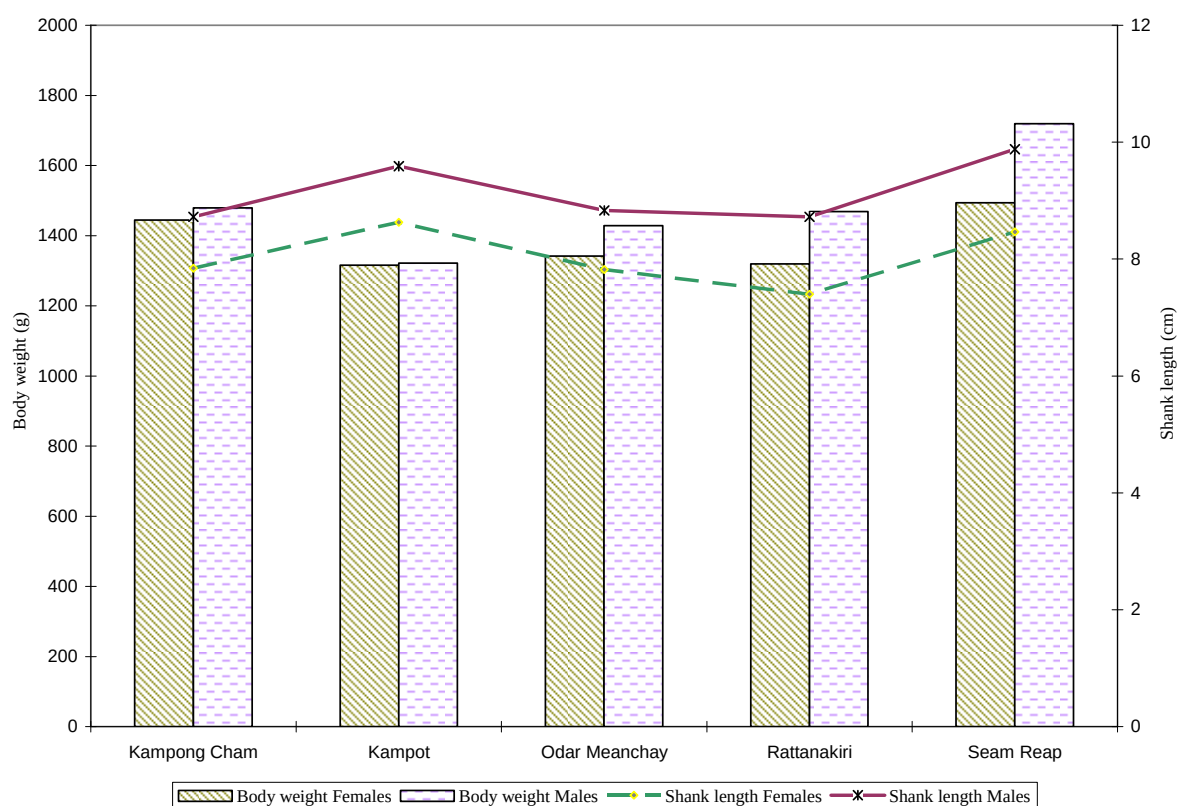
Province	Female	Male	Total
Kampong Cham	505	182	687
Kampot	131	91	222
Odor Meanchey	138	60	198
Rattanakiri	164	66	230
Siem Reap	297	129	426
Total	1 235	528	1 763

Shank length has a different kind of variation within provinces than weight has. Among females, birds from Kampot have the longest shank length (8.6 cm), and among males, those from Siem Reap do (9.8 cm). The birds from Kampot are small in body weight and have long shanks. Table 29 presents details of shank lengths, and Figure 3 depicts the comparison of body weight and shank length.

TABLE 29 COMPARISON OF SHANK LENGTHS ACROSS PROVINCES

Sex	Kampong Cham	Kampot	Odor Meanchey	Rattanakiri	Siem Reap
Males	8.7 ^a	9.5 ^{be}	8.8 ^{abc}	8.7 ^{ac}	9.8 ^{de}
Females	7.8 ^a	8.6 ^b	7.8 ^a	7.3 ^c	8.4 ^{ab}

^{abcd} Means with different superscripts in a row differ significantly ($p < 0.01$).

FIGURE 3 DISTRIBUTION OF BODY WEIGHT AND SHANK LENGTH OF MALE AND FEMALE BIRDS ACROSS PROVINCES

Shank colour

For analysing shank colour the full dataset of 1 943 birds was considered, but shank colour was recorded for only 1 920 birds. The remaining birds were assigned colours by using the photographs taken. Apart from the standard colours – black, green, grey-blue, white and yellow – 37 other colour combinations were recorded. This made the analysis impossible, so birds falling into categories other than the standard colours were reclassified based on the photographs and assigned to one of the standard colour groups.

Yellow is the most prominent colour, with 46.2 percent of all the birds belonging to this group. All the provinces have similar distributions, apart from Kampot, where nearly 62 percent of birds fell in this category. The second most prominent colour is grey-blue, with 18.9 percent. Here again Kampot shows some variance, with only 6.8 percent of the birds in this province belonging to this group. The third most prominent group is white. Overall, 15.5 percent of the birds are in this category, but only 6.4 percent of those from Odar Meanchey are. Siem Reap has the highest percentage (16.5 percent) of birds with black shanks, and Odar Meanchey the highest percentage (21.3 percent) of those with green shanks (Table 30).

TABLE 30 PERCENTAGE DISTRIBUTION OF SHANK COLOURS ACROSS PROVINCES

Shank colour	Kampong Cham ^{abc}	Kampot ^b	Odar Meanchey ^c	Rattanakiri ^a	Siem Reap ^d
Black	7.1	8.5	5.1	6.3	16.5
Green	7.9	10.6	21.3	5.4	10.9
Grey-blue	21.9	6.8	18.3	25.3	16.8
White	21.2	11.9	6.4	16.4	11.3
Yellow	41.7	62.1	48.7	46.4	44.3

^{abc} Different superscripts on the province names indicate significant differences ($p < 0.05$).

Skin colour

As in the case of shank colour, the full dataset was also considered for skin colour. Of all the 1 943 birds analyzed, 1 919 had valid records for skin colour. In total, 16 different skin colours were recorded, which makes analysis complicated, and there were no photos showing skin colour to help reduce the colour groups. However, from the dataset it can be concluded that white and yellow are the most prominent colours. When all the data are considered, 50.8 percent of the birds have white and 35 percent yellow skin. All the provinces have a similar pattern of distribution except Kampot, where 55.9 percent of the birds have yellow skin, and only 27.9 percent white. A high proportion of birds with pink skin (11.8 percent) was also found in Kampot.

Earlobe colour

Of the 1 943 birds phenotyped, only 1 909 had earlobe colour recorded validly. The others were assigned colours using the photographs. As well as the standard colours such as red, white, red-white and blue, the birds were originally grouped into 15 different categories, but photographs were used to narrow the classification down to five groups: red, white, red-white, blue and red-yellow. The non-standard red-yellow category was added because large numbers of birds fall into this category.

Red is the most prominent earlobe colour, accounting for about 84.3 percent of the birds across the study provinces. This figure varies among provinces, from 74.6 percent in Rattanakiri to 91.4 percent in Kampot. The second most common earlobe colour is red-white, with a share of 10.05 percent; the highest proportion of this colour (21.4 percent) is in Rattanakiri. Blue earlobes are found only in Siem Reap for some silky variety of birds (Table 31).



TABLE 31 PERCENTAGE DISTRIBUTION OF EARLOBE COLOURS ACROSS PROVINCES

Earlobe colour	Kampong Cham ^a	Kampot ^{ab}	Odor Meanchey ^c	Rattanakiri ^c	Siem Reap ^b
Red	0	0	0	0	0.2
Red-white	84.0	90.6	75.2	73.8	89.2
Red-yellow	8.9	6.8	15.3	22.3	7.5
White	0.5	0.8	6.8	2.1	1.1
Blue	6.5	1.7	2.5	1.6	1.8

^{abc} Different superscripts on the province names indicate significant differences ($p < 0.05$).

Eye colour

All 1 943 birds had their eye colour recorded, but other than the four standard eye colours, 24 different colour combinations were recorded. Here again the classification was corrected using the photographs.

Orange is the most common eye colour, accounting for 68.2 percent of the birds. A very similar figure was found in each province. The second most common colour is pearl, with 15.7 percent of the birds (Table 32).

TABLE 32 PERCENTAGE DISTRIBUTION OF EYE COLOURS ACROSS PROVINCES

Eye colour	Kampong Cham ^c	Kampot ^a	Odor Meanchey ^{ab}	Rattanakiri ^b	Siem Reap ^a
Brown	19.0	8.5	7.6	5.9	10.0
Orange	64.2	74.8	76.5	73.0	65.2
Pearl	14.3	15.7	12.8	13.0	21.3
Red	2.3	0.8	2.9	8.0	3.4

^{abc} Different superscripts on the province names indicate significant differences ($p < 0.05$).

Comb type

Regarding comb types, 53.4 percent of the birds have a single comb. More than 50 percent of the birds belong in this category in all provinces except for Kampot, with 35.7 percent, and Siem Reap, with 45.3 percent. Relatively high percentages of cushion combs are found in these provinces: 13.6 percent in Kampot and 15.5 percent in Siem Reap. In other provinces, the percentage of birds with cushion combs varies from 2.9 percent in Rattanakiri to 4.7 percent in Odor Meanchey. Only one bird in Rattanakiri was identified with a double comb (Table 33).

TABLE 33 PERCENTAGE DISTRIBUTION OF COMB TYPES ACROSS PROVINCES

Comb type	Kampong Cham ^a	Kampot ^b	Odor Meanchey ^a	Rattanakiri ^a	Siem Reap ^b
Single	56.1	35.7	62.3	64.1	45.0
Pea	37.4	49.3	32.9	31.6	37.7
Rose	2.2	1.2	0	0.8	1.5
Cushion	4.1	13.6	4.7	2.9	15.6
Double	0	0	0	0.4	0

^{ab} Different superscripts on the province names indicate significant differences ($p < 0.05$).

Other characteristics

Other traits such as naked necks, crests, beards and muffs, polydactylity, and frizzled or silky feathers were analysed. A relatively high percentage (11.9 percent) of naked-necked birds are found in Kampong Cham province, and none in the survey area of Kampot. In Rattanakiri, 8 percent of the birds are crested. Only ten birds in the entire study area have beards and muffs, the highest percentage (1.1 percent) of which are in Siem Reap, which also has the highest percentage (2.2 percent) of birds with polydactyl legs.



Only four birds from the entire survey area have frizzled feathers, and these are distributed equally in Odar Meanchey and Siem Reap provinces. Only seven birds – all in Siem Reap – have silky feathers. In general beards, polydactyl legs and silky feathers are found mostly in Siem Reap; naked necks are found mostly in Kampong Cham, crests in Rattanakiri, and frizzled feathers in Odar Meanchey (Table 34).

TABLE 34 PERCENTAGE DISTRIBUTION OF SPECIFIC TRAITS ACROSS PROVINCES

Province	Naked neck	Crest	Beard and muff	Polydactyl legs	Frizzled feathers	Silky feathers
Kampong Cham	11.9	0.2	0.3	0.2	0	0
Kampot	2.5	1.7	0.4	0	0	0
Odar Meanchey	2.5	2.9	0	0	0.8	0
Rattanakiri	0	8.0	0.4	0.4	0	0
Siem Reap	2.5	0.2	1.4	2.2	0.4	1.5

Multivariate analysis of phenotypic characteristics of the birds

To avoid potential sampling bias, only female birds were considered in the multivariate analysis of phenotypic characteristics. The number of birds analyzed is given below.

Province	Frequency
Kampong Cham (KC)	498
Kampot (KP)	128
Odar Meanchey (OD)	138
Rattanakiri (RK)	162
Siem Reap (SR)	292
Total	1 218

The following variables were considered in discriminant analysis. For skin colour, 15 levels were recorded. Grouping into five classes was attempted, but this grouping was rather arbitrary as the use of photos was not conclusive. Results of analyses including original and grouped levels were very similar. The following results are those for the original levels.

Body weight

Shank length

Shank colour; black, green, grey-blue, white, yellow

Comb type; cushion, double, pea, rose, single

Earlobe colour; blue, red, red-white, red-yellow, white

Eye colour; brown, orange, pearl, red

Crest

Naked neck

Beard and muff

Polydactyl

Frizzled

Skin colour; black, grey, grey-black, pink, pink-yellow, red, red-pink, white, white-pink, white-red, white-yellow, yellow, yellow-pink, yellow-pink-red, yellow-red



Stepwise discriminant analysis provides a ranking of traits in terms of their importance for distinguishing among provinces. The top ten variables are:

shank length;
yellow skin colour;
body weight;
naked neck;
crest;
black shank colour;
red-white earlobe colour;
cushion comb;
green shank colour;
brown eye colour.

With discriminant analysis, levels of class variables, such as skin colour, were treated separately. The high importance of yellow skin colour therefore indicates that the proportion of yellow skin colour varies greatly among regions. Body size (body weight and shank length) also figured prominently in distinguishing among regions. As there is also the potential for sampling bias (the choice of birds to include in the phenotypic description), canonical discriminant analysis was performed on all the traits, and also separately considering size traits and then other traits.



Analysis considering all traits

TABLE 35 MAHALANOBIS DISTANCES BETWEEN PROVINCES FOR ANALYSIS CONSIDERING ALL TRAITS

	KC	KP	OD	RK	SR
KC	0	1.68179	1.34970	1.31136	0.97438
KP	1.68179	0	2.00121	2.99509	0.81987
OD	1.34970	2.00121	0	1.42610	1.70949
RK	1.31136	2.99509	1.42610	0	2.21062
SR	0.97438	0.81987	1.70949	2.21062	0

FIGURE 4 CLUSTER ANALYSIS OF FEMALE CHICKENS BASED ON ALL VARIABLES

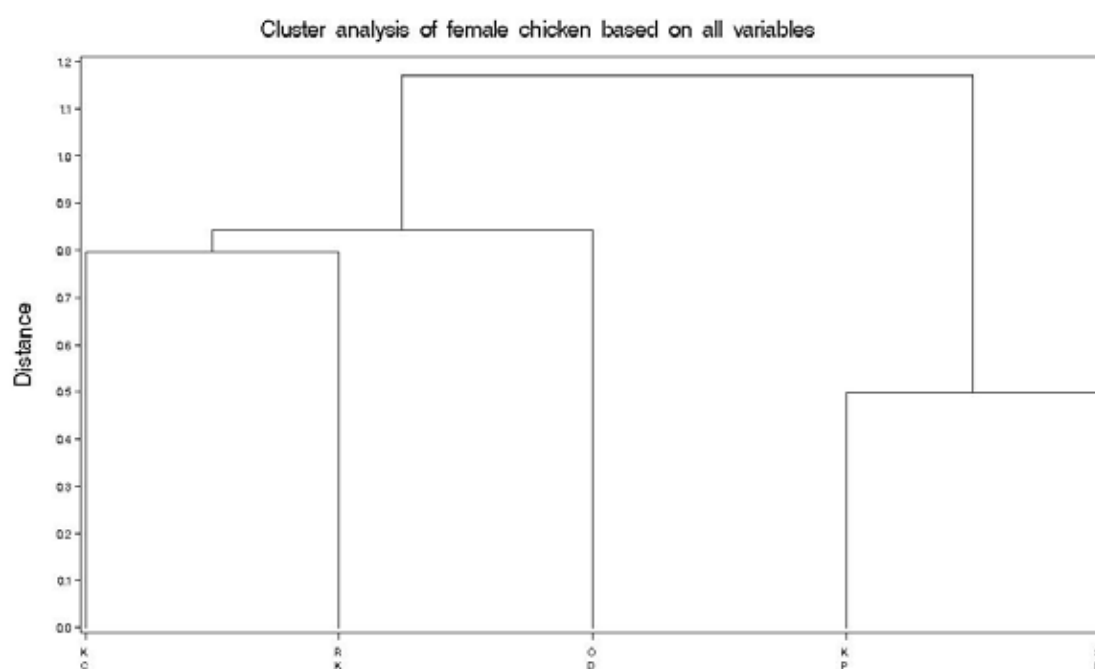


TABLE 36 MAHALANOBIS DISTANCES BETWEEN PROVINCES FOR ANALYSIS CONSIDERING ALL VARIABLES EXCEPT BODY WEIGHT AND SHANK LENGTH

	KC	KP	OD	RK	SR
KC	0	0.89259	1.31053	1.06310	0.76995
KP	0.89259	0	1.29309	1.53889	0.45690
OD	1.31053	1.29309	0	1.27005	1.40978
RK	1.06310	1.53889	1.27005	0	1.34472
SR	0.76995	0.45690	1.40978	1.34472	0

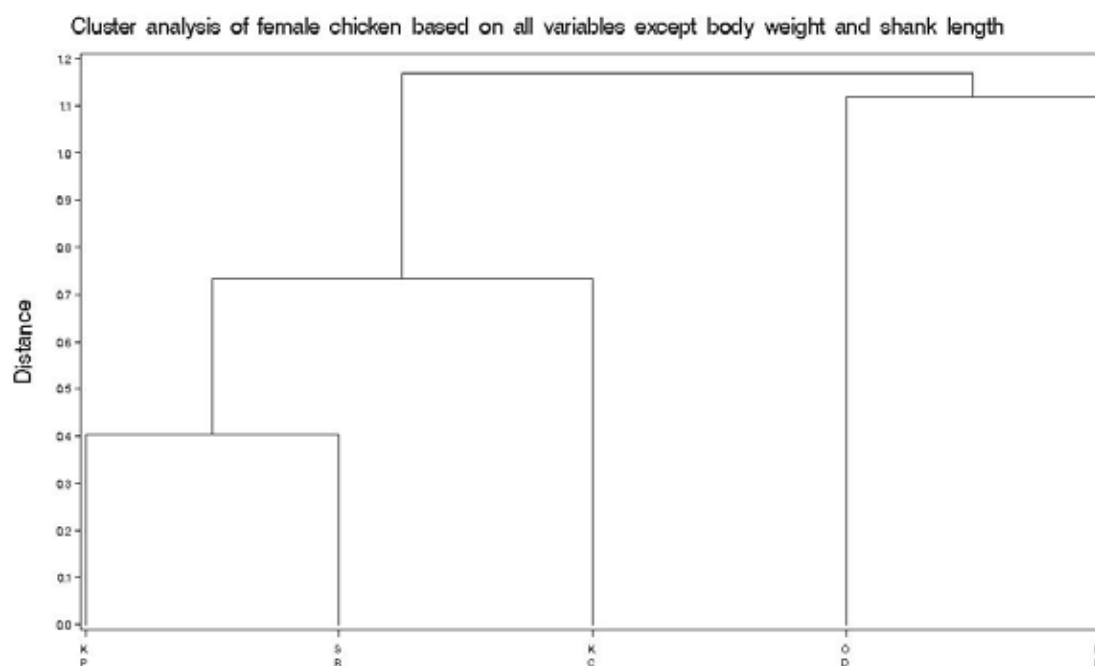
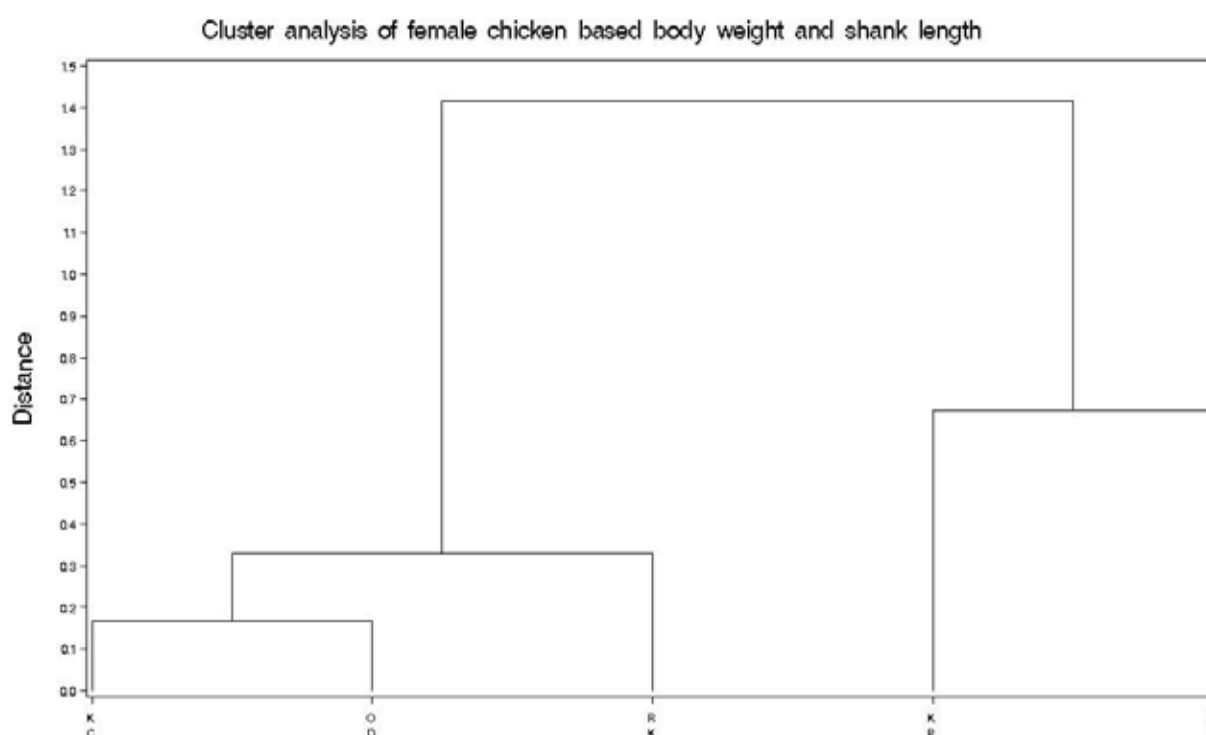
FIGURE 5 CLUSTER ANALYSIS OF FEMALE CHICKENS BASED ON ALL VARIABLES EXCEPT BODY WEIGHT AND SHANK LENGTH

TABLE 37 MAHALANOBIS DISTANCES BETWEEN PROVINCES FOR ANALYSIS CONSIDERING BODY WEIGHT AND SHANK LENGTH

	KC	KP	OD	RK	SR
KC	0	1.00009	0.09516	0.20585	0.31937
KP	1.00009	0	0.68747	1.51995	0.38294
OD	0.09516	0.68747	0	0.16794	0.37011
RK	0.20585	1.51995	0.16794	0	0.94164
SR	0.31937	0.38294	0.37011	0.94164	0

FIGURE 6 CLUSTER ANALYSIS OF FEMALE CHICKENS BASED ON BODY WEIGHT AND SHANK LENGTH

Results of the multivariate analysis of phenotypic characteristics indicate that the populations of different provinces are well separated with no significant similarities among them. The populations of Kampong Cham and Odar Meanchey are similar in size, but very different in other traits. Overall, despite the distance between them, the populations of Kampot and Siem Reap seem to be the most similar.



Analysis of the production systems by province

Kampong Cham

FIGURE 7 MAP OF KAMPONG CHAM SHOWING THE DISTRICTS SELECTED FOR THE SURVEY



This province is located in the southeastern part of Cambodia, and is bisected by the Mekong River into a northern and a southern zone. In the northern zone, forest and rubber plantations are found, while in the southern zone lowland paddy fields predominate. Three districts were selected for the survey: Cheung Prey, Kampong Siem and Preychor. The total estimated population of the province is about 1.8 million people (2004), of whom 52 percent are female.

Farmer households and life style

A total of 170 household from the three districts were included in the study: 73 in Cheung Prey district, 28 in Preychor 28, and 69 in Kampong Siem. The majority of the farmers surveyed in this province (52.3 percent) are men. Only 13.6 percent are illiterate, and the rest have primary, secondary or high school education. This illiteracy rate is lower than that of all other provinces apart from Kampot; 77.3 percent of the farmers have primary or secondary education. 63.6 percent of the households in this province have five or fewer members, and only 9.5 percent have eight or more. These figures reflect the relatively high percentage of farmers with primary or secondary education. 71 percent of the interviewees are regular radio listeners and 96.4 percent use mobile phones.

Another important factor that determines agricultural and animal husbandry activities is the land owned by each farmer. In this province, 44.3 percent of farmers own between 0.3 and 1 ha of land, 37.2 percent own from 1 to 5 ha, and 4.1 percent are landless farmers who might be renting or leasing fields for cultivation. The proportion of landless farmers in Kampong Cham is lower than that in all other provinces apart from Kampot. Details are provided in Table 38 at the end of this section.



Livestock numbers

Farming households in Kampong Cham rear relatively large numbers of cattle, pigs and chickens. On average, each farmer owns about 4.3 head of cattle, 5.2 pigs and 37 chickens. About 69.4 percent of households own cattle, while 51.7 percent keep pigs. These three figures are the second highest in their respective categories across provinces. None of the interviewees keep sheep or goats. Analysis of chicken figures shows that each farmer rears about 19.9 chicks, 9.7 pullets, 5.7 hens, 8.5 cockerels and 2.2 adult cocks. There are about 2.6 adult female poultry to each male.

Only 20.8 percent of the farmers in this province said that the income from chickens is highly important to their families. The majority stated that it is of only medium importance. Similar results are obtained for pig rearing, with 76.2 percent saying that it is of only moderate importance. On the other hand, 81.2 percent of the farmers said that income from cattle is highly important. About 16 percent of households rear buffaloes, with an average of 2.9 animals per household. The high number of farmers owning relatively large areas of land may explain this phenomenon. These figures also point to the importance of rice cultivation in farmers' livelihoods, as cattle in Cambodia are used mainly for draught purposes. Although they rear substantial numbers of chickens, most farmers do not consider them a major source of income. About one-third of the farmers said that their chicken numbers decreased over the last five years, owing to various reasons. The rest mentioned that the numbers increased or remained the same.

Only two households in Kampong Cham keep improved chicken, and there is a total of only three birds in these two households, all adult males. This implies that these two farmers have the general idea of improving breeds using male lines. Details are presented in Table 39 at the end of this section.

Management

Breeding

Farmers were asked about the breeding and husbandry practices they follow. About one-third of the farmers in Kampong Cham buy birds from outside, with 93 percent of these farmers buying from neighbours. The questionnaire does not specify whether these are immediate or distant neighbours. A similar trend is found in the other provinces. The reliability of neighbours and knowledge of the birds' history may be the reason for this. Body weight and number of eggs laid are the two major factors considered during selection.

Very few farmers practise flock improvement methods, and of these 97 percent prefer local breeds. Farmers also prefer to purchase adult rather than young birds, for both local and improved breeds. These responses imply that farmers experience high chick mortality. The figures are in line with those of other study areas. When asked whether they try to obtain better birds for flock improvement, 81.2 percent gave a positive response, which is a lower percentage than that in other provinces. The high importance that farmers in this province give to agriculture and other livestock species may explain this.

Housing

Nearly 24 percent of the farmers in this province reported that they house their birds day and night, but the survey result does not make it clear whether they house all their birds or only some (such as chicks). This figure is very high compared with those for other provinces. Of the remaining households, 68.2 percent provide housing for their birds only at night. The materials used to construct houses vary.



About 60 percent of the farmers use only simple farm materials, and 39.5 percent also use simple purchased materials. These figures show that a large proportion of farmers opt for low-cost housing with few inputs. The provision of housing helps to make chicken farming sustainable. Of the farmers who do not provide any housing, 20.3 percent gave economic factors as the reason. Although the farmers are aware of the importance of housing for their birds' productivity, economic constraints prevent them from providing shelter.

Feeding

In Kampong Cham, 94.7 percent of the surveyed farmers provide their chickens with feed, including kitchen waste, by-products from the fields or purchased feed. Of the farmers providing feed, one-third purchase it. In Kampong Cham, the majority of farmers depend mostly on their neighbours for purchasing feed for their birds, a trend that differs clearly from that in other areas. The main feedstuff is grain from the farm, as farmers own reasonably large land areas. Details are shown in Table 40 at the end of this section.

Productivity

Birds' productivity was recorded during the interviews with farmers, but no cross-checks or monitoring of flock performances were carried out. The number of production cycles per year is 3.7, which is the second highest figure among the five provinces. Farmers reported that they get an average of 11.6 eggs per cycle, which is the lowest figure of all the provinces. 100 percent of the farmers in Kampong Cham answered this question, showing that they are aware of their birds' productivity. A similar trend is found in all the provinces. Of the chicks hatched, only 61.9 percent survive beyond six months of age. Farmers mentioned disease as the main cause of mortality in all three phases. Only 20.7 percent of the farmers use the available veterinary facilities. According to the farmers, birds start to produce eggs at slightly less than six months of age, the lowest age among all the provinces. Details are provided in Table 41 at the end of this section.

Marketing and labour division

94.7 percent of the households sell excess birds, mainly to local traders at the farmgate, followed by local markets less than 10 km away, and neighbours. Only one farmer reported selling eggs; he is the only farmer in the entire survey to do so. Regarding the division of labour, 46 farmers stated that both the husband and the wife are responsible for managing the birds, and 101 that either of them is. Among these farmers, 55.5 percent said that women are responsible. In 66.3 percent of cases, marketing is done by men.

Phenotypic characterization of chickens

In total, 797 birds were characterized in this province and, after applying validity restrictions, 687 (505 females and 182 males) were used for the analysis of body weight and shank length. Male birds weigh about 1 479 g and females 1 444 g, with average shank lengths of 8.7 and 7.8 cm respectively. Female body weight is the second highest in the five provinces, after Siem Reap.

Yellow is the most common shank colour, observed in 41.7 percent of the birds, followed by grey-blue (21.9 percent) and white (21.2 percent). Very few black and green shanks were seen. The most common earlobe colour in this region is red-white, with about 84 percent. The second most common variety is red-yellow, with 8.9 percent. At 6.5 percent, the percentage of blue earlobes is higher in Kampong Cham than in other provinces. Orange is the most common



eye colour, with 64.2 percent, followed by brown. Red is the rarest, with 2.3 percent. A single comb is the dominant comb pattern, with 56.1 percent, followed by pea combs with 37.4 percent. No birds with double combs were reported in this area. The proportion of birds with naked necks is relatively high, at 11.9 percent, compared with about 2 percent in the other provinces.

Kampot

FIGURE 8 MAP OF KAMPOT SHOWING THE DISTRICTS SELECTED FOR THE SURVEY



Kampot is located in the southern part of Cambodia on the coast of the Gulf of Thailand. The topography ranges from coastal areas along the southern border, to extensive lowland paddy fields in the east, and forested areas in the west. The estimated population is about 595 000 people, of whom 52 percent are female. Three districts were included in the survey: Angkorcheay, Chuouk and Kampong Trach. Kampong Trach is located in the southwestern part of the province, near the coastal area; the other two districts are in central and western parts respectively.

Farmer households and life style

In total 48 households were surveyed, 16 from each district. The proportion of men involved in chicken production is lower than in Kampong Cham.

The literacy rate among farmers is higher than in Kampong Cham; the percentage of illiterate respondents is half that reported for Kampong Cham. This province has the highest percentage of farmers with primary, secondary and high school education. 66.6 percent of the households have fewer than five members, which is the highest percentage among all the provinces. The percentage of families with more than eight members is the lowest. The proportion of regular radio listeners is the lowest among the five provinces. This may be because the high literacy rate has a negative impact on radio listening, and because farmers can gather more information from other sources. Farmers seem to be in a good situation economically, as 100 percent of them use mobile phones.

Regarding landownership, 93.7 percent of the farmers own between 0.3 and 5 ha. This is the highest percentage among all the provinces. Only 2 percent of farmers own no land, which is the lowest proportion among the provinces. Surprisingly, no farmers in this province own more than 5 ha, which shows that the land is fairly equitably distributed. Details are provided in Table 38 at the end of this section.

Livestock numbers

Each farming household rears an average of 3.5 cattle and 4.6 pigs. These figures are intermediate compared with other provinces. 95 percent of households rear cattle and only 52 percent keep pigs. None of the farmers keep sheep or goats. Only one farmer in the area keeps buffaloes (two).

Each household also rears an average of 40.1 chickens, which is the highest figure among all the provinces. These birds are, on average, 20.3 chicks, 9.9 pullets, 7.1 hens, 9.9 cockerels and 2.5 cocks. Farmers in this region have more adult female chickens than farmers in Kampong Cham have. There are about 2.8 adult females to each male; slightly more than in Kampong Cham.

Farmers in this province consider income from cattle to be more important than that from pigs or chickens – a general trend found in all provinces. About 80.4 percent of the interviewees consider the income from cattle as highly important, compared with 8.3 percent considering that from chickens as highly important. This is the lowest proportion for chickens found in all the provinces. Almost all the farmers stated that income from pigs is of only moderate importance. Because of the relatively large areas of land owned, farmers might give more importance to agricultural activities such as paddy cultivation, from which they can earn better income. Only 22.9 percent of the farmers in this province reported that chicken numbers decreased over the last five years. This is the lowest figure for any province. None of the farmers keep improved chickens. Details are provided in Table 39 at the end of this section.

Management

Breeding

One-third of the farmers said that they buy birds from outside to improve their flocks; 87.5 percent of these farmers rely on their neighbours as a source of purchases. 31.2 percent of the farmers said that they buy birds for stock improvement, of whom 93.3 percent buy adult birds. All of these farmers buy only local chickens for breed improvement. More than 60 percent of the farmers do not seek to improve their birds. As in Kampong Cham, the high priority given to agriculture may explain this. Another interesting figure is that 100 percent of the farmers use brooding hens for hatching chicks. In general, the survey results regarding breeding in this province are very similar to those from Kampong Cham.



Housing

Only 12.5 percent of the farmers in Kampot provide housing for their birds both day and night. This is just over half of the figure observed in Kampong Cham. 79.5 percent of the remaining farmers provide housing at night. Compared with other provinces, a larger proportion of farmers in Kampot provide housing. The high literacy rate might be a reason for this, as farmers have more resources and are more aware of the importance of housing. Almost all the farmers use either simple farm materials or simple purchased materials. Only eight farmers do not provide housing for their animals, and of these four said that it is for economic reasons.

Feeding

100 percent of the farmers provide feedstuffs to their birds, but only 18.7 percent buy feed. More than 80 percent of the farmers rely on grains from their fields. For both housing and feeding, it can be concluded that farmers try to remain independent from external sources. Details are provided in Table 40 and 41 at the end of this section.

Productivity

All productivity data were recorded through interviews with farmers, and were not validated by monitoring the performance of individual animals or whole flocks. According to farmers, a hen has an average of 3.6 production cycles per year, with 11.9 eggs per cycle. These figures represent moderate productivity when compared with those from other provinces. Farmers said that 66.1 percent of the chicks hatched survive beyond six months of age. This is a high percentage compared with those from other provinces. Disease is the main cause of losses during all three phases. Interpretation of this result should also consider farmers' usage of veterinary services. 54 percent of the farmers in this province use veterinary services provided by the government. The high survival rate of young chicks may be influenced by this high coverage of veterinary service. On average, a hen starts laying eggs at 6.1 months of age. Details are provided in Table 41 at the end of this section.

Marketing and labour division

97.9 percent of farmers sell excess birds, usually to traders at the farmgate. The second choice for selling birds is neighbours, followed by local markets less than 10 km away. Farmers do not sell eggs. None of the farmers said that both husband and wife are equally responsible for managing the birds. In 65.7 percent of cases, the management of chickens is men's responsibility. Similar results are obtained for marketing, which is also male-dominated, with only 24.6 percent of interviewees mentioning that marketing is done by a female member of the household.

Phenotypic characterization of chickens

A total of 230 birds (135 females and 95 males) were used for the analysis. Males in Kampong Cham weigh an average of 1 321.7 g and females 1 315.4 g. The difference between these body weights is only 6.3 g, which is the smallest of any province. These body weights are also the lowest in their respective categories. However, males have a shank length of 9.5 and females 8.6 cm – among the highest figures compared with other provinces. In general, it can be concluded that birds in Kampot are small in body size with long shanks.

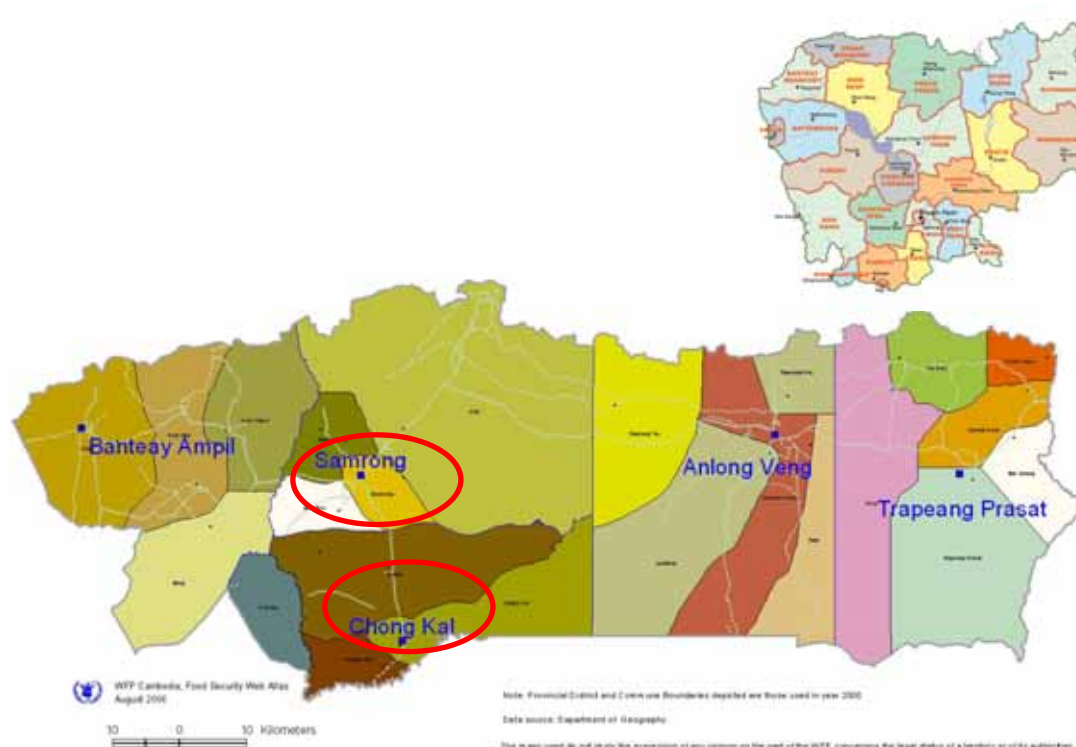
The most common shank colour is yellow, with 62.1 percent. This is the highest proportion among all five provinces. As in other provinces, red-white is the most prominent colour for earlobes (90.6 percent), and orange for eyes (74.8 percent). Pea combs are the most prominent comb type (49.36 percent). This is the usual comb pattern for birds with small



bodies and long shanks. The second most common pattern is the single comb, with 35.7 percent. The study did not find any extraordinary proportions for any of the other traits in the chicken population. The proportions of naked necks is 2.5 percent, crests 1.7 percent and beards and muffs only 0.4 percent.

Odar Meanchey

FIGURE 9 MAP OF ODAR MEANCHEY SHOWING THE DISTRICTS SELECTED FOR THE SURVEY



This province is located in the northwestern part of Cambodia, where the country borders Thailand. The topography varies from lowland mosaic areas to upland forests. This province is the most remote of those considered in the study, and was included in anticipation of finding specific local genetic resources. The estimated population is about 95 000 people, of whom 49 percent are female. The density of the population is low, at 14 people per square kilometre. The survey was conducted in two districts: Chongkal and Samroung. These districts are located in the western part of the province, and Chongkal borders Siem Reap to its south. In total, 48 households were included in the study, 24 from each district.

Farmer households and life style

78.2 percent of the respondents are men, the highest figure observed in the five provinces. Farmers' education level is lower than that in other provinces: 28.8 percent of interviewees are illiterate, which is the highest figure for any survey province. About 71.2 percent have primary or secondary education. Household sizes are fairly similar to those in Kampong Cham and Kampot: 63 percent have fewer than five members; 19.5 percent have six or seven; and 8.7 percent have eight or more.

The landownership pattern is similar to that of Rattanakiri: 4.3 percent of the farmers are landless, and 84.7 percent own between 0.3 and 5 ha. Another interesting figure is that nearly 11 percent of the farmers own more than 5 ha. The low population density might be the reason for these relatively high landholdings.

80.8 percent of farmers are regular radio listeners; this is the highest figure among all five provinces. As the illiteracy rate is high, more people might depend on the radio for information. Mobile phone use is 89.3 percent; this comparatively low figure might be due to the province's remoteness. Details are provided in Table 38 at the end of this section.

Livestock numbers

66.6 percent of the interviewed farmers rear cattle, and 48 percent rear pigs. These households rear an average of 3.5 head of cattle, 2.3 pigs and 26.7 chickens. There are fewer chickens per household than in Kampot and Kampong Cham, but more than in Rattanakiri. Each farmer keeps about 15 chicks, 5.8 pullets, 4.5 hens, 4.3 cockerels and 2 adult cocks. There are about 2.25 adult female poultry to each male, which is fewer than in Kampong Cham and Kampot. In spite of the low numbers of chicken, its importance to household income is high compared with other areas. Nearly 46.5 percent of the farmers rate the income from chickens as very important, which is the highest proportion in any of the five provinces. 56.5 percent of farmers stated that pigs play a very important role in household income. This is also a high value compared with other provinces. About 80.6 percent said that income from cattle is very important. These figures show that farmers in this province rely more on the income from livestock than farmers in other provinces do, even though they maintain lower numbers of livestock. None of the farmers in this province keep improved chickens. A high proportion (53.1 percent) believe that chicken numbers have declined over the last five years. A similar trend is observed in Rattanakiri. Details are provided in Table 39 at the end of this section.

Management

Breeding

Only 25 percent of the farmers in this province buy chickens for their flocks. This is a lower proportion than in the other provinces, where about one-third of farmers buy birds. Of the farmers who purchase animals, 50 percent buy from neighbours. As in other provinces, farmers who are interested in improving their flocks buy local chicken breeds. One observed difference is that only 50 percent of the farmers in Odar Meanchey prefer adults, while the others purchase chicks. This is a clear differentiation from the general buying behaviour in other provinces, where adult animals are preferred. Economic factors may be the driving force behind this behaviour, as the price of chicks is lower than that for adults. 93.7 percent of farmers use brooding hens to hatch chicks.

Housing

Only 2 percent of the farmers house their birds both day and night. Of the rest, only 62.5 percent provide night shelter. These are the lowest proportions found in all five provinces. Housing facilities are usually made from simple farm materials. 52.6 percent of the farmers who do not provide housing for their birds gave economic factors as the reason. These figures point to the poor economic situation of chicken farmers in this province.

Feeding

95.8 percent of the surveyed farmers provide feed for their birds, but only 4.5 percent purchase concentrate. This also indicates the economic constraints faced by farmers. In



contrast to other provinces, none of the farmers in Odar Meanchey buy feed from neighbours, which is usually the most common source for feed purchase. Details are provided in Table 41 at the end of this section.

Productivity

According to farmers' responses, there are 3.6 production cycles per year, with 11.8 eggs per cycle. The proportion of chicks that survive to phase three is one of the lowest among the five provinces, at only 58.7 percent. According to the farmers, the main causes of losses are predators in the first phase, and disease in phases two and three. Only 25 percent of farmers use any kind of veterinary assistance. The average age of hens at first lay is about 6.3 months. Details are provided in Table 41 at the end of this section.

Marketing and labour division

In this province, only 68.7 percent of farmers sell their excess birds, which is the lowest figure of any province. The low chicken numbers per household and the high mortality rate might be reasons for this. Birds are mainly sold to traders at the farmgate, followed by neighbours and local markets less than 10 km away. A similar order of preference is seen in Kampot. In general, farmers do not sell eggs.

In total, 25 farmers said that both men and women are responsible for managing birds; 18 said that one of the other is, of whom 12 (66.6 percent) said that men are responsible and the others that women are. In 78.9 percent of the households where either the wife or the husband is responsible for marketing, sales are carried out by men.

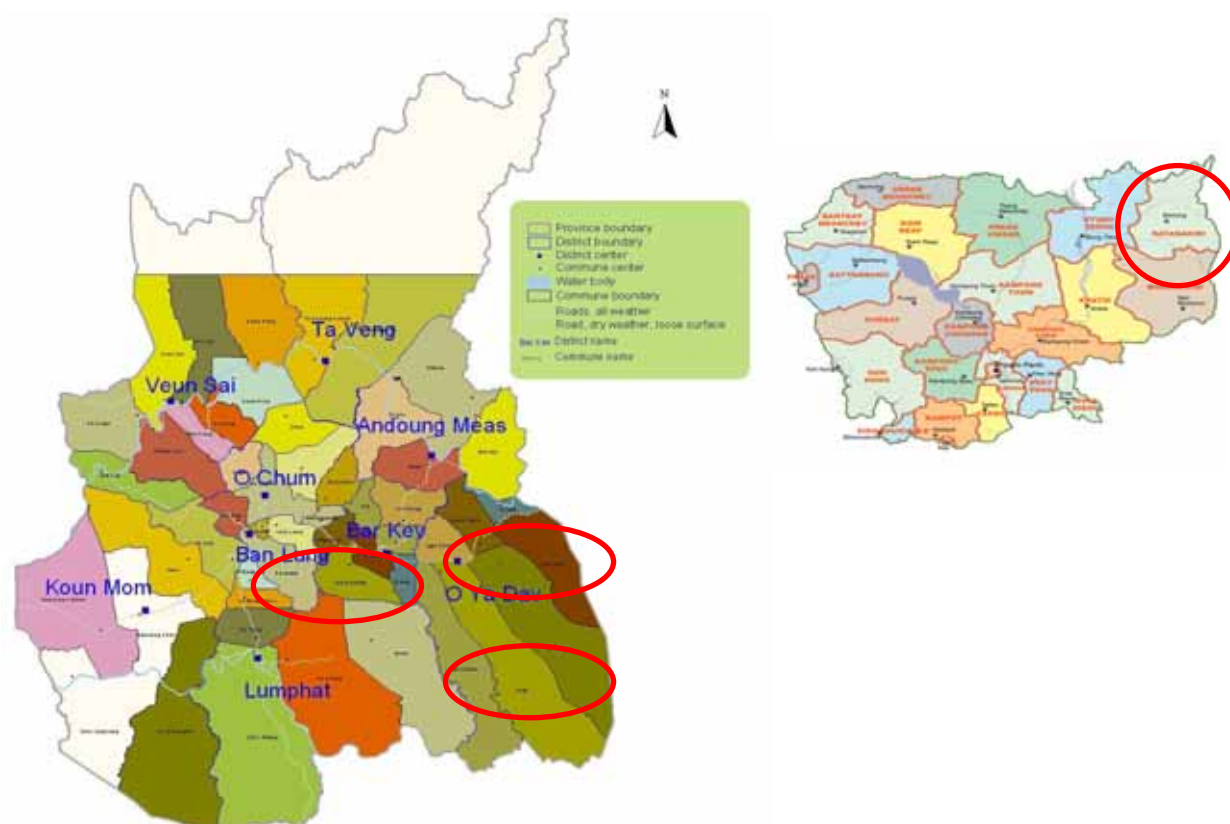
Phenotypic characterization of chickens

The average male bird weighs 1 428.3 g, and females weigh 1 342.3 g. Both these figures are intermediate compared with those from other provinces. The shank length of males is about 8.7 cm and of females about 7.8 cm. Compared with the birds in Kampot, these weigh more and have shorter shanks. Yellow and green are the two prominent shank colours, at 48.7 and 21.3 percent respectively; these were the highest proportions for these colours among all provinces. As in other provinces, red-white is the dominant earlobe colour, with 75.2 percent. Orange dominates eye colours, with 76.5 percent. Regarding comb patterns, the percentage distribution is close to that in Rattanakiri. Single combs are the most common, with 62.3 percent, followed by pea combs, with 32.9 percent. 2.5 percent of birds have naked necks, 2.9 percent have crests and 0.85 percent have frizzled feathers.



Rattanakiri

FIGURE 10 MAP OF RATTANAKIRI SHOWING THE DISTRICTS SELECTED FOR THE SURVEY



The province Rattanakiri is located in the northeastern corner of Cambodia; it borders Lao People's Democratic Republic to the north and Viet Nam to the east. The topography shows upland forest areas and river valleys. The estimated population is about 118 000 people, of whom 51 percent are female. Three districts were selected for the survey: Ban Lung, Koun Mom and Lumphat. 16 households were surveyed in each district. All three districts are located towards the south of the province.

Farmer households and life style

56.2 percent of the interviewees are men. About 20.4 percent of them are illiterate, and the rest have primary, secondary or high school education. The illiteracy rate is similar to that in Siem Reap. A relatively high 17 percent of households have more than eight members, which is the highest proportion for all provinces. Only 46.8 percent have fewer than five members, which is the lowest value for all provinces. Nearly 79 percent of the farmers are regular radio listeners, and about 87.5 percent use mobile phones. This is the smallest proportion observed in the study. The general backwardness of the province may be the reason.

Rattanakiri has the highest proportion of landless farmers, at 22.9 percent, but a large number of farmers (14.5 percent) own more than 5 ha. These are the highest values for all the study provinces and indicate that, in general, there is wide disparity in land distribution, with a large number of people without any land and some farmers owning comparatively large areas. Details are provided in Table 38 at the end of this section.

Livestock numbers

Households that rear cattle own an average of 7.7 head each. This high figure is because, compared with other provinces, fewer farmers (50 percent) rear cattle, and those who do rear large numbers. The average figure for pigs is about 2.3, reared by 37.5 percent of households. Seven households keep buffaloes, with about 2.5 animals each. Fewer chickens are reared per household than in other provinces, with an average of 23.3 birds. The unequal land distribution and general backwardness may explain this. Each farmer rears about 10.4 chicks, 8.8 pullets, 5 hens, 5.6 cockerels and 2.9 adult cocks. There are about 1.7 adult female chickens to each male. This is the lowest sex ratio found in the study and shows that farmers keep large number of males, maybe more than are required for breeding.

Analysis of responses regarding the importance of different livestock shows that only 60 percent of farmers consider the income from cattle as highly significant. This is the lowest proportion in any province. Unlike in the other provinces, only 83 percent of farmers said that rice is their main crop. These figures show that the dependence on rice is less than in other provinces. The land topography may not be suitable for rice cultivation. The proportion of farmers who consider the income from chickens as highly important is a relatively high 23.2 percent. Three farmers rear improved chickens, each having an average of 19 improved birds in different age classes. 62.5 percent of farmers stated that chicken numbers decreased over the last five years. This is the highest observed value. Details are provided in Table 39 at the end of this section.

Management

Breeding

As in most other provinces, 33.3 percent of the farmers buy birds from outside for their flocks, but they only buy from neighbours. Farmers usually prefer local birds and buy adults. Similar to Kampong Cham, 82.2 percent of farmers reported obtaining better birds to improve their flocks and, in line with observations from other provinces, the majority of farmers rely on their own stock for improvement. Body weight is the most important criterion for the selection of breeding animals.

Housing

Only 10.4 percent of the farmers in Rattanakiri provide housing both day and night. Among the remaining households, 68.8 percent provide night housing. Of the farmers providing some kind of housing, 60 percent use simple farm materials for construction and 37.1 percent also use simple purchased materials. Only one farmer from this province uses improved construction methods. None of the farmers stated economic reasons for not providing housing.

Feeding

Only 87.2 percent of the farmers in Rattanakiri provide feed to their birds. This is the lowest proportion in the study. 27.9 percent of these farmers purchase feed, mainly from sources other than neighbours and markets. This practice is similar to that found in Odar Meanchey. Details are provided in Table 41 at the end of this section.

Productivity

Farmers mentioned that each bird has an average of 3.2 production cycles a year, with 12.2 eggs per cycle. This figure is the second highest in the study.



On the other hand, the chick survival rate is the lowest in the study, with farmers reporting that only 58.1 percent of the chicks hatched survive beyond six months of age. The main reason for losses in all three phases is disease. In this province, the use of veterinary services is very low, at only 14.8 percent of the interviewed farmers. The average age when hens start laying is 6.1 months. Details are provided in Table 41 at the end of this section.

Marketing and labour division

Only 78.7 percent of the farmers sell their excess birds, which is the lowest proportion in the survey. Those who do sell, sell mainly to traders at the farm gate, followed by neighbours then nearby markets. In line with the general trend across provinces, farmers do not sell eggs. The management of birds is distributed equally between men and women, but marketing is mainly controlled by men (63.3 percent).

Phenotypic characterization of chickens

A dataset of 230 birds (164 females and 66 males) was used for the analysis of body weight and shank length. On average, male birds weigh 1 468.9 g and females 1 319.7 g. These figures are medium values compared with those from other provinces. Males have a shank length of 8.7 cm and females 7.3 cm. These figures are also moderate in comparison with the other provinces. The most prominent shank colour is yellow, with 46.4 percent, followed by grey-blue, with 25.3 percent. As in other provinces, red-white is the most prominent earlobe colour, with 73.8 percent, followed by red-yellow with 22.3 percent. Orange dominates the eye colours, with 73 percent, followed by pearl, with 13 percent. Single combs are the most common comb pattern, with 64.1 percent, followed by pea combs, with 31.6 percent. No birds in Rattanakiri have naked necks, frizzled feathers or silky feathers. About 8 percent are crested, which is a far higher figure than in other provinces. The percentages of birds having beards and muffs, and having polydactyl legs is each 0.4.



FIGURE 11 MAP OF SIEM REAP SHOWING THE DISTRICTS SELECTED FOR THE SURVEY



Farmer households and life style

Animal Health, Breeds and Livelihoods



Livestock numbers

Fewer than 50 percent of households own pigs, but each of these has about 6.6 animals. Only 47 percent rear cattle, with an average of 3.1 head per household. About 16 percent of households keep buffaloes, with an average of three head each. Of the 88 households surveyed, 86 keep local chickens and two rear improved chickens. Each farmer rears an average of 33.3 local birds, which is more than in Rattanakiri and Odar Meanchey. Each household rears about 16.6 chicks, 8.7 pullets, 5.8 hens, 8.3 cockerels and 2.3 adult cocks. There are an average of 2.5 adult female chickens to each male. The two households with improved varieties each rear three birds. Only 18.3 percent of farmers considered the income from chickens as important for their families, compared with 77 percent considering the income from cattle as highly important. Only 23.8 percent of the farmers in this province said that chicken numbers decreased over the last five years; the majority believe that numbers either remained the same or increased. This is a good trend compared with the figures from Odar Meanchey and Rattanakiri, where more than 50 percent of farmers think that numbers have gone down. Details are provided in Table 39 at the end of this section.

Management

Breeding

About one-third of the farmers buy chickens from outside for their flocks. As in other provinces, farmers rely mostly on their neighbours for purchasing chickens. In line with the general trend, more than 90 percent of the farmers in Siem Reap buy local adult birds. 88 percent said that they try to obtain better birds for their flocks, of whom 77 percent select from their own stock. The most important selection criteria are body weight followed by mothering ability and eggs laid. All the other provinces except Kampot have a similar order of preference for selection criteria.

Housing

Only 14.7 percent of farmers house their birds (or chicks) during both day and night; of the rest, 78.4 percent provide night housing. None of the farmers use costly materials to build houses: 52 percent use simple farm materials and the rest also use simple purchased materials. This figure indicates that farmers in Siem Reap give slightly more importance to housing than those in other provinces, and is comparable to that from Kampot. Of the farmers who do not provide housing, 35 percent gave economic factors as the reason.

Feeding

97.7 percent of the farmers in this province provide feed, and 35.2 percent of these farmers purchase feed. This is the highest proportion in all provinces. Markets are the main source for purchased feed. As in other provinces, farmers depend mainly on grains produced on the own farms. Details are provided in Table 41 at the end of this section.

Productivity

Farmers explained that their hens have four cycles a year, with 12.3 eggs per cycle. Both figures are the highest of any province. Farmers reported that 63.1 percent of hatched chicks survive beyond six months of age. In all three phases, disease is the main cause of mortality. 26.4 percent of the farmers stated that they use veterinary facilities provided by the government. The average age of hens at first lay is about 6.2 months. Details are provided in Table 41 at the end of this section.



Marketing and labour division

Only 83.9 percent of the farmers sell their excess birds; as in other provinces, the main selling points are traders at the farmgate, followed by local markets within 10 km and then neighbours. None of the farmers in Siem Reap sell eggs. There is a clear labour division between men and women. Of the farmers reporting that only the husband or the wife is responsible for management and marketing, women were mainly responsible for management (55.1 percent) and men for marketing (70 percent).

Phenotypic characterization of chickens

A total of 426 birds (297 females and 129 males) were measured for the analysis of body weight and shank length. The average weights are 1 719.4 g for male birds and 1 494.2 g for females. These are the highest body weights reported in the survey provinces. Males have a shank length of 9.8 cm, the highest among the provinces, and females 8.4 cm, the second highest after Kampot. In general, birds in Siem Reap have heavy bodies and long shanks. A relatively even distribution of shank colours can be observed. The highest proportion is for yellow, with 44.3 percent, followed by black and grey-blue, with about 16 percent each, and white and green, with 11 percent each. As in other provinces, red-white is the most common earlobe colour. Orange dominates the eye colours, with 65.2 percent, followed by pearl, with 21.3 percent. A comparatively high 15.6 percent of cushion combs is found in this province, but the most common is the single comb, with 45 percent, followed by pea combs, with 37.7 percent. All the special characteristics are found in this province. 2.5 percent of the chickens have naked necks, 0.23 percent have crests, 1.4 percent have beards and muffs, 2.2 percent have polydactyl legs, 0.45 percent have frizzled feathers, and 1.5 percent have silky feathers.

TABLE 38 LITERACY RATES, HOUSEHOLD SIZES AND LANDOWNERSHIP ACROSS THE FIVE PROVINCES

Province	Proportion					Household size				Land area owned (ha)			
	Male	Illiterate	PS*	RU*	MU*	> 5	6-7	7-8	Nil	>0.3	> 1	> 5	> 10
Kampong Cham	52.3	13.6	77.3	71	96.4	63.6	25.6	9.5	4.1	13.6	44.3	37.2	0.59
Kampot	48.9	6.3	78.7	66.6	100	66.6	22.9	6.2	2	4.1	47.9	45.8	0
Odor Meanchey	72.3	28.8	71.2	80.8	89.3	63	19.5	8.7	4.3	0	28.2	56.5	10.8
Rattanakiri	56.2	20.4	70.4	79.1	87.5	46.8	23.4	17	22.9	4.1	14.5	43.7	14.5
Siem Reap	53.4	20.4	71.5	73.8	100	56.8	23.8	13.6	13.1	10.7	46.4	28.5	0

PS* = Primary + secondary, RU* = Radio users, MU* = Mobile Users

TABLE 39 NUMBERS AND IMPORTANCE OF DIFFERENT LIVESTOCK SPECIES ACROSS THE FIVE PROVINCES

Province	Cattle Pigs		Numbers						Importance (% of respondents)			Believe that chicken numbers decreased (%)
			Chickens total	Chicks	Pullets	Hens	Cockerels	Cocks	Cattle*	Pigs**	Chickens***	
Kampong	4.3	5.2	37.0	19.9	9.7	5.7	8.5	2.2	81.2	76.2	20.8	32.9
Kampot	3.5	4.6	40.1	20.3	9.9	7.1	9.9	2.5	80.4	99.9	8.3	22.9
Odor	3.5	2.3	26.7	15.0	5.8	4.5	4.3	2.0	80.6	39.0	46.5	53.1
Rattanakiri	7.7	2.3	23.3	10.4	8.8	5.0	5.6	2.9	60.0	53.3	23.2	62.5
Siem Reap	3.1	6.6	33.3	16.6	8.7	5.8	8.3	2.3	77.0	76.8	18.3	23.8

*(highly important), ** (moderate), *** (high importance)



TABLE 40 BREEDING AND HOUSING ACROSS THE FIVE PROVINCES (PERCENTAGES)

Province	Breeding			Housing		Building materials		Financial reasons for not providing housing
	Buy chickens for flock	Practise hatching	Improve breeds	Day and night housing	Night housing (from remaining)	Simple farm materials	Simple purchased materials	
Kampong Cham	35.8	97.0	81.2	23.6	68.2	59.7	39.5	20.3
Kampot	33.3	100.0	97.8	12.5	79.5	50.0	50.0	50.0
Odor Meanchey	25.0	93.7	93.3	2.0	62.5	87.5	12.5	52.6
Rattanakiri	33.3	85.4	82.2	10.4	68.8	60.0	37.1	0
Siem Reap	31.0	100.0	88.1	14.7	78.4	52.0	48.0	35.0

TABLE 41 FEEDING, PRODUCTIVITY AND HEALTH CARE ACROSS THE FIVE PROVINCES

Province	Feeding		Productivity			Health Care	
	% providing feed	% of these purchasing	Cycles per year	Eggs per cycle	Age at first lay	% chicks surviving phase 3	% using vet services
Kampong Cham	94.7	29.8	3.7	11.6	5.97	61.9	20.7
Kampot	100	18.7	3.6	11.9	6.16	66.1	54.1
Odor Meanchey	95.8	4.5	3.6	11.8	6.31	58.7	25.0
Rattanakiri	87.2	27.9	3.2	12.2	6.09	58.1	14.8
Siem Reap	97.7	35.2	4.0	12.3	6.24	63.1	26.4

Conclusions

In Cambodia, indigenous chickens are reared under backyard systems and are kept mainly for home consumption and also as a source of income. During the survey, a wide variation was observed in the age of farmers, which ranged from 15 to 76 years, but only a very small proportion of people under 30 engage in this activity, which supports the general trend for fewer and fewer young people to adopt agriculture as a mode of livelihood. The high usage of mobile phones shows that people are willing to adopt new user-friendly technologies, and illiteracy is not a barrier for this. From the survey, it is clear that the adoption of management techniques such as housing, feeding and health care is closely linked to the literacy level of farmers. The literacy level is highest in Kampot, where farmers are well ahead in adopting improved management techniques such as providing good housing and extra feed, utilizing veterinary facilities, and seeking to improve the productivity of their birds. Another parameter that substantiates this is flock size; the average flock size is highest in Kampot, with 40.16 birds per farm. The impact of literacy can also be seen on family size; more than 66 percent of the households in Kampot have fewer than five members.

Rice is the main agricultural crop and most farmers keep cattle. Only five households rear goats and no sheep were found in the entire survey area. Very few farmers use improved varieties to improve their flocks; the majority rely on local birds, which they buy from their neighbours. Body weight and number of eggs laid are the two main criteria for selecting breeding birds. House construction is done mainly with on-farm materials, and about 80 percent of farmers provide housing. In most cases, traditional chicken farmers do not keep production records, but were able to report that an average hen starts laying eggs when it is between 5.9 and 6.3 months of age, and has 3.6 to 4 production cycles per year, with 11.6 to 12.3 eggs per cycle. Regarding the survival of chicks, on average each hen hatches 9.86 chicks, of which 7.44 survive the first month and 6.1 survive for six months. In all three



growth phases, disease is the main cause of mortality. About 34 percent of farmers use the available veterinary facilities, and about 21 percent vaccinate their birds.

Analysis of body weight and shank length shows that birds in Kampot are the smallest and those in Siem Reap the heaviest. Birds in Kampot are small in size but have long shanks. The weight and shank length differences between males and females are very small in Kampot. In general, yellow is the most common shank colour, white the most prominent skin colour, and red-white the most common earlobe colour. Orange is the most common eye colour and, with the exception of Kampot, single combs are found in very high numbers, while a higher proportion of pea combs is found in Kampot.



Annexes

Annex 1

Poultry production system evaluation

Enumerator:	Farm code:
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Identification and characteristics of sample household:

1. Characteristics of household		
Date:	Regular radio listener:	
District:	1 = yes 2 = no	
Village:	Mobile or other phone access:	
GPS coordinates:	1 = yes 2 = no	
Name of respondent:	Land owned:	
Male: ☐ Female: ☐	1 = Nil 2 = Marginal: ≤ 0.3 ha 3 = Marginal/small: ≤ 1 ha 4 = Semi-medium: ≤ 5 ha 5 = Medium: ≤ 10 ha 6 = Large: > 10 ha	
Age:		
Name of household head:		
Education of household head: Education of respondent: 0 = No school 1 = Grade school 2 = High school	HH: RES:	Household size (sharing common kitchen): 1 = 1–5 members 2 = 6 or 7 members, 3 = 8 or 9 members, 4 = > 9 members

2. Farm characteristics		
Main crops	Proportion of land	Main use (1 = Market, 2 = HH consumption)

	Main use (1 = Market, 2 = HH consumption)	Priority for the family (1-5) 1 = lowest, 5 = highest
Large ruminants		
Small ruminants		
Pigs		
Poultry		
Chickens		
Ducks		
Other		



Animal numbers and flock management

2.1 List animals owned						
Category	Calves/ lambs/kids	Female		Male		Total
		< 2 years	≥ 2 years	< 2 years	≥ 2 years	
Cows/bulls						
Buffaloes						
Sheep						
Goats						
Pigs						

Local chickens owned						
	Chicks	Female		Male		Total
	< 1month	< 6 months	> 6 months	< 6 months	> 6 months	
Chickens						
Ducks						
Other (name)						

Improved (crossbreed) chickens owned						
	Chicks	Female		Male		Total
	< 1 month	< 6 months	> 6 months	< 6 months	> 6 months	
Chickens						
Ducks						
Other (name)						

	Chickens	Ducks
2.21 Did the number of birds in your poultry flock change during the last 5 years? 1 = no, remained same 2 = yes, increased 3 = yes, decreased		
2.21 Does the number of birds in your chicken flock change with the season? 1 = yes 2 = no		
2.22 Which months are chicken numbers highest?		
2.23 Which months are chicken numbers lowest?		

Separate form for chickens and ducks from here

2.3.a. Do you buy birds for your flock?		☐ Yes ☐ No (go to Q 2.4.a)
2.3.b. If YES, where do you buy birds?		☐ Market ☐ Neighbour ☐ Commercial chicken farm ☐ Other:
2.3.c. If YES, what kind of birds do you buy?		☐ Local breed ☐ Young birds ☐ Improved breed ☐ Adult birds
2.3.d. Check all the criteria you use for the selection of birds you buy:		
No special criteria:	☐ Yes	Remarks
Size/weight:		
Longevity:	☐ Yes ☐ No	
Ability to live on its own (needs no housing, good scavenger):	☐ Yes ☐ No	
Number of eggs laid:	☐ Yes ☐ No	
Colour of eggs laid:	☐ Yes ☐ No	
Flavour of meat:	☐ Yes ☐ No	
Disease resistance:	☐ Yes ☐ No	
Good mothering qualities	☐ Yes ☐ No	
Colour or pattern of plumage	☐ Yes ☐ No	
Other reasons (describe)		



2.4.a. Do you hatch your own eggs?	☐ Yes ☐ No
2.4.b. Do you try to get better birds for your flock?	☐ Yes ☐ No (go to Q 3.1 a)
2.4.c. If YES, where do you get better birds?	☐ From my own flock ☐ From a neighbour ☐ From the market ☐ From a commercial chicken farm ☐ Other:..... Why?
2.4.d. Check all the criteria you use for selection of the birds you use to improve your flock:	
Size/weight:	☐ Yes ☐ No
Longevity:	☐ Yes ☐ No
Ability to live on its own (needs no housing, good scavenger):	☐ Yes ☐ No
Number of eggs laid:	☐ Yes ☐ No
Colour of eggs laid:	☐ Yes ☐ No
Flavour of meat:	☐ Yes ☐ No
Disease resistance:	☐ Yes ☐ No
Good mothering qualities	☐ Yes ☐ No
Colour or pattern of plumage	☐ Yes ☐ No
Other reasons (describe)	Remarks

Production technology

3.1.a. Are your birds housed all day and night?	☐ Yes ☐ No
3.1.b. If NO, are your birds housed at night?	☐ Yes ☐ No (go to Q 3.1.e)
3.1.c. If your birds are housed (either only at night, or all day/night long), please describe the housing type:	☐ Simple construction with on-farm materials ☐ Simple construction with purchased materials ☐ Improved construction (e.g., disease vector control, climate control)
3.1.d. If your birds are housed, how do you dispose of manure?	☐ No special disposal or storage ☐ Feed to other animals ☐ Use as fertilizer ☐ Sell Other:.....
3.1.e. If your birds are NOT housed, give a reason	☐ Not enough money to build ☐ Not necessary, birds do well without Other:.....
3.2.a. Do you provide feed to your birds?	☐ Yes ☐ No (go to Q 3.3.a)
3.2.b. If YES, do you purchase feed for your birds?	☐ Yes ☐ No
3.2.c. If YES, approximately how much of the feed that you provide to your birds is purchased?	☐ 100 % ☐ 75% ☐ 50% ☐ 25% ☐ 0%
3.2.d. If YES, describe the type of feed for your birds:	☐ Purchased concentrate feeds ☐ Concentrate feeds (grains) produced on own farm ☐ Other (please name):
3.2.e. If YES, describe source of purchased feed for your birds	☐ Market ☐ Neighbour Other:
We define three periods for estimating mortality.	Age Period 1: Up to 1 month of age Age Period 2: From 1 to 6 months of age Age Period 3: From laying age onward



3.3.a. Do you take note of the mortality of your birds?	☐ Yes ☐ No
3.3.b. If you incubate eggs by a broody hen try to give the following numbers:	Number chicks hatched per mother: Number chicks survive period 1 per mother: Number Chicks that survive period 2 per mother:
3.3.c. If you purchase day old chicks try to give the following numbers:	Proportion of chicks that survive period 1: Proportion of chicks that survive period 2:
3.3.d. Name the most important reason for losses in Period 1:	☐ Disease ☐ Predator (incl. theft) ☐ Accident ☐ Unknown reason
3.3.e. Name the most important reason for losses in Period 2:	☐ Disease ☐ Predator (incl. theft) ☐ Accident ☐ Unknown reason
3.3.f. Name the most important reason for losses in Period 3:	☐ Disease ☐ Predator (incl. theft) ☐ Accident ☐ Unknown reason

3.3.g. What is the season of the year with the highest losses?	
3.3.h. Do you use veterinary services for your birds?	☐ Yes ☐ No
3.3.i. Do you vaccinate your birds?	☐ Yes ☐ No
3.3.e. Name the most important reason for losses in period 2:	☐ Disease ☐ Predator (incl. theft) ☐ Accident ☐ Unknown reason
3.3.f. Name the most important reason for losses in period 3:	☐ Disease ☐ Predator (incl. theft) ☐ Accident ☐ Unknown reason
3.3. j If YES, for which diseases do you vaccinate your birds?	

Market and labour

4.1.a. Do you sell birds?	☐ Yes ☐ No
4.1.b. If yes, where?	☐ To neighbours ☐ Local market (< 10 km distance) ☐ Regional market (> 10 km distance) ☐ To traders who come to the village Other:
4.1.c. Do you sell eggs?	☐ Yes ☐ No
4.1.d. If yes, where?	☐ To neighbours ☐ Local market (< 10 km distance) ☐ Regional market (> 10 km distance) ☐ To traders who come to the village Other:
4.2.a. Who in your family is responsible for the birds?	☐ Yourself ☐ Your partner ☐ Your children ☐ Other family members ☐ Hired labour
4.2.b. Who in your family is responsible for feeding the birds?	☐ Yourself ☐ Your partner ☐ Your children ☐ Other family members ☐ Hired labour
4.2.c. Who in your family is responsible for housing the birds (cleaning, maintenance)?	☐ Yourself ☐ Your partner ☐ Your children ☐ Other family members ☐ Hired labour
4.3.d. Who in your family sells eggs?	☐ Yourself ☐ Your partner ☐ Your children ☐ Other family members ☐ Hired labour
4.3.e. Who in your family sells birds?	☐ Yourself ☐ Your partner ☐ Your children ☐ Other family members ☐ Hired labour



Annex 2

Individual observations of the chickens

Farm code:					
Animal/No.	1	2	3	4	5
Number of photo from camera					
Sex: Female = 1, Male = 2					
Body weight (g)					
Shank characteristics					
Colour White (W) Grey-blue (GB) Black (B) Yellow (Y) Green (G)					
Shank length (cm)					
Skin colour					
White (W) Yellow (Y) Black (B)					
Comb type					
Single (S) Pea (P) Rose (R) Cushion (C) Double (D)					
Earlobe colour					
Red (R) White (W) Blue (B) Red-white (RW)					
Eye colour					
Orange (O) Brown (B) Red (R) Pearl (P)					
Crest: Yes = (Y), No = (N)					
Other characteristics					
Naked neck: Yes = (Y), No = (N)					
Beard and muffs: Yes = (Y), No = (N)					
Polydactyl: Yes = (Y), No = (N)					
Frizzled: Yes = (Y), No = (N)					
Silky: Yes = (Y), No = (N)					
Other observations					



Annex 3

Different shank colours



White variety



Black variety



Green variety

Green variety



Different earlobe colours



Red



White



Blue



Red-white

Different eye colours



Orange



Brown

Red



Pearl

Different comb types



Single comb

Double comb



Pea comb



Rose comb



Cushion comb

