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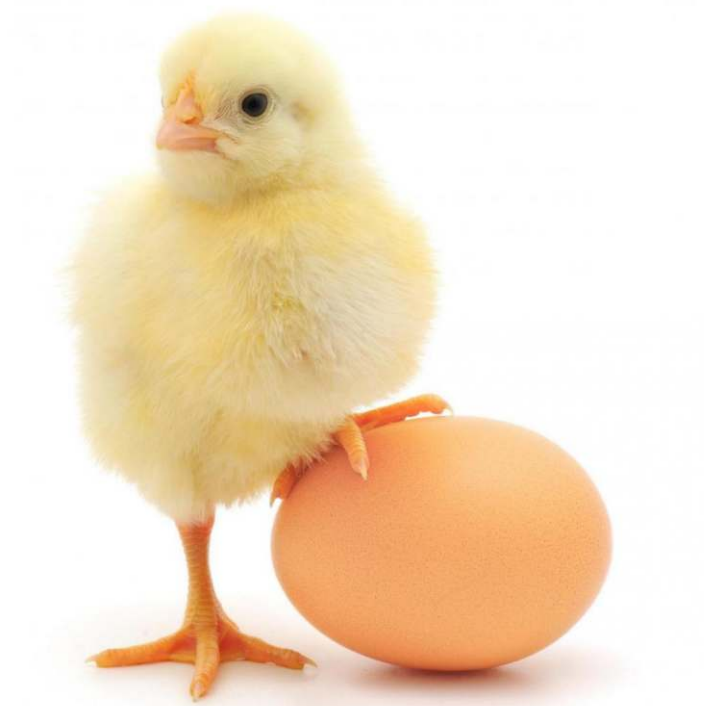

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Technical and Socio-Economic Constraints to Duck Production in the Philippines: A Productivity Analysis

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Abstract: Two hundred and five duck egg producers in four provinces of the Philippines, including Iloilo, Nueva Ecija, Pampanga and Quezon, were surveyed in 2003. They were asked about their socio-demographic and farm characteristics, their income sources and problems encountered in the production and marketing of duck eggs, as well as their access to capital and extension service and their awareness of participation in, farmers' organizations and government programs. The results showed that there was significant diversity in farm size, farm management practices performance in duck farming. We also found from the basic data that duck farmers in the Philippines generally lacked technical know-how and access to capital and extension services encountered serious problems in production and marketing of duck products. Results from the productivity analysis show that the mean technical efficiency is 0.62, with the majority of the technical efficiency estimates being between 0.61 and 0.90. The key factors affecting technical efficiency included both social-economic factors such as education, access to loans and being a member of farmers organization and technical factors such as farm size and management practices. One policy recommendation is that well-targeted extension on technical know-how for duck farming, rather than record keeping or marketing, can help remove production constraints and improve productivity. In addition, more consumer research is needed to understand future demand for duck products in anticipation of any significant increases in supply due to productivity improvement.

Key words: Duck farming, productivity, technical efficiency, the Philippines.

Introduction

In, 2005, the Philippine duck sector generated 5.76 billion Philippine pesos, which accounted for 0.85% of total value of agricultural production (BAS, 2006a). Although the duck sector is relatively small compared to the chicken sector, which contributed 102 billion pesos to the Philippine economy (13% of total value of agricultural production), it is not far behind carabao (6.49 billion pesos) and is larger than goat (5.11 billion pesos) and dairy cattle (337 million pesos). The Philippine duck sector is characterized by egg production for balut making. About 90% of total duck-egg production is used for making "*balut*" (BAS-SRTC, 1998). Balut, referred to as "embryonated eggs" by the Chinese and as "*hot vit lon*" by the Vietnamese, are partially incubated duck eggs whose live embryos are harvested when they are between 14 and 18 days old. Off-sized eggs and infertile eggs are used to make salted eggs and century eggs while dead embryos are sold as "*penoy*" (Lambio, 2001). Although some meat-type ducks are being raised in the Philippines, the majority of duck meat is derived from excess males and culled layers. The contrast in the relative size of duck egg and duck meat production is presented in Table 1. Note that in, 2005 the volume of duck egg production was about five times that of duck meat (53,230 versus 9,968 tonnes). This could mean that opportunities exist to increase duck meat production by for example better utilization of culled ducks. In, 2005 annual per capita consumption of duck egg and duck meat in the Philippines was 0.59kg and 0.12kg, respectively (Table 2). The corresponding figures for chicken eggs and chicken meat were 3.46kg and 7.85kg, respectively. Note that per capita consumption of duck eggs has shown a declining trend since, 1996. In addition to high prices relative to incomes, changing lifestyle and consumption pattern due to urbanization may be responsible for the declining demand for duck eggs (Chang *et al*., 2006b, 2006c). The duck inventory in the Philippines is classified by the Bureau of Agricultural Statistics (BAS) (1987) into commercial and backyard. A duck farm is classified as "commercial" if it has more than 100 head of ducks, regardless of the age and sex of the bird and the production method. Otherwise, it is referred to as "backyard". Ducks have traditionally been raised in the backyard by rural households in the Philippines because they provide good sources of supplementary income and low-cost animal protein to often resource-poor rural households. Table 3 shows the number and production share of the commercial and backyard duck sectors during, 1991-2005. As can be seen, the share of ducks raised on a commercial scale increased from about 10% in, 1991 to about 24% in, 2005 (BAS, 2006b). This trend is likely to continue. It is also expected that

Table 1: Production of duck products (in tonnes), 1991-2005

Year	Duck egg	Duck meat (in dressed weight)
1991	33400	6513
1992	36750	7536
1993	39200	8531
1994	41570	9009
1995	47690	9701
1996	54460	10432
1997	52960	10393
1998	53100	10481
1999	52650	10471
2000	53470	10520
2001	53920	10939
2002	53630	11057
2003	54050	11403
2004	56590	11153
2005	53230	9968

Source: BAS (2005).

Table 2: Per capita consumption of poultry products (in kilograms), 1991-2005

Year	Chicken egg	Chicken meat	Duck egg	Duck meat
1991	2.50	4.56	0.46	0.10
1992	2.59	5.55	0.54	0.12
1993	2.84	5.57	0.57	0.13
1994	2.63	5.49	0.57	0.13
1995	2.69	5.85	0.66	0.14
1996	2.70	6.51	0.73	0.15
1997	2.87	6.96	0.70	0.15
1998	2.86	6.75	0.68	0.15
1999	2.83	7.03	0.66	0.14
2000	2.93	7.20	0.66	0.14
2001	2.91	7.68	0.65	0.14
2002	3.02	8.04	0.63	0.15
2003	3.12	8.00	0.63	0.14
2004	3.30	8.26	0.64	0.13
2005	3.46	7.85	0.59	0.12

Source: BAS (2005).

there will be more commercial operators, growing in size as well as degree of integration. The significant growth in the commercial duck sector in recent years has been attributed to the introduction of commercial duck feeds and high profitability (SIKAP/STRIVE Foundation, 2001). Research has also shown that significant differences existed in the cost of production and profitability between provinces and between farm sizes in duck farming (BAS-SRTC, 1998, SIKAP/STRIVE Foundation, 2001). The latter seems to imply that there is economies of scale in duck production that is, the larger the duck farms, the lower the cost of production and the higher the returns. Nevertheless, more than 75% of the ducks in the Philippines are still being raised in backyards, as discussed earlier, with less than 100 head per household. The objectives of this study are to understand duck farming in the Philippines and to determine whether and how farming practices and farm performance vary with the size of the operation in Philippine duck farming. This paper begins with a brief overview of the Philippine duck sector and a summary of the survey results. It then presents results from the productivity analysis based on the Cobb-Douglas production frontier. The paper ends with some concluding remarks.

Materials and Methods

Data and data collection: About two hundred and fifty duck producers in Iloilo, Nueva Ecija, Pampanga and Quezon provinces in the Philippines were interviewed in, 2003. These provinces were among the top ten duck-producing provinces in, 2002 which included Nueva Ecijia, Laguna, Isabela, Bulacan, Tarlac, Iloilo, Sultan Kudarat, Maguindanao, Pampanga Bukidnon (BAS, 2003a). Together, they accounted for about 50% of total duck inventory in the Philippines. These provinces were also selected because they differed in production structure. In particular, duck farms in Nueva Ecija and Pampanga were generally larger in size compared to that of Iloilo and Quezon. In the survey, farmers were asked about their socio-demograhic and farm characteristics, their profession and income sources, their awareness of participation in farm organizations and government programs, the problems which they had encountered in the production and marketing of duck eggs. Of the total number of farms surveyed, 69% of them specialized in egg production alone, 11% specialized in RTLP production and the remaining 20% had mixed operation. In this paper, we excluded RTLP and Muscovy producers and outliers from the data set to ensure that we had a relatively more homogeneous base for comparison. Consequently, 205 farms remained, including 56,71,5721 egg-producing farms from Iloilo, Nueva Ecija, Pampanga and Quezon provinces, accounting for 27%, 35%, 28% 10% of the sample, respectively (see bottom of Table 4). To examine whether size differences existed in our sample, the data set was sub-divided into four subgroups. More specifically, the egg producing farms were classified as backyard (1-99), small (100-499), medium (500-999) large (1000 and above) based on the number of layers on the farm. This classification is similar to what has been defined by the Bureau of Agricultural Statistics (BAS, 1987) in that farms with less than 100 head are defined as “backyard” and as “commercial”, otherwise. Our classification differs from that of BAS in two significant ways. First, in this study commercial farms (with more than 100 head) were further divided into small, medium and large. Second, in this study only the number of layers were included in the classification, rather than ducks of all ages and types as is in the BAS classification. This new grouping enables us to determine more discriminantly the differences in farming practices and farm performance, if exist, among farm sizes. As shown (last column of Table 4), of the 205 egg farms examined, 18% are classified as backyard,

Table 3: Philippine duck inventory (in head) 1991-2005

Year	Total	Backyard Head	Backyard %	Commercial Head	Commercial %
1991	8267690	7417520	89.72	850170	10.28
1992	8348291	7660895	91.77	687396	8.23
1993	8706783	8175475	93.90	531308	6.10
1994	8186877	7585108	92.65	601769	7.35
1995	9072203	6855460	75.57	2216743	24.43
1996	9469693	7335159	77.46	2134534	22.54
1997	8923496	6762241	75.78	2161255	24.22
1998	8823566	6953335	78.80	1870231	21.20
1999	8613651	6589101	76.50	2024550	23.50
2000	9245788	7074944	76.52	2170844	23.48
2001	9986803	7810034	78.20	2176769	21.80
2002	9911269	7650162	77.19	2261107	22.81
2003	9802773	7479769	76.30	2323004	23.70
2004	10211310	7837069	76.75	2374241	23.25
2005	10438739	7915740	75.83	2522999	24.17

Source: BAS (2006b).

Table 4: Distribution of farm size (based on the number of layers)

Province	No. of farms Iloilo	N.Ecija	Pampanga	Quezon	Total
Backyard (1-99)	34	1	0	2	37
Small (100-499)	20	37	22	5	84
Medium (500-999)	2	18	15	10	45
Large (> 1000)	0	15	20	4	39
Total	56	71	57	21	205
Percentage					
Backyard (1-99)	61	1	0	10	18
Small (100-499)	36	52	39	24	41
Medium (500-999)	4	25	26	48	22
Large (> 1000)	0	21	35	19	19

whereas 41%, 22% and 19% are classified as small, medium large, respectively. In addition, there are cross-province differences in terms of farm size. For example, in Iloilo about 60% of duck farms are classified as backyard and 36% of them are classified as small. By comparison, all farms examined in Pampanga are classified as commercial, with 39%, 26% and 35% of them being classified as small, medium and large. Data also showed that in both Nueva Ecija and Pampanga, there were two farms that had more than 5000 layers. It is clear that Iloilo has more backyard farms than the sample average, whereas Nueva Ecija has more small farms, Quezon has more medium farms and Pampanga has more large farms, compared to the sample average. Other key results from the farm survey are summarized below: Key findings from the survey are:

- Out of 205 farms, 18% were classified as backyard, whereas 41%, 22% and 19% were classified as small, medium and large, based on the number of layers on the farm.
- 40% of the respondents were involved in duck farming as their primary occupation.
- 56% of the respondents were part-time poultry raisers and 44% were full-time.
- Average age of the respondents was 44 years old.
- 64% of respondents had a high school certificate or higher degrees.
- Average number of years in duck business were 8 years.
- 94% of the respondents were sole proprietorship, 5% in partnership and 1% on contract farming.
- 62% of the respondents were raising ducks because it was a good source of additional income and 30% were in it because it was profitable.
- 63% of the respondents observed a decline in flock performance in recent years.
- 40% of the respondents used vitamins, 21% used antibiotics, 1% used vaccines 36% used disinfectants to control diseases and pests.
- 21% of the respondents claimed to have encountered problems with flock health, 52% had problems with feeding (high cost and lack of feeds), 16% had problems in replacing stock and 57% had problems in laying (low productivity).
- 36% of the respondents kept some records on production, breeding, marketing and finance.
- 75% of the respondents said that it was buyers (wholesalers, viajeros, balutans, retailers) who provided price information and determined prices.
- 68% of the respondents used their own capital while 26% of them borrowed from outside sources, the main sources of capital came from relatives and informal sources (60%), traders/suppliers (22%) 16% borrowed from the banks.
- 17% of the respondents were aware of some government programs and 8% had participated in them.
- 24% of the respondents received extension services and technical assistance from government, NGOs, farmers organizations, or commercial feed companies.

Table 5: Descriptive statistics of variables used in productivity analysis

Item	Variable	Mean	Std. error	No. of farms	%
Production function variables					
Output (no. of eggs laid)	y	162303.17	289214.50		
Size of Operation	x_1	603.99	785.99		
Feed	x_2	9.56	6.64		
Production Cycle	x_3	2.52	5.15		
Labour	x_4	14.03	9.87		
Area for duck raising	x_5	8242.52	28701.69		
Zero feeding	D_1			23	17
Egg/Duckling Enterprise	D_2			29	21
Provides Vitamin	D_3			54	39
Provides Antibiotics	D_4			27	20
Provides Disinfectant	D_5			46	34
Provides Nest	D_6			87	64
Provides Lighting	D_7			52	38
Nueva Ecija	D_8			30	22
Pampanga	D_9			47	34
Quezon	D_{10}			13	9
Inefficiency effects variables					
Age of household	Z_1	43.87	11.91		
Education	Z_2	9.75	2.96		
Years in business	Z_3	8.06	8.54		
Small farms	D_4			46	34
Medium farms	D_5			25	18
Large farms	D_6			29	21
Practice flock replacement	D_7			110	80
Fulltime duck farmers	D_8			51	37
Practice record keeping	D_9			51	37
Avail loan	D_{10}			9	7
Member of farmer organization	D_{11}			30	22
Marketing arrangement	D_{12}			69	50
Confined system of raising	D_{13}			63	46
Ad libitum system of feeding	D_{14}			56	41
RTLP system of flock replacement	D_{15}			100	73
Received technical assistance	D_{16}			35	26

Number of observation = 137

Table 6: Results of hypothesis tests for model specification

No.	Null hypothesis	λ*	Critical value**	Result
1	$\gamma = \delta_0 = \delta_1 = \delta_2 = ...= \delta_{15} = 0$	185.1	28.27	Reject
2	$\delta_0 = \delta_1 = \delta_2 = ...= \delta_{15} = 0$	110.76	26.98	Reject
3	$\delta_4 = \delta_5 = \delta_6 = 0$	29.76	7.04	Reject
4	$\delta_7 = \delta_9 = ...= \delta_{16} = 0$	17.56	16.27	Reject

λ* denotes the value of the log likelihood function under the null hypothesis (H_0) and alternative hypothesis (H_1), respectively.
**Taken from Table 1 of Kodde and Palm (1986) using 5% level of significance.

- Areas that required outside assistance included: technical know-how, supply of inputs, provision of credit and market information marketing of outputs.
- 76% of the respondents said they would expand their duck operation while 24% said they wouldn't. "lack of capital" was sited as the main reason for not expanding while "a good source of income" was cited as the main reason for expansion.
- Farm size matters in terms of flock performance, record-keeping, access to capital and product proposal, but not economies of scale.
- The average returns to backyard, small, medium and large farms were 36 943, 50 864, 66 144 53 888 pesos per 100 layers, respectively, with an average across all sizes being 52 277 pesos per 100 layers.
- Returns to duck farming was the highest for medium-sized farms, followed by large farms, small farms backyard farms.

Productivity analysis:

The basic model: A stochastic frontier production function is applied to cross-sectional data to model duck production in the Philippines. The model of Battese and Coelli (1995) is used in accordance with the original models of Aigner *et al.* (1977) and Meeusen and van den Broeck (1977). The stochastic production frontier has the general form: $Y_i = f(X_i; \beta)\exp(\epsilon_i)$, (1)
where Y_i is the scalar output of farm I (I = 1, 2, ..., N); X_i is a vector of N inputs used by farmer *I*; β is the vector of parameters to be estimated and ϵ_i is the error term that

Table 7: Maximum-likelihood estimates of C-D stochastic frontier production function

Variable	Parameter	Estimated Coefficient	Standard Error
Constant	β_0	3.725***	0.436
Size of Operation	β_1	0.848***	0.086
Feed	β_2	0.018	0.049
Production cycle	β_3	0.991***	0.122
Labour	β_4	0.124	0.086
Area for duck raising	β_5	0.056**	0.026
Dummy for zero feed	φ_1	-0.209	0.152
Dummy for type of enterprise	φ_2	0.598***	0.176
Dummy for Vitamin	φ_3	0.143	0.125
Dummy for Antibiotics	φ_4	-0.039	0.147
Dummy for Disinfectant	φ_5	-0.183	0.135
Dummy for Nest	φ_6	0.032	0.133
Dummy for Lighting	φ_7	0.133	0.143
Dummy for Nueva Ecija	φ_8	-0.206	0.275
Dummy for Pampanga	φ_9	-0.074	0.298
Dummy for Quezon	φ_{10}	0.142	0.328
Variance parameter	σ^2	8.046***	1.131
Gamma	γ	0.982***	0.008
Log-likelihood function		-148.20	

Note: ** and *** denote significance at the 5% and 1%, respectively.

is composed of two independent elements, V_i and U_i, such that $\epsilon_i = V_i - U_i$, (2)

Where the V_is are assumed to be symmetric identically and independently distributed errors that represent random variations in output as a result of factors outside the control of the farmers as well as the effects of measurement error in the output variable, left-out explanatory variables from the model and statistical noise. They are assumed to be normally distributed with mean zero and variance σ^2_V. The U_is are non-negative random variables that represent the stochastic shortfall of outputs from the most efficient production. It is assumed that U_i is defined by a truncated normal distribution with mean μ and variance σ^2_U, where $\mu_i=\delta_0+\delta_i Z_i$, of which Z_i is a vector of factors associated with technical inefficiency of farm *i* and δ_0 and δ_j are unknown parameters to be estimated. The parameters of both the stochastic frontier model and the inefficiency effects model can be consistently estimated by the maximum likelihood method. The variance parameters of the likelihood function are estimated in terms of $\sigma^2 = \sigma^2_v + \sigma^2_u$ and $\gamma = \sigma^2_u / \sigma^2$.

Using cross-sectional data, the farm's technical efficiency can be defined by the ratio of the observed output to the corresponding stochastic frontier output; i.e.,

$$TE_i = \frac{Y_i}{f(X_i;\beta)\exp(V_i)} = \exp(-U_i) \qquad (3)$$

The prediction of the technical efficiencies is based on its conditional expectation, given the observable value of (V_i–U_i) (Jondrow *et al.*, 1982; Battese and Coelli, 1988). The technical efficiency index lies between zero and one. It is equal to one if the farm lies on the frontier and is fully technically efficient.

The empirical model: We employed a Cobb-Douglas functional form to estimate the model expressed in equation (1). The Cobb-Douglas form of the stochastic frontier production is given by:

$$\beta_0 + \sum_{j=1}^{5} \beta_j \ln x_{ji} + \sum_{k=1}^{10} \varphi_k D_{ki} + V_i - U_i \qquad (4)$$

where the subscripts, *j* and *l* refer to the *j*-th major input (*j* = 1, 2, …5) used by the *l*-th farmer, *l* = 1, 2, .., 137) and *k* denotes *k*-th dummy variable; *y* is the total eggs produced; x_1 is the size of operation (number of layers); x_2 is feed per head per month; x_3 is the length of production cycle (in months); x_4 *is the* total number of hours spent on poultry production (hours/day); x_5 is the total area for poultry raising (in squared meters). D_1 is a dummy variable for zero feed cost. Other dummy variables are also included in the model to take into account other inputs (mostly minor) used in the production process. D_2 is a dummy variable for type of operation (1 if engaged in both egg and duckling production; zero, for egg production only); D_3 is a dummy variable and is equal to 1 if vitamins are provided; D_4 is a dummy variable and is equal to 1 if antibiotics is provided; D_5 is a dummy variable and is equal to 1 if practicing disinfecting; D_6 is a dummy variable and is equal to 1 if providing nests; D_7 is a dummy variable and is equal to 1 if providing lighting; D_8 is a dummy variable and is equal to 1 if the farm is located in Nueva Ecija; D_9 is a dummy variable and is equal to 1 if the farmer is in Pampanga and D_{10} is a dummy variable and is equal to 1 if the farm is in Quezon. We have considered various factors that affect individual farm's level of inefficiency. These factors can be divided into two, including (1) inherent characteristics of farmers and (2) management practices. Given the functional specifications presented

Table 8: Maximum likelihood estimates for parameters of the inefficiency effect model

Variable	Parameter	Estimated Coefficient	Standard Error
Constant	δ_0	-12.358***	2.955
Age of household head	δ_1	0.022	0.030
Education (years)	δ_2	-0.349**	0.135
Years in business	δ_3	0.271***	0.043
Dummy for small farms	δ_4	2.246**	0.936
Dummy for medium farms	δ_5	-6.390***	0.809
Dummy for large farms	δ_6	10.061***	1.125
Dummy if practice stock replacement	δ_7	-3.135***	0.941
Dummy if full time in duck raising	δ_8	0.009	0.774
Dummy if practice record keeping	δ_9	1.140	0.765
Dummy if avail of loan	δ_{10}	-8.267***	1.036
Dummy if member of organization	δ_{11}	-3.112***	0.688
Dummy if marketing arrangements	δ_{12}	3.443***	0.735
Dummy for confined rasing	δ_{13}	-0.028	0.611
Dummy for ad libitum feeding	δ_{14}	0.848	0.821
Dummy for RTLP replacement	δ_{15}	-0.100	0.824
Dummy for technical assistance	δ_{16}	1.635*	0.861

Note: *, ** and *** denote significance at the 10%, 5% and 1%, respectively.

above, the technical inefficiency model that is estimated is the specification of Battese and Coelli (1995), which is defined as:

$$\mu_i = \delta_0 + \sum_{j=1}^{3} \delta_j Z_{ji} + \sum_{j=4}^{15} \delta_j D_{ji} \qquad (7)$$

where the δ_js (j = 0,1, …15) are unknown parameters to be estimated; Z_1 is the age of household head (in years); Z_2 is the years of schooling completed by the household head; Z_3 is the number of years in duck raising; D_4 is a dummy variable for small farms (1 = yes; 0, otherwise); D_5 is a dummy variable for medium farms (1 = yes; 0, otherwise); D_6 is a dummy variable for large farms (1 = yes; 0, otherwise); D_7 is a dummy variable if the farmer practices stock replacement (1 = yes; 0, otherwise); D_8 is a dummy variable is the farmer is involved in poultry raising full-time (1 = yes; 0, otherwise); D_9 is a dummy variable if the farmer keeps record (1 = yes; 0, otherwise); D_{10} is a dummy variable if the farmer is able to avail loan (1 = yes; 0, otherwise); D_{11} is a dummy variable if the farmer is a member of farmer organization (1 = yes; 0, otherwise); D_{12} is a dummy variable if there is marketing arrangement with traders (1 = yes; 0, otherwise); D_{13} is a dummy variable if ducks are raised in confinement (1 = yes; 0, otherwise); D_{14} is a dummy variable if ducks are fed ad libitum (1 = if, 0, otherwise); D_{15} is a dummy variable if ready-to-lay-pullets (RTLPs) are used as replacement stock (1 = yes; 0, otherwise); and D_{16} is a dummy variable if farmer received technical assistance (1 = yes; 0, otherwise).. The empirical model is similar in its specification to Dinh Xuan Tung and Rasmussen (2005) and Ojo (2003). Descriptive statistics for these variables are presented in Table 5. Note that the sample size is further reduced from 205 to 137 after observations with missing and unreasonable values are removed.

Results and Discussion

Stochastic frontiers were estimated using FRONTIER 4.1c (Coelli, 1996). Various hypotheses tests were conducted to confirm the validity of the model. The first null hypothesis, stating no technical inefficiency effects in duck production in the Philippines, is rejected. In other words, the traditional ordinary least squares production function would not be an adequate representation of the data. In fact, the γ-parameter associated with the variance of the technical inefficiency effects in the stochastic frontier is estimated to be 0.98 (with a standard error of 0.008), indicating that the technical inefficiency effects are a significant component of the total variability of duck production in the Philippines. The second null hypothesis that all parameters in the technical inefficiency model have a value of zero is rejected. This implies that the technical inefficiency effects follow a truncated normal distribution rather than half-normal distribution. The third hypothesis tests for the impact of farm size on efficiency. The test result indicates that the size of operation is a significant technical inefficiency variable. Finally, likelihood ratio test indicates that management practices are a significant factor affecting inefficiency levels. These test results are presented in Table 6. Parameters of the maximum-likelihood estimates of the Cobb-Douglas stochastic frontier production function are presented in Table 7.

Most estimated coefficients have expected signs, but not all are statistically significant at least the 10% significance level. The estimated coefficients associated with the size of operation, production cycle land area for duck raising are statistically significantly greater than zero at the 1% significance level. This means for best-practice farms, a 1 percent increase in the size of operation leads to a 0.85 percent increase in egg output. The corresponding impacts of production cycle, land area for duck raising and type of enterprise are 0.99 and

Table 9: Comparison of efficiency estimates between provinces and between farm sizes

	Mean	Standard Deviation
By Province		
Iloilo	0.66	0.17
Nueva Ecija	0.54	0.29
Pampanga	0.60	0.22
Quezon	0.67	0.15
By Farm Size		
Backyard	0.68	0.15
Small	0.62	0.22
Medium	0.74	0.12
Large	0.44	0.27
All	0.62	0.22

0.056, respectively. The estimated coefficient for the dummy variable for "type of enterprise" is positive and statistically significant at the 1% significance level, meaning that farms which are engaged in both egg and duckling production tend to have higher output than farms which specialize in egg production. This is counter-intuitive but may be possible for an often multi-output, diversified farm where "economies of scope" may be at play[1]. The estimated coefficients of labour and feed inputs and dummy variables for the provision of vitamins, lighting and nests all have expected positive signs. This means these extra inputs help increasing egg output. However, they are not statistically significant. The coefficients for the dummy variable for antibiotics and disinfectant are negative, but not statistically significant at 10%. This also makes sense in the Philippine context. Since the majority of Philippine duck farmers do not use antibiotics and disinfectants unless they have to, i.e., when the birds are really sick. These negative results mean that farms which (are forced to) use these items have lower output than farmers who don't presumably because they have experienced serious disease problems at some stage of the production cycle. Finally, there is no significant difference in egg output among the four provinces (Iloilo, Nueva Ecija, Pampanga and Quezon). Using the main inputs (no. of layers, land, labor and feed), the estimated returns to scale is 1.046 with a standard error of 0.106. This mean that duck egg production in the Philippines exhibits constant returns to scale as the test statistic (0.43) indicates that the estimated returns to scale is not statistically significantly different from one. This is consistent with the results that large farms are neither more profitable (from a cost-return analysis) or more efficient (from the productivity analysis) than the smaller farms. The maximum likelihood estimates of the parameters of the inefficiency effects model for the Cobb-Douglas function are presented in Table 8. Most of the coefficients of the explanatory variables in the inefficiency model have the expected signs. The variables *age* and *years in business* have positive signs indicating that older farmers and those who are in business longer tend to be more inefficient (presumably because they are more reluctant to make changes to their farming practices). The estimated coefficient of the *education* variable is negative and statistically significant at 5% level, which implies that higher education has a strong, positive effect on technical efficiency in duck production. The results for dummy variables for farm size are mixed. That is, estimated coefficients for medium farms are negative while for small and large farms are positive. All of the estimated coefficients for farm size are statistically significant at the acceptable level. This implies that medium farms are more efficient while small and large farms are less efficient when compared with backyard production. Some management practices appear to have significant effects on the levels of inefficiency. Farmers who practice replacement of breeder, who avail loan and who are members of farmer organizations tend to be more efficient. However, full time farmers and those who practice record keeping and have prior marketing arrangements with traders appear to be less efficient. These results are counter-intuitive. One possible explanation could be that at the stage of subsistence and semi-commercial duck farming, farmers may be better-off if their valuable time were devoted to on-farm activities, rather than on paperwork or marketing. The signs for dummy variables for system of raising and stock replacement are negative, which implies that those that are under confinement and farmers who practice replacement of stocks with ready-to-lay-pullets appeared to be more efficient. Farmers who practice *ad libitum* system of feeding appeared to be less efficient, along with those farmers who received technical assistance on poultry raising . The latter result appears to be counter-intuitive since one would expect farmers who claimed to be lacking in technical know-how would benefit in some way from extension. Indeed, preliminary analysis shows that more than 50% of all respondents reported to need technical assistance and 24% of all respondents had received some form of extension services and technical assistance from government (27%), NGOs (20%), farmers organizations (17%), or commercial feed/private companies (22%). However, it seems that extension or technical assistance cannot really have an impact on productivity if they are not the right kind or if farmers don't have the means to make necessary changes. This appears to be the case here. During the survey, farmers were asked what types of assistance they needed. They indicated strongly that they needed technical assistance, followed by provision of credit and farm inputs. Given that extension and technical assistance on poultry farming from the main suppliers were often aimed at converting subsistence to semi-commercial or commercial farming (and selling inputs) for broiler chickens, not for ducks, it is possible that they are not the right kind of assistance. Even if they were on duck raising, they might require substantial investment in and changes to, housing, feeds and veterinary medicines, which was beyond the

[1]When this variable was included in the inefficiency effects model, it showed that mixed enterprises were indeed less efficient.

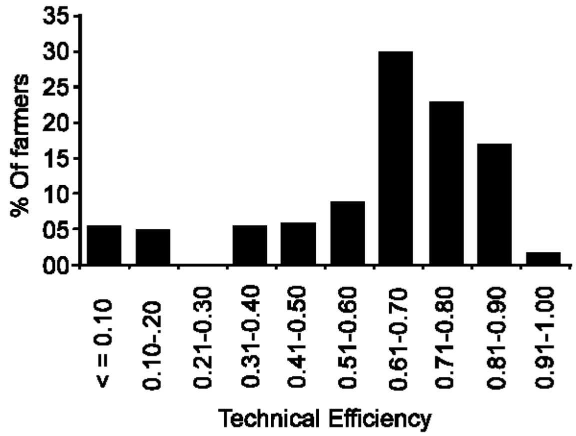

Fig. 1: Distribution of Technical Efficiency Estimates

means of financially constrained poor farmers. Having said that, the question remains: can the extension or technical assistance be so unhelpful as to hindering progress? The summary of technical efficiency estimates is presented in Table 9. The overall mean for all farmers is 0.62, implying that, on average, their production is 0.38 percent below their potential. Both ANOVA and Kruskal-Wallis were used to test for differences in the estimated technical efficiency estimates between farm sizes and between provinces. Test results based on the mean and median technical efficiency estimates indicate that there is no significant difference between farm sizes or between provinces. The distribution of efficiency estimates is presented in Fig. 1. It can be seen that the majority of the technical efficiency estimates are between 0.61-0.70 and 20 percent of farmers obtain an efficiency estimate of less than 0.50. Only about one per cent of sample considered obtains efficiency scores of more than 0.90, which comprises mainly medium-size farms. It is a common belief among industry analysis that backyard poultry sector is generally less productive compared to the commercial sector (e.g. Devendra, 1993; FAO, 2000; Alders and Spradbrow, 2001; Lambio, 2001; Chang, 2007). That is, the backyard poultry sector tends to have a slower growth rate, lower laying rate higher mortality rate than their commercial counterpart. This is because small, backyard producers tend to use primitive production and management practices that are centuries old with insufficient housing and feeding and disease control and without systematic breeding or selection. Studies also show that duck farmers in the Philippines often lack of information on technical know-how and when they do, lack of capital makes necessary productivity improvement difficult (e.g., Chang *et al.*, 2006a). Output and productivity are generally low and tend to remain low over time despite efforts to improve them. The results presented here seem to confirm those observations.

Conclusions: Two hundred and five duck egg producers in Iloilo, Nueva Ecija, Pampanga and Quezon provinces were surveyed in, 2003. Farmers were asked about their socio-demographic and farm characteristics, their income sources and problems encountered in the production and marketing of duck eggs, as well as their awareness of participation in, farm organizations and government programs. The main findings from the preliminary data analysis indicate that duck farmers in the Philippines generally lacked technical know-how and access to capital and extension services faced serious problems on both production and marketing fronts. However, differences exist between provinces and between farm sizes in terms of issues facing the duck farmers in the Philippines, management practices, flock performance and profitability. Results from productivity analysis show that the overall mean for technical efficiency for all farmers is 0.62. Thirty percent of the technical efficiency estimates are between 0.61-0.70 and 20 percent of farmers obtain an efficiency estimate of less than 0.50. Only about 1 per cent obtains efficiency scores of more than 0.90. However, there is no statistically significant difference in TE between farm sizes or between provinces. The key factors that contribute to higher TE are: social-economic factors such as education, access to loans and being a member of farmers organization and production systems which include being a medium-size farm and practicing stock replacement and using purchased ready-to-lay-pullets as replacement stock (as opposed from own farm). Factors such as being a full-time duck farmer, keeping farm record and having marketing arrangements were found to reduce TE. These results seem counter-intuitive, but could be an indication that farmers' time and energy might be better spent on improving the quality of inputs into the production process (e.g., feeding, culling and disease management), rather than on paperwork and marketing. One policy implication is that training of extension workers in technical know-how in duck farming and the provision of extension services to well-targeted duck farmer groups (based on desirable social-economic characteristics) can help remove production constraints and improve productivity. In particular, extension may best be done through existing farmers organizations, targeting at farmers with both higher education and the basic means to access sufficient capital to expand to medium-size. It also appears that at this initial stage of industry development from subsistence to semi-commercial duck farming, the kind of extension services that will be more useful are on-farm production technical know-how and provision of basic inputs directly or indirectly through loans. Most importantly, the kind of assistance provided will have to match the kind of assistance farmers actually need. Record keeping and marketing, although may be crucial for commercial farms, are not priorities in improving farm productivity at the moment. The other recommendation is to identify most efficient farms and use them as "model farms" to demonstrate what best practices are and how they can be adopted or adapted by other farms. And it goes without saying that if significant increases in supply are expected due to productivity improvement, more research on consumer demand for specialty product such as balut will be warranted to ascertain a balance of demand and supply and sustainable profitability for the industry.

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