Understanding village poultry through the agricultural household model
– A systematic literature review

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Acknowledgements

"Wisdom is the principal thing; Therefore get Wisdom. And in all your getting, get understanding. Exalt her, and she will promote you; She will bring you honour."
— *Proverbs 4:7–9 (Bible, New King James Version)*

Abstract

Village poultry fulfils many roles in the livelihood of rural households such as food security and income generation. Their global prevalence in tropical villages attests to their relative ease of production and low demands on household resources. Nevertheless, such low input-output production systems are plagued by multiple challenges associated with high flock mortality and low productivity. Community-based programmes to raise the physical performance of poultry by targeting technical improvements have met with mixed success. This is partly due to a neglect of the important economic motivations underlying household objectives for village poultry production.

The research aim of this thesis is to identify the socio-economic variables relevant to farm-households and which consequently influence intra-household preferences and the resources that households thereby allocate to poultry production. Using the theoretical framework of the agricultural household model, the thesis pieces together a socio-economic profile of rural, semi-subsistence farm-households engaged in village poultry, with the aim of investigating household optimising decisions and within-household allocation of resources, particularly household time. The agricultural household models by Barnum and Squire, and Low, are applied to the economic analysis of farm-household behaviour in semi-subsistence poultry production. The models also provide the conceptual framework for identifying and comparing non-causal relationships that might otherwise be hidden in the diverse and heterogeneous literature of applied interdisciplinary studies.

The research methodology is a systematic literature review using best practices gleaned from various disciplines, namely, medicine and healthcare, business management, the social sciences, and inter-disciplinary development studies. The key is to identify, analyse and interpret all available evidence in a way that is unbiased and to some degree replicable, using selection criteria and checks for qualitative and quantitative standards. A total of 17 papers making up 12 studies across eight countries in tropical Asia and Africa were used for the analysis.

Findings suggest that across the literature, exogenous household characteristics such as agro-ecology, family size, education levels and gender access to resources were linked to poultry production outcomes. Factors endogenous to the farm-household, such as income and livelihood opportunities were key variables influencing and interacting with the production decisions of households. In the exogenous or external context of a rural economy, market access and institutional factors (credit and extension facilities) affected household optimising behaviour and decisions to engage in production and consumption activities. Gender dimensions were significant in influencing outcomes on poultry and other production activities, particularly in endogenous household labour allocation and exogenous issues of market and institutional access. It is hoped that the insights generated in this thesis could shed light on the economic motivations of farm-households and thereby further the understanding of village poultry production.

Abbreviations

ADB	Asian Development Bank
BRAC	Bangladesh Rural Advancement Committee
CBP	Community-based programmes
Danida	Danish International Development Agency
DLS	Department of Livestock Services (Bangladesh)
FAO	Food and Agriculture Organization of the United Nations
HDI	Human Development Index
IFAD	International Fund for Agricultural Development
INFPD	International Network for Family Poultry Development (FAO)
SFRB	Scavenging feed resource base
SLR	Systematic literature review

Abbreviations and notations used in Appendix 4

+ or –	Positive or negative correlation between variable 1 / variable 2.
Y	Correlation between one or more dummy variable(s).
X	No correlation reported between variables.
I	Inconclusive or conflicting results from the studies. Correlation was reported but the direction of correlation (positive or negative) cannot be confirmed across other studies due to other possible interactions.
1, 2, 3	Denotes rank in descending order of priority, where given.

Abbreviations and notations used in Appendix 6

Fh	Female-headed households.
Mh	Male-headed households.
NA	Data not available.
[a] [b] [c]	Significant differences $p<0.01$, <0.05, <0.1 for a, b, c respectively.
[a] [b] [c]	Significant spatial differences at $p<0.01$, <0.05, <0.1 for a, b, c respectively.
%	All percentages are reported as a percentage of sample size (total households or respondents surveyed) unless otherwise stated.
[…]	Denotes given range value.

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1 Introduction

1.1 Problem background

Village poultry, *backyard poultry*, *homestead farming*, *indigenous poultry, semi-scavenging system*, and *family poultry* are common terms used throughout the literature to refer to the system of semi-subsistence, semi-scavenging poultry farming commonly found in developing rural economies in Africa, Asia and Latin America. Although almost always used interchangeably, each of these terms reveal distinct nuances that together describe the composite whole that is village poultry. Village poultry takes place within a heterogeneous livelihood setting of the *village* with its various production activities. These birds roam, roost and source their nutritional needs in the confines of a *backyard* while the *homestead* provides additional resource inputs such as water, feeding scraps and rudimentary shelter.

Unlike commercial poultry, village poultry are mainly *indigenous* breeds distinct in their genotype which influences biological parameters such as growth rates and egg production. The local genotype also enables a robust adaptability to the backyard environment as it predisposes the birds to unique traits such as strong predator avoidance, disease resistance and other survival instincts (Permin & Detmer, 2009; Alders & Pym, 2009). Such traits make the system of free-range, *semi-scavenging* feeding possible. Finally, these birds are part of the *family* in more ways than one: they are a source of income and nutrition and a valuable asset. Poor households often consider poultry as the very last asset in the event of economic shocks (Aklilu, 2008; Jensen, 1996). Poultry also fulfils socio-cultural obligations: they are given as gifts, slaughtered at feasts, and offered as sacrifices, thereby strengthening much needed social capital for resource-poor households (Aklilu, 2008; Kryger *et al.*, 2010; Akter & Farrington, 2011).

Although rural communities operate in vastly different agro-ecological, cultural and socio-economic contexts, the role of poultry as a source of income, nutrition and asset-building capital is a common theme that transcends cultural and geographical space. The low-input nature of village poultry, particularly in reference to its semi-scavenging feed system, allows it to be replicated with minimal resource requirements (Guèye, 2002; Dolberg, 1997). Despite the emergence of the global commercial poultry farming sector, it is estimated that backyard poultry comprise about 80% of the global poultry population and account for 90% of total poultry products in many countries (Mack *et al.,* 2005). It is estimated that 60% to 80% of rural households worldwide raise village poultry (Permin & Detmer, 2009).

While village poultry can be found in both developed and developing countries, it is in the latter where poultry is an important asset for households. Often from marginalised groups, such households are found in rural areas and/or female-headed. They live at the semi-subsistence level, are dependent on agriculture and have little if no access to marketing and institutional facilities such as credit and extension services. Development initiatives have targeted small-holder poultry farmers on the premise that higher production will achieve specific outcomes such as poverty reduction and improved food security. While community-based programmes (CBP) such as the Bangladesh Poultry Model which began in the 1990s have been successful in raising poultry performance, replicating similar concepts in other countries has proven to be problematic partly due to the differences in institutional capabilities and socio-cultural factors even at the village level (Dolberg, 2001). A key issue

raised was that socio-economic parameters tended to be completely neglected in such project replications (Jensen & Dolberg, 2003).

The low-input village poultry system belies a complex structure that is unique even among other small-holder farming activities. Much of this complexity lie in the multiple household objectives that village poultry fulfil, juxtaposed with the limited resources available to the families that keep them. The problem of poor performance – high flock mortality coupled with low reproduction and growth – presents much room for improvement using simple techniques or interventions. Yet, a failure to comprehend the socio-economic context of households in implementing interventions has led to disappointing outcomes (Asem-Bansah *et al.*, 2012; Udo *et al.*, 2011). This suggests the importance of understanding the economic intuitions behind households' objectives for poultry, the resource constraints they face and the interactions between optimisation decisions and the external environment in which households operate.

1.2 Research aim and questions

"Any intelligent fool can invent further complications, but it takes a genius to retain, or recapture, simplicity." ― Schumacher, 1973

Simple yet effective solutions may require looking at the problem from a different angle – in this case, from the perspective of the farmer rather than that from the policy-maker or poultry specialist. The research aim of this thesis is to understand village poultry systems through the lens of socio-economic factors relevant to the household and which influence household objectives and resources allocated to poultry. To investigate this critically, the following research questions were raised:

- What could be understood about the farm-household profile in terms of their socio-economic characteristics, resources and inputs used for village poultry and other production activities?
- How do these characteristics influence household optimising behaviour in the allocation of household resources and objectives for poultry farming?
- What are the potential trade-offs or opportunity costs facing households in such decisions on resource allocations?

Addressing these research questions would enable insights towards a better understanding of farm-households and the context of village poultry production. The theoretical framework used to guide this understanding is the agricultural-household model, as specified by Barnum and Squire (1979) and Low (1986). In these models, household[1] characteristics such as gender of household head, age, education, physical endowments, market access and institutional services constitute the resource and constraints that influence household priorities and are optimised with respects to resource and labour allocations. This sets the contextual framework for understanding the economic intuitions of village poultry producers through which production goals and recommendations for improvements must be considered.

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[1] The terms "farm-household", "household", "farm" and "family" are used interchangeably in this thesis to denote the representative farm-household; likewise for the terms "small-holder", "producer" and "farmer".

2 Theoretical framework

The view of American economist Theodore Shultz (1964) that peasants are "poor but efficient" offered a fresh approach to understanding the motivations behind farm-household decisions that has influenced research on agricultural households (Ellis, 2000: p.65). This hypothesis of peasant efficiency was in stark contrast to mainstream ideas during that era which postulated peasant subordination and their inability to act as rational agents. This chapter sets the framework for understanding farm-household incentives and objectives in village poultry production, which are rooted in the microeconomic behaviour explored in the agricultural household model.

2.1 Theory of household production

The model of the agricultural household relies on the theory of household production largely credited to Nobel laureate Gary Becker and his work *A Theory on the Allocation of Time* in 1965. In it, Becker sought to model human behaviour after principles of microeconomics, a concept that has been applied in "non-traditional" economic fields such as marriage, fertility and crime (Becker – Nobel lecture, 1992) and the labour participation of women (Low, 1986: p.16). Under Becker's analysis, households faced with dual production-consumption objectives aim to maximise utility from the consumption of a set of goods and leisure by allocating the time and inputs of its members to the purchase and/or production of these goods at minimal cost.

Adding time as a constraint in household production allows the value of domestic maintenance activities to be incorporated into production economics in the allocation of factors to farm production (Colin & Crawford, 2000). Semi-subsistence poultry production takes place alongside other household activities such as child care, house-keeping, social obligations, food production, wage work and marketing. Each of these activities demands the household's labour time and other market inputs. Farm-household choices in allocating resources towards various production activities, all of which compete for household labour time, provide an important window for analysing small-holder agricultural systems that operate at low levels of "observable" market behaviour (Pollak, 2011) and exhibit unresponsiveness to exogenous price incentives (Singh *et al.*, 1986: p.27; Taylor & Adelman, 2003). The agricultural household model is applied in order to address the factors that determine household objectives for poultry and labour allocation decisions, given the farm-household's dual role as a producer and consumer of market commodities and production factors (Singh *et al.*, 1986; p.4-5) specifically household labour.

2.2 Agricultural household models

In the agricultural household model, farm-households are assumed to operate under a utility and/or profit maximising objective motivated by economic efficiency. Economic or Pareto efficiency states that households should allocate their limited resources such that reallocation cannot result in any further gains in output or utility within the household. As a consumer, the household aims to maximise utility, derived from the consumption of a set of commodity goods and leisure, by allocating resources of time, income and factors of production (or market inputs) to the purchase or production of these goods.

However, unlike a profit-maximising firm, village poultry production is influenced not only by exogenous prices but also household consumption objectives (Tung, 2012). Data on small-holders in Africa and parts of Asia have provided empirical evidence of positive own-price elasticity of demand where higher prices stimulated the consumption rather than sale of own farm produce (Singh *et al.*, 1986: p.26; Taylor & Adelman, 2003). To investigate optimisation decisions, the agricultural household models by Barnum and Squire (1979) and Low (1986) provide the theoretical frameworks by which to understand the resource allocation and production and consumption behaviour of farm-households engaged in semi-subsistence poultry. The household is considered as a unit of analysis. References made to a representative farm-household (or 'household') are assumed to reflect the aggregate of all household responses and interactions with the market (Barnum & Squire, 1979: p.12).

2.2.1 Barnum and Squire model

Barnum and Squire developed the model based on data drawn from a rice cultivating region in the Muda Valley of Malaysia. In the model adapted here from Singh *et al.* (1986: p.17-20), household utility is derived from the consumption of three goods: an agricultural good produced by the farm-household X_a, a market good X_m which may be a good sold on the market and purchased by the household or a good for which the household is a net-producer, and leisure X_l as follows:

Equation 1: $U = U(X_a, X_m, X_l)$

The household maximises utility subject to time T, production Q and a budget constraint as shown in *Equations 2, 3* and *4* respectively:

Equation 2: $T = F + X_l$

Equation 3: $Q = Q(L, A)$

Equation 4: $p_m X_m = p_a(Q - X_a) - w(L - F)$

The above constraints include inputs of family labour F, total labour L, land A, and prices of the market good P_m, the agricultural good P_a, and labour or wages w. Substituting *Equations 2* and *3* into *4* yields a single constraint. Total expenditure on utility-generating commodities is represented on the left-hand side, with full income from maximising farm profits on the right-hand side as follows:

Equation 5: $p_m X_m + p_a X_a + w X_l = p_a Q(L, A) - wL + wT$

Equation 5 shows that the optimisation problem takes into account both production and consumption decisions. Household consumption of each market commodity X_m and X_a and leisure X_l, shown on the left-hand side, is optimised with respects to production decisions on quantity to produce Q, labour L and time T inputs that maximise farm profits, shown on the right-hand side. Q represents the quantity of all agricultural products by the farm-household which includes cash crops, livestock and subsistence Z goods. Z goods are commodities produced and consumed by the household and for which there is no market. For this reason, village poultry products are assumed to be Z goods in this thesis.

Disaggregating the right-hand side of *Equation 5*, the first two terms depict a measure of farm profits while the third (wT) reflects Becker's concept of the stock of time. Barnum and Squire

also showed that the consumption of own commodities (X_a), which includes the poultry Z good, results in own price effects as follows (Singh *et al.*, 1986: p.20):

Equation 6: $\frac{dX_a}{dp_a} = \frac{\partial X_a}{\partial p_a}\big|_{Y^*} + \frac{\partial X_a}{\partial Y^*}\frac{\partial Y^*}{\partial p_a}$

Assuming that $X_a = Z$, *Equation 6* can be seen to imitate the Slutsky equation in the analysis of consumer behaviour. The first term on the right-hand side shows the income-compensated change in demand. The second term shows the farm profit effect which takes into account the effect of farm profits from a change in poultry (shadow) prices, and the substitution and income effects on the household as a result of the price change. The model thus captures the joint production and consumption decisions that farm-households aim to optimise, including the allocation of labour inputs that maximise farm profits. The first-order conditions with respects to the labour input L and utility generating consumption goods X_a, X_m and X_l are derived from *Equation 5* as follows:

Equation 7: $p_a * \frac{\partial Q}{\partial L} = w$

Equation 8: $\frac{\partial U}{\partial X_m} = \lambda p_m$

Equation 9: $\frac{\partial U}{\partial X_a} = \lambda p_a$

Equation 10: $\frac{\partial U}{\partial X_l} = \lambda w$

Equation 11: $p_m X_m + p_a X_a + w X_l = Y^*$

Equation 7 shows the condition where the marginal revenue product of labour equals the market wage w, a necessary condition for allocative efficiency. The relative market wage $\frac{w}{P_a}$ from *Equation 7*, which equates to the marginal product of labour $\frac{\partial Q}{\partial L}$, also reflects the opportunity cost of household time. Solving *Equation 8, Equation 9* and *Equation 10* produce the shadow price of consumption λ where the marginal rate of substitution between each pair of goods in the utility function is equal to the price ratio of those goods. Finally, *Equation 11* specifies the budget constraint with expenditures on the left-hand side and full income Y^* on the right-hand side. The household's lacklustre response to exogenous prices is reflected in that a marginal increase in poultry prices raises the shadow price of consumption by $\lambda = \frac{\partial U}{\partial X_a * P_a}$.

The Barnum-Squire model (Barnum & Squire, 1979: p.26-30) aggregates the consumption of home-produced Z goods and other agricultural goods for which a market exists into a single agricultural commodity X_a. Household members' time allocated to the production of Z, other agricultural goods and wage labour are encapsulated by the total stock of family labour F which is a function of household size. Barnum and Squire made several assumptions in their model which can be applied to the representative village poultry producer as follows (Ellis, 2000: p.131; Barnum & Squire, 1979: p.28-29; Singh *et al.*, 1986: p.18):

- A functioning labour market allows households to buy or sell labour at exogenous market wages.
- Households are price-takers in factor and commodity markets and sell or consume own poultry produce based on exogenous market prices.

- Income from the sale of village poultry is used to purchase food and market goods.
- Land is a fixed factor and any rent is captured as non-farm income.
- Uncertainty and risk are ignored.
- Effects of migration on household size and labour are ignored.

Implicit in the first two assumptions is a further assumption of available markets for factors of production as well as commodities, credit and finance (De Janvry *et al.*, 1991). At a given market wage, the farm-household will equate the marginal value output of agriculture with the price of labour or market wage and will either engage workers or use own family labour depending on production conditions (*Equation 10*). With exogenous wages calibrating demand and supply in the labour market, household members are assumed to be indifferent between working on the farm and finding non-farm waged employment, and between consuming their own produce or purchasing from the market.

However, farm-households operate in highly imperfect markets where optimisation decisions on poultry production, consumption and labour are non-separable, interdependent or jointly determined. In a mixed market scenario characterised by some tradable factors and missing markets for other factors, optimisation decisions on production, consumption and labour are made simultaneously. Households are therefore neither indifferent towards one from their own family or a hired worker, nor towards the specific household member who is tasked with poultry keeping; hence, the significance of intra-household labour allocations is evident.

Production and consumption decisions on poultry are also jointly determined and non-recursive. In a recursive model with the assumption of household as price takers, production decisions influenced by exogenous prices in turn influence consumption and labour supply decisions, leading to what is termed a profit effect (Singh *et al.*, 1986: p.7) as shown in *Equation 6*. Yet, empirical research on small-holder systems operating in inefficient markets has shown that misspecification using a recursive or separable model would yield inconsistent parameter estimates of optimisation outcomes (Singh *et al.*, 1986: p.50). The exogenous socio-economic context of mixed and missing markets for farm-households in developing countries therefore argues for a non-separable approach to analysing intra-household resource allocation and household objectives for poultry in this thesis.

2.2.2 Low's model

The Barnum-Squire model sought to explain the underlying mechanisms behind the apparent inertia to exogenous price incentives using data of Malaysian padi farmers. Low's model, on the other hand, sheds light on the lack of response of "formerly self-sufficient subsistence households to 'modernization' and the introduction of new market opportunities" in Southern Africa (Low, 1986: p.18). In Low's model, time, rather than budget, is the main constraint facing households who may choose to spend their time in wage work (market production) or in the non-market production of the subsistence *Z* good (Low, 1986: p.3) or poultry. A defining characteristic is that labour for poultry keeping is drawn from the family rather than from wage hire, thereby fulfilling one of the household's objectives of utilising its family labour all year round (Sonaiya *et al.*, 1999 cited in Sonaiya & Swan, 2004). *Table 1* presents several features of Low's theory modelled after households in southern Africa which differ from those studied under Barnum and Squire.

Table 1: Household characteristics and implications for production, consumption and intra-household labour allocation under Low's model.

Household characteristics	Implications for production, consumption and labour allocation
Households in low-income countries are semi-subsistence.	Production is mainly for own consumption and little of what is produced enters the market.
Households face food deficits.	Relative to total family income, the value of subsistence home production is large.
Household size is directly related to household production.	The size and composition of a household provides the primary resource input available for poultry production. This key input is household labour time.
Households are net suppliers of labour and aim to utilise all family labour towards production.	Households seek to allocate labour among a range of productive activities, namely non-market poultry production, market goods and wage labour, rather than between production and leisure.
Households operate within traditional rural societies that differ from modern ones in terms of the rural economy.	Fractured labour markets and gender biases prevalent in traditional societies give rise to variable wages that reflect discrepancies in the value of labour between men and women.

Source: Author's own, adapted from Low, 1986: p.17, 44; Ellis, 2000: p.139-140.

Based on Low's model (1986: p.35-39), household utility is derived from the consumption of both market goods and poultry Z goods. Unlike the Barnum-Squire model, the leisure component is omitted and labour time between household members are differentiated rather than aggregated as family labour. Given the differences in the market value of labour among its members, households will allocate poultry production so as to minimise the time costs of producing the poultry Z good, such that:

Equation 12: $C_Z = P_X X_i + W_i T_i \qquad i = 1.2, ..., n$

Where C_Z is the cost of producing village poultry, P_X is the price of input x used in village poultry production, X_i is the physical input required by member i to produce a unit of poultry product, W_i is the wage rate of member i, and T_i is the time member i takes to produce a unit of poultry products. It can be said that W_i and T_i are disaggregated from wage w and family labour F respectively from *Equation 13* in the preceding Barnum-Squire model.

To model household decisions on whether to engage in poultry production, the market price of poultry P_Z is compared with the household opportunity cost of producing it. The household thus combines market inputs and the time of its household members such that the cost of producing the poultry Z good is minimised relative to comparative differences in wage employment between members. The difference in the opportunity cost of production is reflected in the comparative advantage of different household members in wage employment. Households will generally relegate poultry production to the member with the lowest comparative advantage in wage labour or to more than one member, as long as P_Z exceeds any costs of input X_i and forgone wages $W_i T_i$:

Equation 14: $P_Z > P_X X_i + W_i T_i \qquad i = 1, 2, ..., n$

Rearranging:

Equation 15: $\frac{P_Z - P_X X_i}{T_i} > W_i \qquad i = 1, 2, ..., n$

The left-hand side of *Equation 14* depicts the opportunity cost of the household purchasing the Z good. On the right-hand side, the opportunity costs of producing the Z good by member i is shown by the foregone wage W_i. Thus, if the cost to the household of purchasing poultry products exceeds the cost of producing it as shown in *Equation 14*, the household will decide to produce poultry. Low (1986: p.37) noted that households will allocate members to the production of the Z good "until either the household's requirement for the (…) Z good is satisfied or the next member's wage rate becomes greater than his opportunity cost of purchase, in which case the balance of requirements will be purchased".

Labour allocation in a multi-enterprise farm-household
Figure 1 shows the labour allocation choice facing a food-deficit household in relation to the opportunity cost of members' labour time (Ellis, 2000: p.140-141). Total household labour time on the horizontal axis is a sum of the labour time of its three members A, B and C. The vertical axis reflects the importance of the relative market wage (or real wage) $\frac{w_i}{P_X}$ of member i, rather than money income. For the food-deficit household, wages earned are viewed in relation to its purchasing power for food. The linear total product curve (TPP) shows the contribution of labour input to real income, assuming constant marginal physical product of labour (MPP_L). The slope of the line OW at the segments A, B and C corresponds to the opportunity costs of the respective household member. Shifting OW to ww' where it is tangent to the TPP curve gives the optimal or profit maximising level for labour allocated to farm production and wage work. Household members A and B with lower opportunity costs of time relative to their marginal productivity of labour (comparative disadvantage in wage work) will engage in the production of the poultry Z good, while member C with the higher comparative advantage in wage work should seek off-farm employment.
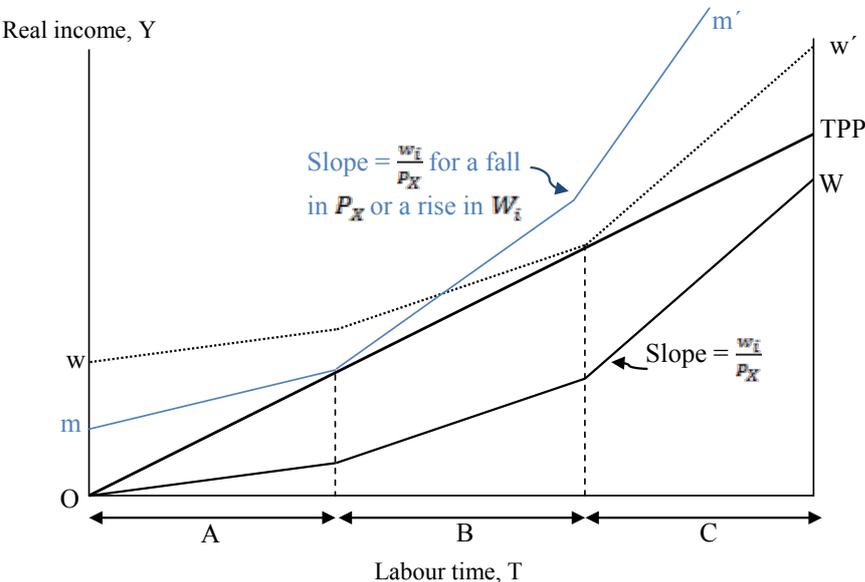
Figure 1: Intra-household labour allocation under Low's model

Source: Ellis, 2000: p.140

A change in the relative prices of food changes the opportunity costs of labour time. In the case of a price fall, this raises real wages relative to food prices such that ww' shifts to mm; the same effect is seen with a rise in wages, keeping food prices constant. In such scenarios, the household will be better off allocating two members B and C to wage work while only A

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remains in the production of poultry. This is also in line with risk aversion behaviour as households minimise risk by allocating the member with the lowest comparative advantage in wage employment to the production of the poultry *Z* good (Low, 1986: p41–42). The literature also acknowledges that diversification into multiple production activities is a risk minimising strategy (Muchadeyi *et al.*, 2004).

2.3 Analysing village poultry production

Both the Barnum-Squire and Low models of agricultural household production typify a representative rural farm-household that engages in multiple production enterprises, farms poultry to meet its subsistence needs and sells any surplus to the market. Implicit in both models are that households combine time and other inputs towards producing utility generating market and non-market goods for a broad range of household production activities such as general consumption, off-farm wage work and domestic chores (Low, 1986: p.35; Becker – Nobel lecture, 1992; Colin & Crawford, 2000). For the purpose of this study, the effects of migration on labour supply and land as a factor input are ignored. Applying the concepts from the agricultural household models, several key points emerge to guide the systematic literature review and analysis of village poultry (Hunt, 1991: p.65; Becker – Nobel lecture, 1992; Low, 1986; p.172):

- Farm-household objectives: To maximise utility, where infinite utility is tied to the ability to meet basic subsistence needs at minimum cost and risk.
- Price sensitivity: Weak or absent supply responsiveness to price incentives result from dysfunctional markets. This implies the working of endogenously determined shadow prices for factors and outputs.
- Time as the key input in household production: This parallels Becker's view of time as the fundamental constraint. Households aim to maximise returns to labour-time by engaging in production activities that promote multiple utilities. For example, time spent on poultry may allow keepers to interact with each other, bringing social benefits as well as economic and nutritional benefits from sale and consumption.
- Labour allocation: Households will allocate labour among its members to poultry based on the member's implicit wage and the implicit price of poultry. Allocative efficiency is thus implied.
- Opportunity costs: Non-separable production and consumption decisions imply a shadow price that equilibrates household demand and supply. Poultry interventions incur trade-offs with respects to household resources and labour time.

2.3.1 Shadow prices and transaction costs

Incomplete markets for commodities and factor products void the notion of exogenous prices, and thus the assumption of households as price-takers. In such a scenario, production and consumption decisions for poultry are linked by an endogenous price. In the Barnum-Squire model, the endogenous shadow price is the solution to the first-order conditions which state that the marginal utilities derived from the consumption of a range of goods and leisure relative to their respective prices should be equal (*Equation 8, Equation 9* and *Equation 10*). In Low's model, the shadow price is a proxy of the opportunity costs of production (or self-sufficiency) relative to purchase (or market participation), and of farm relative to wage labour (or the shadow wage).

In the absence of exogenous market prices, shadow prices calibrate the equilibrium of supply and demand. The extent to which an exogenous price increase might stimulate marketed surplus and farm incomes would depend on how well integrated farm-households are in markets. Market imperfections impose transaction costs such that if the costs of participating in the market exceed the benefits, the household is better off being self-sufficient. High transaction costs result in non-tradables that create a wedge between the price received by the producer and that paid by the consumer. This price wedge, also known as the price band (Key *et al.*, 2000) widens as transaction costs increases. Within this price band lies the shadow price. If the farm-household's shadow price for its poultry products is higher than what it will obtain from the market, it is better off selling the product to itself, that is, to consume its own produce. Along the same argument, if the shadow price for consumption is lower than the market price of the produce or a substitute, the household is better off buying from itself (Taylor & Adelman, 2003). As demonstrated in the Barnum-Squire model, a consequence of market imperfections is that production, consumption and labour supply decisions are thus non-separable or jointly determined.

2.3.2 Endogenous and exogenous variables

As discussed above, the virtual or shadow price is a key endogenous variable of the farm-household model used to further the understanding of village poultry production in this thesis. Endogenous, as opposed to exogenous, prices for labour, poultry output and inputs, are functions of household preferences and production technology, and influence the interdependence in production and consumption of village poultry (Singh *et al.*, 1986: p.79). Other endogenous factors include shadow wages, farm profits, household savings and investment, and labour productivity (*ibid.*). In this thesis, the variables identified as endogenous are those that pertain to household joint production-consumption objectives and labour allocation, poultry performance and the adoption of poultry interventions and management practices.

Household optimisation takes place in the context of exogenous farm-household characteristics. Based on the literature of agricultural household models, variables of interest to this thesis include the household size, number of dependents, age, education level and gender of the household head or farmer, location (linked to agro-ecological resource base and market access) and access to services (Barnum & Squire, 1979: p.80). Other exogenous variables such as market wage, capital available to the household and production factors are policy influenced and affect household production decisions and production outcomes (Evenson, 1981; Singh *et al.*, 1986: p.50).

Appendix 1 presents a conceptual map of the socio-economic context for understanding village poultry production, using the key variables identified in the agricultural household model as discussed in this chapter. This conceptual map sets the framework for analysing household optimisation decisions, and is used to guide the analysis of results from the literature in C*hapter 5* Results.

3 Background of study

This chapter introduces developments in village poultry as a means of rural development and poverty alleviation. These aims were demonstrated successfully in a small-holders' livestock project in Bangladesh that has inspired subsequent attempts to implement similar models in the other developing countries. Characteristics of village poultry systems and major technical improvements or interventions are briefly outlined. Departing from previous emphases on improving the technical and production aspects of poultry, new strategies have increasingly focused on undertaking improvements by considering the socio-economic and cultural dimensions unique to the households that keep village poultry.

3.1 The emergence of village poultry in rural development

Village poultry systems have existed for centuries, yet it was only in the last two decades that more prominence has been given to its role in rural development, specifically as a livelihood strategy and poverty alleviation tool (Alders & Pym, 2009). After a series of failed attempts in the 1960s and 70s, development-oriented projects to engage small-holder poultry are now widely recognised as having an unparalleled reach in poverty reduction, compared with other agricultural or livestock-based programs such as cattle farming (Dolberg, 2001). Among all agricultural activities, poultry production is most widespread among the poorest segments of the population who often constitute female-headed households and the landless (Islam & Jabbar, 2005; Saleque & Mustafa, 1996). As such, village poultry has become almost synonymous as a tool for poverty eradication and food security.

There are many reasons why poultry has an exceptional reach among the poorest households. Firstly, unlike field crops, poultry can be raised by the very poor, classified as the landless or marginal landowners with less than 0.5 hectares (Saleque & Mustafa, 1996; Tadelle & Ogle, 2001). Poultry requires little land and land quality and arability are also not important factors. Dolberg (2003), for instance, showed that poultry keeping in Bangladesh was negatively correlated with the size of land holding. Secondly, unlike other livestock such as cattle or fish farming, indigenous poultry are natural scavengers requiring minimal feed inputs. Semi-scavenging systems also complement the mixed farming systems common in developing countries (Alders & Pym, 2009; Kryger *et al.*, 2010). Thirdly, unlike other agricultural activities and wage employment options, village poultry is not time or season specific and can be managed by children and women as part of household chores.

Fourthly, there are few religious and cultural taboos associated with poultry, hence its broad appeal. Gifts of poultry are a socio-cultural obligation in many rural areas and important for cultivating social relations and enhancing social capital (Aklilu, 2008; Kryger *et al.*, 2010). Finally, the relatively short life-cycle of poultry (about 80-90 days to slaughter for broilers, 4-6 months to laying age for layers) demands little capital investment. Resource-constraint households can thus raise poultry and obtain quick returns at a low investment. In addition to providing quality protein, chickens and eggs can be sold for cash and used to buy foodstuffs, purchase market goods and send children to school. For these reasons, poultry has been viewed as the first rung in a metaphorical livestock ladder where the poorest start with poultry before moving on to acquire larger livestock assets such as dairy cattle (Udo *et al.*, 2011; Dolberg, 2001; Aklilu, 2008).

3.1.1 The Bangladesh poultry model

Widely regarded as a successful pro-poor development initiative focusing on poultry (Alam, 1997; Dada & Martin, 2003; Jensen & Dolberg, 2003), the so-called Bangladesh poultry model (or 'Bangladesh model' for short) was based on the idea that small-sized flocks of about 10 birds could present a viable strategy for rural poverty alleviation among the "hard-core poor" and disadvantaged women (Jensen, 1998). When the founders of the model, the Bangladesh Rural Advancement Committee (BRAC) first proposed this concept in the 1970s, neither the policy makers nor rural poor regarded poultry as a significant livestock activity (Jensen, 1996; Saleque & Mustafa, 1996).

Starting as an ad-hoc project administered by the BRAC and the Department of Livestock Services (DLS) in 1978, the concept gradually evolved through several phases into an organised supply chain for inputs required to maintain an enhanced semi-scavenging poultry model (Saleque & Mustafa, 1996; Nielsen, 1996). A well-structured poultry value chain encompassing breeding, feed and vaccination supply, marketing and credit provided both income generating opportunities and the necessary production inputs for its participants (Jensen, 1996; Islam & Jabbar, 2005; Saleque & Mustafa, 1996). All activities operated under free market conditions (Jensen, 1998) where prices were fixed with many buyers and sellers, information on credit and technical training was disseminated through the service line, and the existence of markets reduced the transaction costs that village producers would otherwise face. Subsidies were not given and services were sold at market price (Riise *et al.*, 2005). Technical assistance and funding were provided by the Danish International Development Agency (Danida), the International Fund for Agricultural Development (IFAD) and the Asian Development Bank (ADB).

In the mid-1980s, when this prototype of a small-holder poultry project was beginning to develop (Islam & Jabbar, 2005), over 80% of rural households in Bangladesh were raising scavenging poultry with 98% of the country's poultry meat and eggs coming from small-scale poultry systems (Huque *et al.*, 1999). The participants were typically females from both male- and female-headed households farming on no more than 1.5 acres of own or rented land (Nielsen, 1996). By the turn of the millennium, the project had reached over two million participants in Bangladesh (Dada & Matin, 2003). This inspired the idea that the small-holder poultry concept could work in other developing countries with similar profiles of high rural poverty and a prevalence of backyard poultry production.

3.1.2 Village poultry as a development tool

Overall, the Bangladesh model resulted in positives outcomes with improved poultry performance and beneficial socio-economic impacts a result of the project's interventions (Islam & Jabbar, 2005; Kryger *et al.*, 2010). Surveys showed that poultry mortality fell drastically among the intervention groups while egg and poultry meat consumption as well as income from sales of poultry products among the participants more than doubled during the project period (Fattah, 2000). There were also positive gender effects with women reporting more involvement in household decisions and control over finances gained from poultry sales (Saleque & Mustafa, 1996; Fattah, 2000). Various studies have documented the experiences and lessons learnt over the two decades in Bangladesh, thereby contributing to the improvement of the project design and the development of a conceptual framework using village poultry to address rural poverty (Jensen & Dolberg, 2003; Riise *et al.*, 2005).

As a result of the Bangladesh experience, parallel concepts using poultry as a development tool have been attempted in other countries, to varying levels of success. Some of these countries are Benin, Burkina Faso, Cambodia, Ghana, Eritrea, Ethiopia, Indonesia, Kenya, Laos, Malawi, Mozambique, Nicaragua, Senegal, Tanzania, Vietnam and Zimbabwe (Guéye, 2008; Riise *et al.*, 2005). Dolberg (2001) noted that the Bangladesh model, whose success lies in a well-integrated supply-chain structure and institutional backing, had to be adapted to countries with less developed infrastructures and markets. Recognising the need for a holistic understanding of village poultry systems, a number of formal networks have been set up to address technical and production issues. Some examples are the FAO-based International Network for Family Poultry Development (INFPD), the Network for Small-holder Poultry Development in Denmark, and the International Rural Poultry Centre in Australia (*ibid.*).

3.2 Characteristics of village poultry systems

The low-input, low-output system has been cited as a unique advantage of village poultry (Jensen & Dolberg, 2003). The low cost not only reduces the entry barrier to production but also incentivises families to continue maintaining small backyard flocks at little cost. As feed cost contributes about 70% to the total cost of commercial poultry production, the fact that village poultry subsists mainly by scavenging drastically lowers the financial cost of keeping them. They also require few other physical inputs and household time, thereby exacting low demands in terms of resources and opportunity costs for resource constrained households. It is estimated that indigenous poultry comprise some 80% of total poultry stocks in Asia and Africa where over 70 to 90% of rural households rear small flocks of about 20 birds, normally cared for by women (Guèye, 2000). The pervasiveness of backyard poultry in developing rural economies lends much potential to its use in addressing issues such as poverty, food security, nutrition and rural employment.

Village poultry systems often exist side-by-side in developing countries with a growing commercial poultry sector (Pym *et al.*, 2006). The latter is distinguished by its use of high yielding poultry breeds and advanced management processes to cater to the growing demand for animal protein among the urban population, while the former is made up of indigenous birds raised with few inputs by rural households and for various objectives. The FAO and World Organization for Animal Health (OIE) have classified four main poultry production systems: the industrial integrated system (Sector 1), commercial production (Sector 2), small-holder commercial production (Sector 3) and the village or backyard system (Sector 4). Productivity is low compared with other production systems (sectors 1-3) due to high mortality from diseases, parasites, predation, theft, accidents and inadequate nutrition.

Table 2 shows the classification of poultry systems in Sector 3 and 4. Sector 4 typifies the traditional scavenging system of interest in this thesis. This sector has also been referred to as "safety net" production, distinguished from Sector 3 known as the "asset builder" (Permin & Detmer, 2007). Within Sector 4 are two other sub-systems. Sector 4A, the traditional free-range, refers to the most rudimentary level of scavenging, pure bred indigenous poultry commonly found in mixed farming systems. Sector 4B is an enhanced variant of 4A where improved breeds, management and some basic inputs such as supplementary feed are used. It is estimated that more than 80% of poultry producing households in developing countries belong to Sector 4 (*ibid.*).

Households invest little in their flock in terms of time, management expertise, physical inputs and capital (Kryger *et al.*, 2010). There are also vast regional differences with flock sizes averaging from 3 to 97 in Africa, 10 to 31 in South America, and 50 to 2,000 in Asia (Sonaiya *et al.*, 1999). This suggests that households in different geographies may be operating under different scales of production ranging between Sectors 3 and 4. Flock sizes also reflect farm-household objectives and usage. These variables are highlighted in green in *Table 2*.

Table 2: Characteristics of small-scale poultry production in Sector 3 and 4.

Characteristics		Sector 4A: Traditional free-range	Sector 4B: Improved free-range	Sector 3: Small-scale confined
Socio-economic	Key rearers	Majority of rural families	Moderate number of rural families	Few rural families
	Ownership	Owned mostly by women	Owned by women and family	Middle men and entrepreneurs
	Product use	Home consumption	Home consumption and local sales	Family income
	Profit	Small cash income	Family income	Business income
	Objectives	Social and cultural importance (gifts, religious), no credit	Social importance, micro credit available	Little social importance, credit-based asset
Production	Productivity	Low input/low output	Low input/medium output	High input/high output
	Flock size	1 - 10 birds	10 - 50 birds	50 - 200 birds
	Type of breeds	Indigenous breeds	Indigenous/ improved breeds	Hybrids (broilers or layers)
	Mortality rate	High mortality	Moderate mortality	Low mortality
Interventions	Feed resource	No feeding (scavenging)	Supplementary feeds (semi-scavenging)	Balanced feed rations
	Vaccination	No vaccination	Vaccination for common diseases e.g. Newcastle	Several vaccination schemes
	Medication	No medication	Little medication/ local remedies	Full medication
	Shelter	No housing	Simple housing	Houses with cages or deep litter
Performance	Egg production	30-50 eggs/ hen/ year	50-150 eggs/ hen/ year	250-300 eggs/ hen/ year
	Broodiness[2]	Long broody periods	Short broody periods	No broodiness
	Growth rate	5-10 g/ day	10-20 g/ day	50-55 g/ day

Green rows show the characteristics referred to in the paragraphs above.

Source: Adapted from Permin et al., 2007; Goromela et al., 2006.

Apart from the challenges in the backyard, factors exogenous to the household impose constraints on village poultry production. Poor infrastructure and market inefficiencies hinder the sale of poultry products and the supply of inputs such as feed and vaccines. There is also a

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[2] Broodiness is a trait common among hens during egg laying and signifies reproductive capability (Pym *et al.*, 2006)

lack of knowledge on poultry management and an absence of organised services such as extension services and credit facilities for small-holders.

3.3 Interventions and general management

Village poultry suffer from high output loss and low productivity which limit their usefulness as an economic resource for households. This section presents some of the most common technical interventions and general management techniques undertaken to tackle the problems of high mortality and low productivity in village poultry. The literature reviewed in this section was sourced mainly from technical articles and research that specifically addressed the production challenges faced by small-holder producers.

3.3.1 Feed resource supplementation

A popular intervention is optimising the scavenging feed-resource base (SFRB) available to poultry (Goromela *et al.*, 2006; Jensen & Dolberg, 2003). The SFRB is the major physical input for village poultry systems and consists of any resource given by the household or which are available in the immediate environment that the scavenging birds can feed on (Goromela *et al.*, 2006). Forage material, household food scraps and agricultural by-products constitute the typical SFRB, which is influenced by the climate, density of households in the area, number and type of livestock owned, crops grown and religion (Sonaiya & Swan, 2004). Scavenging typically supplies about 60-70% of a bird's nutrient requirements (Alders & Pym, 2009). Therein lies the key advantage of local scavenging breeds – their ability to covert low quality energy feed to animal protein (Kitalyi *et al.*, 1998) and the potential for improving household nutrition.

Despite the advantage of scavenging, the lack of feed supplementation is a major limiting factor. Huque *et al.* (1999) found that egg production under the scavenging system was about 40% that of commercial farms due to inadequate feed nutrition. Moving from Sector 4A to Sector 4B requires increasing the nutrient availability of the SFRB such that scavenged feed should be sufficient and safely accessible with minimal predator risks (Jensen, 1998). However, the extra costs of poultry feed supplementation may not be economically feasible for households.

3.3.2 Disease treatments and vaccinations

Disease challenges are a major cause of mortality and losses, which affect about half the flock or more on average (Sonaiya *et al.*, 1999; Permin & Detmer, 2007). Young chicks are particularly susceptible to diseases caused by viruses and parasites. Some common diseases among village poultry are Newcastle disease which affects mainly wild bird species, fowl pox in young chicks and the Highly Pathogenic Avian Influenza (HPAI) epidemic or bird flu which emerged in the last decade.

Bell (2009) proposed that eliminating viral diseases through vaccination should be the first step to improving village poultry before implementing other interventions such as improving the SFRB. However, modern vaccinations are problematic for village producers as these require cold storage facilities and precise administration by a trained veterinarian. Traditional remedies using ethno-veterinary medicine to treat poultry diseases have also shown positive results and potential for further study (Mapiye & Sibanda, 2005; Muchadeyi *et al.*, 2004).

3.3.3 Housing and biosecurity

Village poultry are free in range in the day but the provision of night shelter protects flocks from predators and increases their chances of survival. Housing can be constructed at low cost using locally available material but should have the following features for optimal production: space for litters and perches, ventilation, light and protection (Sonaiya & Swan, 2004). Shelter is especially important for young chicks as they are the most vulnerable to predators and are highly susceptible to disease infections. It is sometimes recommended that young chicks be housed separately as they are more easily severely affected by disease vectors and insects in henhouses than older poultry (Sodjinou, 2011). However, the usefulness of chick-housing depends on how often the houses are cleaned and whether adequate steps have been taken to ensure optimal biosecurity.

Poultry housing is the starting point for biosecurity that prevents the introduction and spread of viral diseases among the flock. Basic biosecurity strategies can be successfully implemented in small-scale systems (Alders & Pym, 2009). Some measures include cleaning poultry houses regularly, avoiding contact with other animals or humans, and putting under quarantine birds that show symptoms of illness and those bought from the market.

3.3.4 Improved breeds

Unlike feed availability, genetic potential is often not the most significant limiting factor in scavenging systems (Alders & Pym, 2009). Attempts to introduce commercial crossbreeds have found that such birds fared badly in the backyard environment despite their much higher yield potential on commercial farms (Huque *et al.*, 1999; Sonaiya *et al.*, 1999). In addition to preserving genetic diversity, indigenous breeds are preferred for their tastier meat. Their colourful plumage and unique feather and comb types create a niche in the market for their use as gifts and in cultural ceremonies (Pym *et al.*, 2006; Islam & Jabbar, 2005).

Crosses between local and exotic species yielded birds with high adaptability to the free-range system and improved production potential but only under semi-intensive conditions (Islam & Jabbar, 2005; Huque *et al.*, 1999) such as in Sector 3. It has been recommended that a more effective way to improve production is to first implement feed supplementation and disease control interventions before cross-breeding (Tadelle *et al.*, 2003; Bell, 2009).

3.3.5 Other interventions

Households may conduct interventions such as egg candling to improve hatchability, brooding management for chicks, and general maintenance such as watering, cleaning poultry houses and penning the flock at night. In sharing arrangements, households pool together resources for poultry production such as sharing feed grains and vaccination duties. Households may also participate in community-based programmes (CBP) and farmers' groups designed to impart practical skills on the adoption of interventions. Such programmes often grant participants greater access to credit and facilities to market their poultry products.

3.4 Matching programme aims with household objectives

Schumacher (1973) proposed that scientists and technologists should provide "methods and technologies which are cheap enough so that they are accessible to virtually everyone, suitable for small-scale application (and) compatible with man's need for creativity"

(Schumacher, 1973: p.29-30). Schumacher's call for appropriate technologies resonates with the experience of village poultry practitioners. For instance, the Bangladesh model has shown that disadvantaged groups can make a living from 10 layer hens through a concept creatively modelled after the input supply chain of an integrated commercial poultry enterprise. Other field experiences have also proven that interventions in scavenging systems can enhance production and promote socio-economic well-being among poor rural households (Alders & Pym, 2009; Kryger *et al.*, 2010).

This has led to the view that raising the status of village poultry towards a market-oriented enterprise presents a viable pathway out of poverty (Ahuja & Sen, 2007; Jensen, 1996; Islam & Jabbar, 2005). For households to continue reaping the benefits of poultry, recommendations posit that production should develop from small-scale to semi-intensive (see for instance Islam & Jabbar, 2005). The first step is to implement low-cost interventions that reduce flock mortality and improve hatchability, thereby raising productivity. Following this is the next stage where households gradually move away from the semi-subsistence level to small-scale confined (Sector 4 to Sector 3) in the longer term (Conroy *et al.*, 2005).

Despite low yields, studies have shown that small-scale farming systems may not be inferior to commercial production in terms of profitability and technical efficiency (Delgado *et al.,* 2004; Chavas *et al.,* 2005). Raising output or production does not necessarily concur with efficiency and profitability from the point of view of the small-holder. According to Bell (2009), although commercial poultry have far superior growth and egg production rates, their reliance on purchased feed and specialised housing makes them far less efficient compared with indigenous birds that have the ability to scavenge for feed and fend for themselves away from predators. This suggests that profitability should be assessed in relation to the economic investment of household time and resources (*ibid.*).

While interventions to raise output addresses important technical aspects of production, too little attention has been paid to understanding how such interventions relate to the socio-economic contexts in which households operate (Asem-Bansah *et al.*, 2012; Aklilu, 2008; Kryger *et al.,* 2010). Questions have been raised about the extent to which poultry projects have contributed to poverty reduction and the physical well-being of rural households especially women, how well adapted the interventions introduced are to local farming conditions and technology adoption behaviours, and whether markets and institutional settings support or actually hinder production (Dolberg, 2003; Sodjinou, 2011; Udo *et al.*, 2006). There is hence a need to prioritise research towards other objectives besides increasing output alone, by understanding who the poultry keepers are, their portfolio of production activities, objectives for poultry and spatial or regional differences that influence production (Hunt, 1991; Birol *et al.*, 2010). The research aims of this thesis, as outlined in *2*, are hence aligned with these objectives and will be expounded subsequently in *Chapter 5* and *Chapter 6.*

4 Methodology

This chapter begins by stating the reasons for the choice of the methodology, which is a systematic literature review (SLR) of individual studies that constitute the primary data of this study (Kitchenham, 2007). The three stages involved in conducting the SLR – surveying the literature, sorting, and synthesizing – are described in the different sections of this chapter.

4.1 Why a systematic literature review?

Empirical and primary research of village poultry systems is neither new nor lacking in content. A number of comparative studies have been conducted on the characteristics of village poultry systems (Barrett *et al.*, 2012, Sonaiya *et al.*, 1999; Birol *et al.*, 2010), on a range of interventions to improve production (Udo *et al.*, 2006; Tung & Rasmussen, 2005) and on the different scales of poultry production (Delgado *et al.,* 2003; Islam & Jabbar, 2005). However, there appears to be a gap in the literature on studies that have systematically compiled and synthesised findings of village poultry systems across countries from the perspective of household economic decisions and socio-economic contexts. Searches using search engines, journal databases, library databases and consulting with librarians yielded no notable results (Brown, 2007).

The aim of the SLR, also known as a systematic review, is to utilise all available research to address a specific research question (the Campbell Collaboration, 2012). The SLR is a "secondary study that uses a well-defined methodology to identify, analyse and interpret all available evidence related to a specific research question in a way that is unbiased and (to a degree) repeatable" (Kitchenham, 2007). For this paper, the SLR was conducted using original primary studies on village poultry in different countries. A review of cross-country studies could potentially yield new insights into farm-households' socio-economic characteristics and intra-household resource allocation which would not be obvious from a single study. By laying out the evidence from previous research in a systematic and replicable fashion, the SLR can further provide impetus for new research and policy directions (Petticrew & Roberts, 2006: p.28).

This chapter outlines the processes and methodological issues frequently encountered in the process of conducting a SLR. As the SLR is an evidence-based research method developed mainly for the medical and clinical fields, the methodology applied for this thesis was guided by similar research techniques applied across a range of disciplines. These included psychology and healthcare (Fink, 2005; the Campbell Collaboration, 2012), engineering and science (Kichenham, 2007), economics and business (Brown, 2007; Tranfield, 2007) and development studies (Masset *et al.*, 2011). The SLR is conducted in three stages in the sections as numbered:

4.2)   Stage 1: Surveying the literature
4.3)   Stage 2: Sorting the literature
4.4)   Stage 3: Synthesizing the findings

The first stage, surveying the literature, refers to the initial process of discovering the existing available research. This requires two broad-ranging steps, namely 'search' and 'identify'. The second stage, sorting the literature, describes the process of going through what is available to arrive at what is relevant. Relevant papers are those that address the research questions as

outlined in *Chapter 1*. In the third and final stage, the results from the selected studies are synthesised and reported in a systematic fashion.

4.2 Stage 1: Surveying the literature

The aim of a literature survey is to obtain as many primary studies as possible as a starting point for data collection (Bartolucci & Hillegass, 2010). Surveying provides a broad-based understanding of the findings and objectives in existing research, which lays the groundwork for formulating and refining one's own research questions (Brown, 2007).

4.2.1 Developing search strategies

An initial search gives an overview of the available literature. As the Internet was to be the main source of information, it was critical to develop effective search strategies using Boolean logic. Identifying reliable internet resources such as journal databases increases the likelihood that the search will cover as much of the available literature as possible (Bartolucci & Hillegass, 2010).The keywords selected for the initial search were purposefully broad-ranging to encompass village poultry production systems under a range of topics in economics, development studies and animal sciences.

Table 3: List of search sites and Boolean keywords.

Search engines	Boolean keyword combinations
• Google & Google Scholar • MetaPress • Scirus • SLU library (Primo search tool) • WebEc	• [poultry OR chicken] AND [poverty OR "food security"] AND ["systematic review" OR "literature review" OR "systematic literature review"] (to determine if any such study already exists) • [poultry OR chicken] AND [backyard OR family OR rural OR scavenging OR small*[3] OR traditional OR village] • "Bangladesh poultry model" • [Danida OR BRAC OR FAO OR ADB] AND [poultry OR chicken]
Journal databases	
• AgEcon Search • Cab Direct • EconLit • RePEc • Web of Knowledge	• [poultry OR chicken] AND [poverty OR "food security"] AND ["systematic review" OR "literature review" OR "systematic literature review"] (to determine if any such study already exists) • [poultry OR chicken] AND [backyard OR family OR rural OR scavenging OR small*[3] OR traditional OR village] • "Bangladesh poultry model"
Institution websites	
• ADB • BRAC • FAO • IFAD • World Bank	• poultry OR chicken] AND [backyard OR family OR rural OR scavenging OR small*[3] OR traditional OR village] • "Bangladesh poultry model"

Source: Author's own

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[3] 'Small*' employs the Boolean logic to include possible terms as 'small-holder', 'smallholder' or 'small-scale' in the search.

"Village poultry" is just one of many terms used in the literature to describe the semi-subsistence rearing of indigenous or local poultry breeds. To extend the search, all possible terms used to describe village poultry were entered as Boolean combinations (see *Table 3*). "Bangladesh Poultry Model" and the project's key supporters (Danida and BRAC) were also used as keywords to guide the initial search. To differentiate between small-scale poultry keeping in developed and developing countries, the words "poverty" and "food security" were also used in the search.

Other strategies were also used to tighten the search process. Firstly, backward citation was used, where references were gleaned particularly for authors whose works had been cited frequently across various literatures. Secondly, forward-citation was used through the 'cited by' tool in Google Scholar or recommended links in journal databases to locate follow-up or similar research. The third was to contact the authors of some of these papers to request for further information (Masset *et al.*, 2004). This last strategy yielded a number of recent papers that were yet-to-be-published or not found at all on the Internet, two of which (Mtileni *et al.*, 2012; Teng, 2011) were finally included in the list of selected studies. Details of the search strategy and results are shown in *Appendix 3*.

4.2.2 Identifying studies

The initial search yielded an overview of the available studies in village poultry. Two distinct topics emerged in the literature—the first, which focused on biological performance parameters of village poultry; and the second, which were based on the social sciences and policy and included research in the sphere of economics, rural development and livelihoods.

Table 4: *Inclusion and exclusion criteria for identifying available literature.*

	Include if	Exclude if
Date of study or data collection	1990 or later	Before 1990
Language	English only	Non-English
Subject focus	Sector 4 as characterised in the FAO classification system (see *Table 2*).	Studies on other small-holder livestock systems. Contract farming involving poultry small-holders (Sector 3 and 2, see *Table 2*) were set aside as grey literature.
Countries	Developing countries where village poultry production accounts for at least 70% of domestically produced poultry.	Studies of village poultry conducted in developed countries and countries where village poultry is less than 70% of total domestic production.
Type of study	Primary study with original fieldwork data.	Non-primary studies and studies without fieldwork data.
Key objectives and data	The household as a study objective; study must include socio-economic data.	Study objective focuses solely on poultry production parameters.

Source: Author's own, adapted from Masset et al., 2011; Kitchenham, 2007.

As discussed in the earlier chapters, studies had to focus on the socio-economic context of poultry farming. A set of criteria was further developed to "sieve out" the potentially relevant literature from the rest. Also referred to as "scoping" the literature, this delimits the subject area or topic (Tranfield *et al.*, 2003). *Table 4* in the previous page shows the inclusion/exclusion criteria applied herein.

The last criterion is important in order to identify the socio-economic constraints of farm-households. Due to the cross-disciplinary nature of the topic, the initial search was bound to produce a range of information coming from a diversity of disciplines. By first identifying a broad range of potentially useful studies (Fink, 2005: p.52), surveying identifies what is *available* in preparation for selecting what is *relevant* for answering the research questions.

4.2.3 Mapping the literature and defining the research objectives

The visual mapping strategy precedes and aids in the formulation of the key research questions outlined in *Chapter 1*. It also lays the groundwork for subsequent processes in the SLR methodology. The process of mapping the studies enables one to gain an overview of the existing "intellectual territory" (Tranfield *et al.*, 2003) before proceeding to define the necessary research questions.

Concepts related to *poultry production and performance* were mapped under **Production economics**

Concepts related to the *social sciences and policy* were mapped under **Socio-economics** and **Rural & development economics**
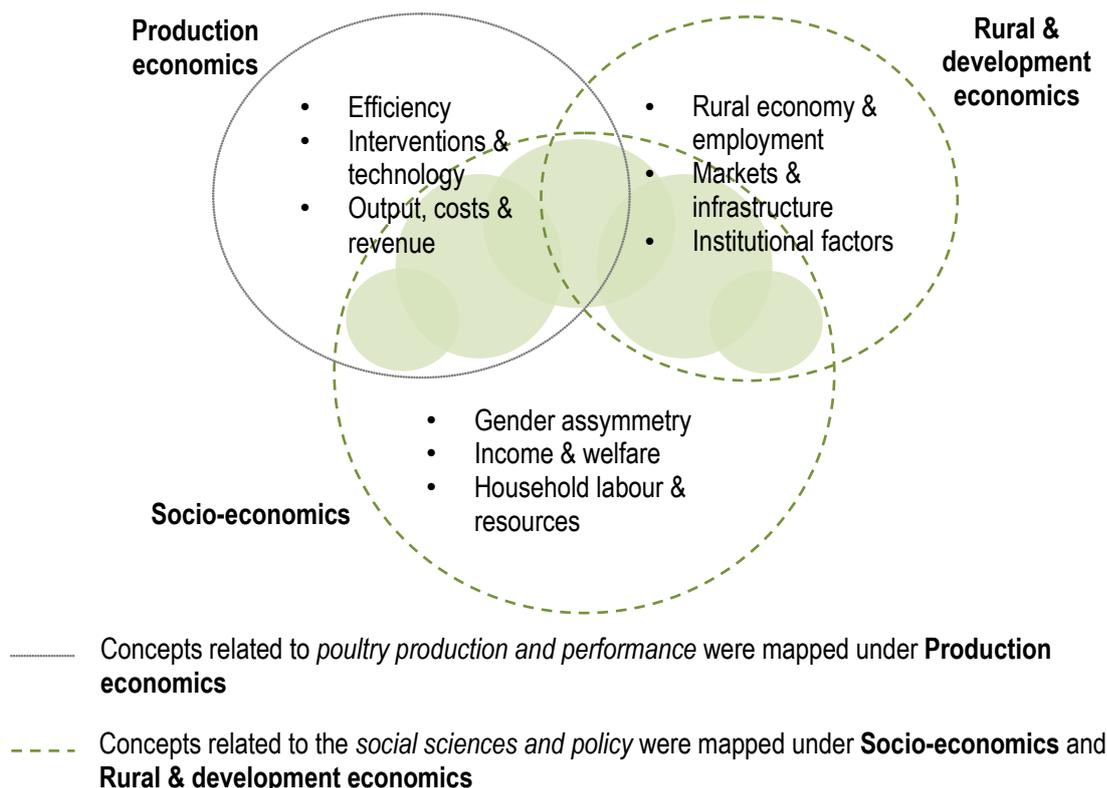
Figure 2: Venn diagram showing overlapping themes in the literature on village poultry.

The green shaded areas approximately represent the key overlapping themes.

Source: Author's own based on survey of the literature.

To manage the heterogeneous knowledge and fragmented nature of cross-disciplinary studies (Brown, 2007), a visual map was constructed to further the understanding of the distinct yet

inter-related themes in village poultry research. *Figure 2* is a Venn diagram that shows the conceptual mapping of the most prominent themes from economics disciplines that emerged from the initial survey of the literature. The potentially relevant studies are those with overlapping themes as shown by the shaded space in the figure. This overlap indicates the importance of including socio-economic variables as a compulsory requisite in selecting the studies. Using the agricultural household model as the theoretical basis, the studies were reviewed in line with the following objectives:

- To identify the resources and constraints in the *socio-economic environment* in which farm-households operate
- To understand how these resources and constraints affect *household objectives* for keeping poultry
- To investigate the *allocation of household resources* specifically household labour time.

4.3 Stage 2: Sorting the literature

Primary research on village poultry entails the study of farm-household economic behaviour under assumptions of utility maximisation, and within a context of resource and constraints that affect trade-offs in resource allocation and household optimisation outcomes. With the wide range of research objectives, data and methodological approaches found in the available literature, sorting the literature is a process of "exploration, discovery and development" which requires a flexible approach (Tranfield *et al.*, 2003). A balance has to be achieved between allowing for flexibility in developing selection criteria and minimising biases.

4.3.1 Developing criteria for quality

Following the initial survey of the literature, the next step involved screening and selecting from the broad range of studies obtained in Stage 1. Screening and selecting is an iterative process which takes place over several rounds. Screening involves applying criteria for quality assessment in order to narrow the selection of studies (Fink, 2006: p.52-53). Tranfield *et al.* (2003) noted that specifying criteria remains a key challenge when conducting SLRs for qualitative research fields. Unlike clinically controlled studies, fieldwork studies do not produce such readily quantifiable results. "Staying in real world, non-laboratory settings" means that research should employ techniques that allow for "less clarity of causal inference" while not discounting threats to methodological quality (the Campbell Collaboration, 2012).

Common threats to methodological quality are biasness and validity. Biases pertaining to selection and research are common problems encountered in both qualitative and quantitative research (Fink, 2005: p.62). Selection bias refers to a statistical or sampling bias in selecting individuals or groups for the study (Petticrew & Roberts, 2006: p.282). Researcher bias arises when a researcher's personal beliefs and values are reflected in the choice of methodology and interpretation of findings. To counter the first bias, the paper should state its research design clearly, including the method for sampling stratifications and how this relates to the objective of the study. It was assumed that studies conducted by more than one researcher or a team of field researchers should counter the problem of research bias.

Validity refers to the degree to which a variable actually measures what it is supposed to measure (Fink, 2005; p.111). The key issues of validity are those concerned with causality

and correlation, described as internal and external validity respectively. An internally valid study is one that allows causality between two variables to be established while external validity refers to the extent to which results from one literature could be applied to other studies, or the ability to establish correlation (Petticrew & Roberts, 2006: p.127). Internally valid studies should be free from methodological biases such as selection and observer bias and is a common measure of assessing the quality of studies in a SLR (*ibid.*).

Owing to time and resource constraints as a single researcher, it was not possible to scrutinise in great detail the research design of every one of the thousands of papers obtained in Stage 1. It was assumed that papers published in peer-reviewed journals, reports from institution and published theses would meet these quality criteria (Tranfield *et al.*, 2003). In addition, citation by other academic journals was taken as a fair proxy of the paper's methodological rigour. To address the possible biases and threats to validity in this thesis, it was also assumed that selecting from a wide range of studies with different methodologies and research design would balance out systematic biases from any single paper as random errors when combined with other literature. *Table 5* shows the criteria developed to critically appraise the literature in this sorting stage.

Table 5: Criteria and measures for critical appraisal of the literature.

Criteria	Measures for critical appraisal
Methodology	Details should be provided of the research design, sampling stratifications, data collection and analysis.
Data	Statistical tables should be included for quantitative studies and direct interview quotes for qualitative studies. This would allow a first-hand interpretation of the results and assessment of the validity of conclusions.
Quality proxy	Published in a peer reviewed journal or as part of a research or conference report from global institutions involved in livestock, agriculture and rural development.
Control for bias	Include studies with different research designs (e.g., intervention-control, comparative study between regions, population baseline study) to control for overall bias.
Sample size validity	Minimum sample size of 50 households or individual respondents to control for generalizability of results (external and internal validity).
Settings	Include only original studies and empirical research involving fieldwork data.

Source: Author's own, adapted from Fink, 2005: p.55-56; Kichenham, 2007; Petticrew & Roberts, 2006: p.293; Tranfield et al., 2003.

4.3.2 Screening and selection for relevance

Defining criteria for relevance refers to the ability of the literature to address the research objectives. The conceptual map in58 *Appendix 1* was used to identify the relevant variables in the literature.

To screen and select relevant papers for this SLR, the titles, keywords, abstracts and research objectives of the literature retrieved from Stage 1 were scanned through to identify any of the variables as listed in the preceding section. The database search process does not stop at the

survey of the literature but continues even to this stage. A practical indication of when the search process should stop is when further search in all the most relevant databases and bibliographies yield no interesting results (Petticrew & Roberts, 2006: p.79).

Papers with the relevant variables listed in the abstracts are put aside, while the rest are discarded. It can be observed that studies on village poultry conducted in the 1990s or earlier part of this millennium tended to focus solely on production without relating this to household characteristics. Papers that looked at the socio-economic characteristics of households were found to be mostly written in the last decade and involved a mix of qualitative as well as quantitative research designs. A checklist to guide the screening and selection of the literature is shown in *Table 6*.

Table 6: Checklist for screening and selecting the literature.

Objectives
Are the study objectives (research questions, hypotheses) clearly stated?
Was the study designed clearly in a way to address these objectives?
Research design
Are the independent and dependent variables clearly defined?
Do the variables defined address the study objectives?
Are the characteristics of the study participants clearly described?
Is the sample size of study participants adequate?
Are the outcome measures used in the study relevant for answering the study objectives?
Data collection and analysis (for quantitative studies)
Are the data collection methods described?
Are the methods for statistical analysis described?
Is the statistical program used to analyse the data referenced?
Qualitative studies
How adequately has the research process been documented?
How well does the evaluation address its original aims and purpose?
How well defined are the sample design/target selection of cases/documents?
How clear are the links between data, interpretation and conclusions?
Results and conclusions
Did the study address the objectives?
How do the results add to understanding on village poultry interventions?
Do the results contribute to an understanding of farm-household production?

Source: Adapted from Brown, 2007; Fink, 2005: p.132-141; Kitchenham, 2007; Petticrew & Roberts, 2006: p.136, 142.

To limit own researcher bias, each paper was reviewed a week apart using the above checklist as a guide (Fink, 2005: p.176). The screening and selection process was also conducted over several rounds to minimise error in judgment due to familiarity and research fatigue. Despite the subjective nature of social science research, applying such criteria allows for the process of the SLR to be documented and hence replicated to some degree.

Appendix 2 shows the breakdown of the search results using the search sites and Boolean keyword combinations in *Table 3* and applies the various criteria and checklists developed in *Table 4, 5* and *6*. *Appendix 3* shows the flow of steps involved in both stages of surveying and sorting the literature as discussed in this and the previous sections.

4.4 Stage 3: Synthesizing the findings

The aim of this systematic review is to generate insights on the socio-economic context of village poultry production by synthesizing findings across multiple studies in different countries. Unlike a meta-analysis which relies on statistical and econometric analyses, a SLR uses a descriptive method to present and discuss the key findings that address the research questions (Becheikh *et al.,* 2006). Synthesizing findings requires treating each paper as a person being surveyed and asking: What does this "person" (paper) have to say about a specific variable and how this variable is linked to other variables or findings in the paper (Kitchenham, 2007)? The key task is to therefore collate a big picture while keeping an eye on details of the qualitative and quantitative findings and any interactions reported between the variables.

The findings from the selected literature provide the necessary evidence-base for answering the research questions. The systematic organisation and presentation of the results is an important aspect of narrative synthesis that helps to draw attention to common themes as well as differences between the studies (Petticrew & Roberts, p.172; Kichenham, 2007). Both quantitative and qualitative data obtained from the primary studies were tabulated on data extraction forms created using Microsoft Excel. As the narrative and qualitative nature of social science research may yield results of greater subjectivity than in clinical research (Tranfield *et al.*, 2003), the use of data extraction forms are guided by the need to clearly present details of the research design, results and conclusions of each study. These details constitute the data for this SLR.

To evaluate and compile data from the selected literature, all key variables were listed in an 'x by x matrix', where x denotes the total number of key variables identified. The purpose of constructing such a matrix was to detail the specific interactions between the variables. Organised in a way similar to a social accounting matrix, these interactions were tabulated in an Excel spreadsheet such that the variables were listed in columns and rows and any interaction between two variables was listed in the intersection between the row and column containing that variable. As this matrix of variables was too large to present coherently on a page, the variables and their reported correlations as identified in the literature are listed in *Appendix 4*.

5 Results

This chapter begins with a summary of the selected literature as well as the key results of the systematic literature review (SLR). The socio-economic variables identified and mapped in *Appendix 1* are used to guide the presentation of the results in this chapter. Details of the results are presented in the context of the socio-economic resources, constraints and objectives of village poultry producers. The relationship between the variables as identified in the conceptual map are summarised in *Appendix 4*.

5.1 Summary of the literature and presentation structure

Based on the selection criteria established in the previous chapter, a total of 17 papers were included and assessed to be relevant to the research questions. The 17 individual papers made up a total of 11 studies on 8 countries. Several papers (from South Africa, Zimbabwe, West Kenya and Vietnam) were grouped into studies based on common data used as confirmed by similarities in the sample sizes, sites, stratifications and authors. *Appendix 5* provides an overview of the research design, sampling and data collection, and the papers that have been combined into studies.

A trend observed is the increasing research interest towards understanding how household socio-economic characteristics influence production-consumption outcomes and poultry practices. This observation formed the basis for the conceptual map for analysing village poultry optimisation decisions, as shown in *Appendix 1*. The search results also produced a prolific number of socio-economic studies from Ethiopia but none from Bangladesh (Kryger *et al.*, 2010) as the latter had focused mainly on impact assessments of the small-holder poultry programme and did not include household socio-economic data.

While the qualitative nature of this thesis allows for interesting observations, a massive challenge lies in presenting the results in a clear and coherent way. For instance, a single variable, such as market access, can be analysed based on its interactions with flock size, intra-household labour allocation and household objectives. To approach the presentation of results systematically, this chapter is guided by the conceptual map in *Appendix 1*, with the numbers in the map corresponding to the section number in this chapter under which the variables are discussed. Socio-economic variables and the interactions between these variables as reported in the literature open the discussion in the next section, followed by the presentation of household optimisation decisions. Together, these two sections set the context of poultry farming. Finally, poultry production, economic performance and poultry intervention strategies are assessed in relation to this context.

5.2 Socio-economic variables

This section draws up a profile of farm-households engaged in village poultry production by identifying the key exogenous and endogenous variables. Respondents surveyed were poultry farmers, heads of households and/or other household members who were primary caretakers of poultry. Several studies also surveyed poultry breeders and traders (Sodjinou, 2011; Aklilu, 2008; Tung, 2012).

5.2.1 Exogenous variables

Farm-household characteristics

Land area, indicated in six of the 13 studies, ranged from landless to over 10 hectares. The effect of land size on poultry farming remained unclear although strong links have been reported between landlessness and poultry especially among women in Bangladesh (Saleque & Mustafa, 1996; IFAD, 2004). This could be due to geographical differences in land as a wealth indicator and resource constraint. Poor households in Asian countries such as Bangladesh with high population densities may experience tighter land constraints compared with less land-scarce Africa. However, land area was not found to influence poultry production in Vietnam (Tung & Rasmussen, 2005).

Agro-ecology and seasons affected the availability of grain and forage material that make up the scavenging feed resource base (SFRB). Several studies reported the effect of seasonal variations on the availability and quality of nutrition from the SFRB (Muchadeyi *et al.*, 2004; Teng, 2011; Mtileni, 2012). Production-related challenges were also linked to distinct wet-dry seasons which affected the proliferation of disease vectors and predators (Sodjinou, 2011; Muchadeyi *et al.*, 2004; Mapiye & Sibanda, 2005). In Kenya, the prevalence of village poultry in favourable agro-ecological districts was linked to the availability of grain and smaller land holdings which precluded extensive cattle herding (Okeno *et al.*, 2011). Poultry was also seen as an important source of livestock income in medium-to-high-potential agricultural areas but trailed goats in semi-arid areas where land holdings were bigger and conditions less suited to poultry (*ibid.*).

Household size is a proxy for available household labour. The average household size recorded was between four and five typically consisting of a husband, wife and several children. Parents sometimes tasked their children with poultry tending duties (Mtileni *et al.*, 2012; Muchadeyi *et al.*, 2004). Household size may be influenced by the gender of the household head. For instance, in Tigray, Ethiopia, female-headed households were significantly ($p<0.05$) smaller than male-headed households (Aklilu, 2008).

The age of farmers varied from youth (Muchadeyi *et al.*, 2004) up to those in their fifties (Ochieng *et al.*, 2011; Sodjinou, 2011; Muchadeyi *et al.*, 2004; Dinesh *et al.*, 2011). Formal education and literacy levels were recorded and/ or discussed in relation to other variables in five papers (Sodjinou, 2011; Muchadeyi *et al.*, 2004; Aklilu, 2008; Dinesh *et al.*, 2011; Tung, 2012). In Cambodia, the authors found that literacy levels correlated with the use of mobile phones and the market behaviour of farmers (Dinesh *et al.*, 2011). Education was also considered a form of household capital that enables a greater range of livelihood options such as cattle keeping and wage work (Aklilu *et al.*, 2008).

Infrastructure & institutions

Access to markets allowed households to trade, buy poultry inputs, and sell poultry produce and labour factors. Women generally had lower levels of market access than men, which may explain the differences in output levels between women poultry owners in female-headed households and male-headed households (Aklilu, 2008). Men dominated marketing activities in several studies (Aklilu, 2008; Dinesh *et al.*, 2011) but in Vietnam, marketing was the responsibility of women (Tung, 2012).

Market access encouraged male participation in poultry marketing. In Tigray (Ethiopia), sites with higher market access had more men and fewer women involved in both primary and

secondary marketing (*Figure 3*) (Aklilu, 2008). Women and children were the primary sellers of poultry in that study, with some roadside bartering and selling by children and students. Regardless of access, a larger proportion of men than women were involved in secondary selling, reflecting the secondary importance of poultry as an income generating activity. The link between accessibility and male involvement also indicated shadow wage prices possibly coming into play, with household members allocated to poultry marketing according to the shadow unit cost of labour given the transaction costs implied in market participation.
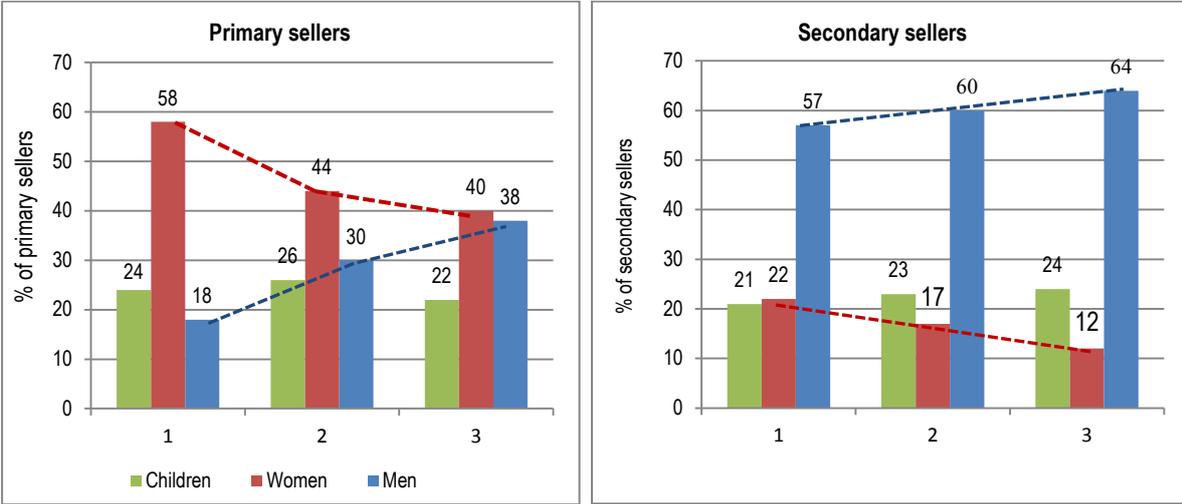
Figure 3: Effect of market access on marketing activities by gender in Tigray, Ethiopia.

The horizontal axis represents sites 1 (least accessible) to 3 (most accessible). The red and blue dashed lines show the trend in female and male marketing participation respectively as market access improves. Numbers at the top of the bars represent percentage figures.

Source: Author's graphs using data from Aklilu, 2008: p.60.

Marketing of poultry products was informal and took place as buying, selling and bartering between neighbours and the local market (Mtileni *et al.,* 2012; Dinesh *et al.,* 2008; Tadelle *et al.,* 2003). In Cambodia, the most remote province in the study (Odar Meanchey) had the fewest farmers buying birds for restocking (25% compared with 33% for the study average) and selling poultry. Odar Meanchey households bought mainly chicks for restocking as these were more affordable, whereas farmers in other provinces bought full-grown hens. In Laos, a higher proportion of control group farmers (the group with no prior interventions who were located in more remote areas) bought eggs and poultry meat directly from other farmers rather than the village store, compared with the intervention group (Teng, 2011). Only 6% of control group farmers bought eggs from the store regularly every two to three days, compared with 40% in the intervention group (*ibid*.). Aklilu (2008) also reported that poultry had a high bartering value in remote areas with undeveloped cash economies and markets.

Fractured marketing chains added transaction costs to farmers through a combination of more middle-men involvement and lack of pricing information. Aklilu (2008) reported that prices for eggs and poultry were 68% and 25% lower respectively for areas with poorer market access. However, such higher marketing costs may not be due to middle-men and traders but infrastructural difficulties that create transaction costs. Tung & Costales (2007) showed that regardless of level of market access or production system, traders were able to offer higher prices as sales were conducted in urban centres with higher prices. Nevertheless, the small quantities produced may explain why about a third of small-holders viewed trader dominance

as a marketing problem in the same paper. Shorter market chains improved market access and output prices while informal marketing structures were more common in the highland regions characterised by poorer infrastructure and market access (*ibid.*). Regardless of the production system (semi-scavenging or semi-commercial), households in the less accessible highlands prioritised consumption over sales of poultry products (Tung & Costales, 2007).

Credit availability significantly ($p<0.01$) facilitated the adoption of interventions and technologies that improve production (Sodjinou, 2011). In Vietnam, household income but not credit had a significant ($p<0.05$) effect on poultry output, suggesting that farmers preferred to invest using their own income rather than incur borrowing risks (Tung, 2012). Extension services and training also reduced the likelihood of farmers diversifying away from agriculture to other non-farm activities (Sodjinou, 2011). Access to veterinary services increased the odds ratio of selling chickens in South Africa as it improved total poultry output and individual physical parameters such as weight (Mtileni *et al.,* 2012).

Gender differences in training and knowledge were, however, inconclusive. Women had lower access to training than men in Zimbabwe (Mapiye & Sibanda, 2004) and poorer knowledge of the market (Aklilu, 2008). however these findings do not suggest that women were less knowledgeable than men in actually managing poultry as flock sizes were significantly larger ($p<0.05$) in female-headed households in Zimbabwe than in male-headed households (Mapiye & Sibanda, 2004). Females in male-headed households also owned the largest flocks, compared with male owners and female-headed households (Aklilu, 2008). These results parallel findings where women were reported to know more about poultry management than men (Tadelle & Ogle, 2001; Tadelle *et al.*, 2003) and dominated marketing activities (Tung & Rasmussen, 2005). Such findings suggested cultural biases and their effects on gender roles in institutional factors that influence rural farm-household production.

5.2.2 Endogenous variables

Household income and wealth status
In the literature, household income and wealth were estimated using asset-based measures rather than money income. Wealth status was determined by livestock ownership, land area owned, involvement in other agricultural activities particularly cash crops and non-farm income (Tadelle *et al.*, 2003), as well as number of children, food sufficiency and the housing type (Sodjinou, 2011). In the latter study, livestock ownership signified wealth in the north but not in the south, indicating spatial and cultural differences in measures of wealth. Poverty and food insecurity were the selection criteria for several studies (Ochieng *et al.*, 2011; Sodjinou, 2011; Aklilu, 2008) and could be taken as proxies of income and wealth.

Household wealth was positively linked to market access (Aklilu, 2008) and flock size (Mtileni *et al.*, 2012), but negatively correlated ($p<0.01$) to income from poultry (Tadelle *et al.*, 2003). In Laos, poultry was often the only livestock raised in poorer households (Teng, 2011), an observation that parallels other research (Alders, 2004; Behnke *et al.*, 2012, Aklilu *et al.*, 2008). There were differences in findings for gender as a predictor of income. In Benin, rural poverty was more prevalent in male-headed households (Sodjinou, 2011) but in Tigray, Ethiopia, the high proportion of female-headed households was an indicator of regional poverty (Aklilu, 2008).

Production activities

Due to its low demands on household resources, poultry production takes place alongside other production activities. Households also engaged in vegetable gardening, crop and livestock farming. Non-farm sources of income were recorded in the form of social grants and wage work in South Africa (Mtileni *et al.*, 2012) and from natural resource extraction in Zimbabwe (Muchadeyi *et al.*, 2004). Except for Cambodia, poultry was a key farm activity and source of income for households in all the studies. Cattle was viewed as important as a draught animal for ploughing, cash income, source of food and nutrition, and as an asset (Aklilu, 2008; Dinesh *et al.*, 2011).

Seasonal variations in poultry farming were linked to weather patterns which affected other farming activities and labour availability. As household labour alternated between various crop and livestock activities, poultry production followed the seasonal wet-dry cycles that determined agricultural production. Households engaged in seasonal farming activities reportedly neglected their poultry during those seasons (Muchadeyi *et al.*, 2004; Tadelle *et al.*, 2003). For instance, poultry conflicted with vegetable growing as the birds pecked at and destroyed gardens (Muchadeyi *et al.*, 2004). But in Tigray, Ethiopia egg production increased during the peak agricultural seasons of land ploughing, sowing and harvesting due to higher availability of feed grain (Aklilu, 2008).

Production activities interacted with the physical resources and wealth status of households. Livestock herd sizes were positively linked with flock sizes (Aklilu, 2008; Dinesh *et al.*, 2011). Larger stock required more land, feed and labour, which increased the risks of ownership and kept poor households from owning them (Aklilu, 2008). Households in Zimbabwe with larger flocks were also involved in "higher yielding" enterprises such as cattle herding and cotton growing (Muchadeyi *et al.*, 2004).

How households viewed poultry in relation to other production activities provided a perspective of the livelihood alternatives available and thus, the opportunity cost of poultry in terms of family labour utilisation. In remote regions such as the central highlands of Ethiopia, poultry farming was important in the absence of alternative sources of income (Tadelle & Ogle, 2001). Across six regions in Kenya, households with more cattle and other livestock rated poultry with lower importance; such households were in semi-arid regions and kept significantly ($p<0.05$) more cattle and goats than those in non-arid areas (Okeno *et al.*, 2011). In Cambodia, cattle were deemed more important than poultry as they ploughed the rice fields which households depended on as their main income source (Dinesh *et al.*, 2011).

5.3 Household optimisation

It is hypothesised that household objectives for keeping poultry affect household optimisation with respects to the allocation of household time and labour, in line with the Barnum-Squire model and as indicated in *Appendix 1*. Allocating a specific household member to the task of poultry keeping follows the opportunity cost of labour (market wage rate) and market production (output prices) as Low's theory suggests (*Chapter 2*).

5.3.1 Household objectives

Household objectives are termed in the literature as the role of poultry, reasons for keeping poultry, value of poultry and usage patterns (Aklilu, 2008; Teng, 2011; Dinesh *et al.*, 2011;

Tadelle *et al.*, 2003; Okeno *et al.*, 2011). Despite low productivity and disease challenges, households choose to keep poultry for various reasons, namely economic-nutritional, asset-building and socio-cultural (Aklilu, 2008). The economic-nutritional role refers to the consumption and sale of poultry products. Eggs kept for hatching, hens and cocks as breeder stock and poultry droppings for manure fertiliser constitute the asset-building role. The socio-cultural role refers to the use of poultry to fulfil cultural and religious obligations.

Economic-nutritional
Households can choose to either consume or sell poultry products. Several studies in different parts of Ethiopia found that egg sales were prioritised above the sale of live birds and the consumption of eggs and poultry meat (Aklilu, 2008; Tadelle & Ogle, 2001; Tadelle *et al.,* 2003). Selling poultry and eggs allowed households to raise cash quickly to cover emergency expenditures (Tadelle & Ogle, 2001; Mtileni *et al.,* 2012). Selling poultry allowed households to cover small but urgent expenses while preventing the sale of larger livestock considered as more important assets.

Consumption or food security reasons were ranked as the primary objectives for keeping poultry in several studies (Okeno *et al.*, 2011; Muchadeyi *et al.*, 2004; Mtileni *et al.*, 2012). Tadelle *et al.* (2003) reported a significant and negative correlation ($p<0.05$) between the consumption and sale of poultry products (chickens and eggs) across five regions in the study. The study also showed that income from poultry correlated negatively with egg consumption ($p<0.05$) and chicken consumption ($p<0.01$), suggesting the conflict in production-consumption objectives. Furthermore, Aklilu (2008) reported that households in Tigray with livestock preferred to consume rather than sell their egg and poultry but for the poor with few livestock, consuming their own poultry products was "considered unaffordable". This pointed to the endogenous shadow prices households face in the consumption of own poultry products, as denoted by the first-order conditions with respects to utility generating goods in *Equation 8:* $\frac{\partial U}{\partial X_m} = \lambda p_m$ and *Equation 9:* $\frac{\partial U}{\partial X_a} = \lambda p_a$ (see *Chapter 2*).

There were also differences in gender attitudes towards the economic (sales) and nutritional (consumption) outcomes. While women in Zimbabwe showed less interest than men in poultry as an income source (Muchadeyi *et al.*, 2004), female-headed households in Tigray, Ethiopia placed significantly ($p<0.05$) greater value than male-headed households on egg sales over consumption (Aklilu, 2008). A non-parametric test also showed that a significantly ($p<0.05$) higher proportion of female-headed households kept only poultry compared with male-headed ones (*ibid.*). Although poultry meat consumption and sales were significantly ($p<0.05$) lower in female-headed households, the amount consumed or sold was higher per household member ($p<0.05$) than in male-headed households (*ibid.*). This paralleled findings in other studies showing that women attached more value to poultry (Ochieng *et al.* 2012, Sodjinou, 2011) which appear to confirm the hypothesis that poultry labour is allocated to the member with the lowest wage cost (Ellis, 2000: p.140-141). Poultry was also deemed as an important "source of self-reliance" for women and as "a first step in the livestock (asset) ladder" for households (Aklilu, 2008). Such gender-related findings have important implications for policies to promote village poultry for improving food security and nutrition on the one hand, and income generation on the other.

Asset building and restocking
Eggs for hatching were considered important in Laos (Teng, 2011) and ranked as the top reason for keeping poultry among all five study regions in an Ethiopian study (Tadelle *et al.*, 2003). Poultry as replacement stock was ranked ahead of consumption but after poultry sales

in three regions in the latter study, suggesting that households valued more the higher income derived from sales of poultry than eggs. Similar priorities were reported in another study in central Ethiopia by the same author, with egg hatching ranked highest among household objectives followed by egg sale and egg consumption (Tadelle & Ogle, 2001). In both papers, the importance of eggs for the purposes of restocking, sales and consumption in that order preceded the importance of poultry for the same purposes.

Similar results were obtained in Vietnam and Cambodia where both purchase and hatching were important for restocking (Tung, 2012; Dinesh *et al.,* 2011). In Laos, flocks were also obtained through exchange or bartering with neighbours (Teng, 2011). Tadelle *et al.* (2003) reported that in all regions foundation stock was acquired by purchasing poultry, followed by hatching and gifts.

Socio-cultural
In all the studies, socio-cultural objectives such as in gift-giving, hospitality, and religious and cultural ceremonies were ranked below economic-nutritional and asset-building ones. In Vietnam, villagers reportedly sold poultry and eggs to each other to maintain social relationships rather than for income (Tung, 2012).

The studies revealed the effects of income, regional differences and gender on household preferences and values attached to poultry. A significant and positive correlation ($p<0.05$) was found between the consumption of poultry products and family income (Tadelle *et al.*, 2003). In another study by the same author (Tadelle & Ogle, 2001), wealthier households ranked consumption above sales. In the Cambodia study where households considered poultry a side activity, no clear preferences were observed between sale and consumption (Dinesh *et al.*, 2011). In contrast, Tadelle & Ogle (2001) noted that poor families viewed poultry as a source of income and held back on consumption. However, farmers in remote areas raised poultry mainly for consumption as the lack of markets imposed subsistence conditions (Tadelle *et al.*, 2003); similarly, remote areas placed greater emphasis on the socio-cultural importance of poultry (Aklilu, 2008).

5.3.2 Intra-household labour allocation

Labour allocated to village poultry was firmly linked to gender and age of household members. Data were stratified and analysed according to gender (male, female) and age (or youth) of household head, ownership, flock management, decision-making on poultry production and control over finances, which in the order given portray successively greater levels of control over poultry. Although several studies did not provide descriptive statistics on the number of respondents by gender, gender effects were analysed in relation to socio-economic characteristics, poultry performance, interventions and management. (Tadelle *et al.*, 2003; Tung, 2012; Ochieng *et al.*, 2011; Sodjinou, 2011; Tadelle & Ogle, 2001; Dinesh *et al.*, 2011). These results are summarised in *Appendix 6*.

Several studies surveyed majority male-headed households where poultry farming was an important activity (Okeno *et al.*, 2011; Mtileni *et al.*, 2012; Teng, 2011) while two studies surveyed equal (Aklilu, 2008) or almost equi-proportions of male and female respondents (Mtileni *et al.*, 2012). However, sampling based on gender of household head alone belies the systematic gender bias of poultry activities. Sodjinou (2011) specified the collection of data based on the gender of the farmer or breeder rather than the household head in order to analyse the effects of gender of the main caretaker on technology adoption. To counteract the

traditionally low female participation in field surveys, special efforts were made to observe and record the activities of women in the household (Aklilu, 2008; Tadelle *et al.*; 2003; Tung, 2012; Tung & Rasmussen, 2005). The need to incorporate gender-sensitive data collection methods signalled the influence of the gender variable in village poultry.

Ownership patterns
Poultry ownership by gender varied across the literature. Poultry could belong to the husband, wife, children or several members of the household. Mapiye & Sibanda (2004) and Muchadeyi *et al.* (2004) recorded dominant female ownership of poultry in the majority male-headed households surveyed in Rushinga, Zimbabwe. Mtileni *et al.* (2012) reported variations in ownership by gender between the different agro-ecological zones in South Africa, with male ownership dominant in the two semi-arid study areas. Muchadeyi *et al.* (2004) observed that while female-headed households made up only 19% of the sampled households, women owned poultry in 56% of the households.

Flock management and care
An important distinction should be made between flock ownership and management. Although male ownership was reported in 36 out of 100 households surveyed in Zimbabwe, in only three households (or 3%) were men the main caretakers (Muchadeyi *et al.*, 2004). Poultry management included such daily duties as cleaning the poultry houses, providing water, feeding, disease treatment, penning of poultry indoors at night and letting them out to scavenge in the day. These duties were carried out predominantly by women (Tung, 2012; Mapiye & Sibanda, 2004; Tadelle & Ogle, 2001; Mtileni *et al.*, 2012; Teng, 2011). Children were also tasked with poultry activities and cattle herding (Mapiye & Sibanda, 2004; Aklilu, 2008; Muchadeyi *et al.*, 2004). In several studies, men were responsible for constructing poultry housing (Teng, 2011; Sodjinou, 2011; Mtileni *et al.*, 2012) and for treating and vaccinating the flock (Tung, 2012). Only in Cambodia was poultry management reported to be equally divided between the husband and wife (Dinesh *et al.*, 2011).

Decision-making and control over poultry finances
Along with flock management, women were the key decision makers in matters concerning poultry production. Tadelle *et al.* (2003) reported that women were more knowledgeable than men in flock management while Muchadeyi *et al.* (2004) noted that 45% of women respondents made decisions about poultry regardless of the gender of household head. This was not unusual given that women were the main caretakers of the flock.

Women had greater control over income from poultry if they conducted the sale themselves (Aklilu, 2008; Tadelle *et al.*, 2003). This was also confirmed in Laos where over 80% of women in the control group and over 90% in the intervention group reported to be in charge of poultry finances (Teng, 2011). Ochieng *et al.* (2011) attributed higher control of finances to the fact that women were more involved in poultry, spent more time caring for the flock and earned more income from poultry than did men. Women also had greater access to poultry than cattle and valued poultry more than men who generally favoured larger livestock (Tadelle *et al.*, 2003; Muchadeyi *et al.*, 2004).

5.4 Performance & outcome

This section describes the performance of village poultry in terms of production and economic parameters and intervention strategies, and how these linked to household socio-

economic variables and optimisation outcomes. Poultry performance consists of physical production parameters such as flock size, composition and threats to production, while economic parameters are discussed in terms of factors of production (labour and capital), prices of poultry output, and income derived from poultry.

5.4.1. Poultry production performance

Village poultry is a low-input-output production system defined by sector 4 in the FAO classification (see *Table 2*). Productivity refers to productive parameters such as chick survivability and growth rates, and reproductive performance parameters such as clutch size and hatchability (Tadelle & Ogle, 2001; Ochieng *et al.*, 2011) rather than the economics definition of output value per unit input. Mortality rates are often highest among young chicks in the first months of age (Tadelle & Ogle, 2001). Except for a section on semi-commercial production in the Vietnam and Laos studies (Tung, 2012; Teng 2011), all studies surveyed only households that farmed poultry under the sector 4 traditional semi-scavenging system.

Flock structure and composition
A typical flock consisted of young chicks (up to one month), pullets, cockerels, hens and cocks. Flock sizes ranged from one to 50 on average. There were within-study regional differences in flock size (Okeno *et al.*, 2011; Mtileni *et al.*, 2009; Tadelle *et al.*, 2003; Aklilu, 2008) and composition based on the sex of birds (Aklilu, 2008; Muchadeyi *et al.*, 2004). Where data on flock composition was available, chicks made up the most numbers (Muchadeyi *et al.*, 2004; Okeno *et al.*, 2011; Tadelle *et al.*, 2003; Tadelle & Ogle, 2001) except in a South African study where hen numbers were higher (Mtileni *et al.*, 2012).

Female birds (hens and pullets) exceeded males (cocks and cockerels) in all the available data at 1.3 to 3 females for every male (Tadelle & Ogle, 2001, Mtileni *et al.*, 2012; Dinesh *et al.*, 2011; Muchadeyi *et al.*, 2004; Aklilu, 2008). Indigenous breeds predominated with some improved breeds through crosses between different indigenous species or between indigenous and commercial breeds (Sodjinou, 2011; Aklilu, 2008; Teng, 2011; Mtileni *et al.*, 2012)..

Flock size, productivity and production challenges
Flock productivity was linked to several parameters such as the age of layer hens (Tadelle *et al.*; 2003), the proportion of mature hens in the flock (Mtileni *et al.*, 2009) and male-to-female bird ratio (Dinesh *et al.*, 2011). Mortality, particularly due to Newcastle disease, was cited as the biggest challenge to production (Mapiye & Sibanda, 2004; Dinesh *et al.*, 2011; Tadelle & Ogle, 2001; Teng, 2011; Okeno *et al.*, 2011; Sodjinou, 2011). Although indigenous birds were better suited to scavenging conditions, inbreeding and low productive breeds were cited as problems (Okeno *et al.*, 2011; Aklilu, 2008). Inadequate nutrition affected productivity through the quality of the SFRB as village chickens obtained most of their nutritional needs by pecking and foraging (Muchadeyi *et al.*, 2004; Okeno *et al.*, 2011; Teng, 2011).

Where spatially stratified data was available, regional differences were reported in productivity and flock size. For instance, Tadelle *et al.* (2003) reported highly significant differences ($p<0.001$) in flock sizes across five agro-ecological zones in Ethiopia while Okeno *et al.*, 2011 observed statistical differences ($p<0.05$) between flock sizes across regions. Such differences could be attributed to differences in natural resource endowments which affected the SFRB particularly in semi-arid areas (Okeno *et al.*, 2011; Mtileni *et al.*, 2012). Flock productivity was also influenced by seasonal variations that affected the availability of grain and forage material, the allocation of household labour to poultry (Teng,

2011), and the virulence of disease vectors and predator numbers which increased flock mortality. Festivals also raised the demand for poultry and likelihood of theft (Teng, 2011; Aklilu, 2008; Tadelle *et al.*, 2003).

Differences in market access may explain flock sizes although findings in the literature varied. Poor market access in remote areas hampered production due to the lack of available inputs or limited avenues for selling produce (Tadelle *et al.*, 2003; Dinesh *et al.*, 2011). Similar findings were reported by Aklilu (2008) who found that households with the best market access had significantly ($p<0.05$) larger flocks. Dinesh *et al.* (2011) showed that the weight of birds differed statistically ($p<0.01$) across five provinces, with the heaviest birds reported in Siem Reap, the largest city among the five study areas. It was also observed that larger flocks were linked to higher literacy rates in Cambodia (see *Table 7*), although no significant levels could be established. Provinces with the highest proportion of households ranking poultry as important (Odar Meanchey and Rattanakiri) had the smallest flock sizes. This suggested that flock size was linked to resource endowments and market access rather than household objectives.

Table 8: Literacy rates, mobile usage, flock sizes and importance of poultry in five provinces in Cambodia.

| Province | Proportion of households | | | Flock size | *Rank of education level (Most educated = 1)* | *Rank of poultry importance (Most number of households = 1)* | *Rank of flock size (Largest =1)* |
	Up to secondary education	Mobile usage	Poultry ranked important				
Kampong Cham	77.3	96.4	20.8	37.0	*2*	*3*	*2*
Kampot	78.7	100	8.3	40.1	*1*	*5*	*1*
Odar Meanchey	71.2	89.3	46.5	26.7	*4*	*1*	*4*
Rattanakiri	70.4	87.5	23.2	23.3	*5*	*2*	*5*
Siem Reap	71.5	100	18.3	33.3	*3*	*4*	*3*

The blue rows show the provinces with the largest flock sizes and the green rows those with the smallest flock sizes.

Source: Author's table using data from Dinesh et al., 2008.

Flock size was also positively linked to female ownership of poultry in several studies (Ochieng *et al.*, 2011; Teng, 2011; Muchadeyi *et al.*, 2004). Although flock sizes were smaller in female-headed households, poultry ownership in male-headed households was mainly in the hands of women (Aklilu, 2008), suggesting the influence of gender-related access to credit, marketing opportunities and resources on poultry productivity among women. Controlling for differences in gender access to resources would allow for a more accurate observation of the true effect of gender ownership on productivity. On the other hand, Tung (2012) noted a significant ($p<0.01$) effect of husbands' education level on flock mortality, as men were responsible for treatment and disease prevention in the small-holder farms surveyed in the Vietnam study. Farmers' age also correlated with poultry productivity. In west Kenya, productivity was seen to decline with age (Okeno *et al.*, 2012) but flock mortality was highest in youth-headed households in South Africa (Mtileni *et al.*, 2012).

5.4.2. Economic performance

Economic variables were captured by factors of production (labour and capital), analyses of costs and efficiency, prices and profit or income from poultry. Flock size and live weight

were considered as proxies for poultry output. Data on the economic performance of village poultry was not readily available due to the varied socio-cultural, economic-nutritional and asset-based values which cannot be easily quantified. Economic performance is discussed in relation to the socio-economic and physical production variables described above.

Factor usage, efficiency and costs
In an analysis of technical efficiency, Sodjinou (2011) estimated that a 10% increase in capital had a marginal effect on poultry output of 3.1% while a similar increase in labour yielded a 0.3% increase ín output, noting that labour added most to the cost of production. Women who participated in CBP (community-based programmes) also had a higher marginal product of capital and labour than men, although these results were not significant (*ibid*.). Ochieng *et al.* (2011) found a significant ($p<0.01$) and positive contribution of labour to chicken productivity or reproduction.

Costs of production were linked to transaction costs as a result of poor infrastructure, distance to markets and the small quantities produced, which hindered households from participating in markets. Long distances and infrastructural deficiencies accounted for an estimated 35-47% of total transport costs in Benin and discouraged rural households from participating in urban markets where prices were higher than at the farm-gate (Sodjinou, 2011). Distance to market had a significant ($p<0.05$) effect on poultry output in Tigray (Ethiopia) as the lack of rural demand capped production in remote areas (Aklilu, 2008). Marketing costs were also higher for rural than peri-urban households (*ibid*.). In Benin, marketing costs in the north was 25-33% higher than in the south (Sodjinou, 2011). The inability to market the birds at the right time also raised feeding and production costs (Muchadeyi *et al.*, 2004). Distance to markets correlated significantly ($p<0.01$) with technical inefficiency in production (Sodjinou, 2011).

Capital constraints influenced the lack of feed and poor quality nutrition which led to production challenges. While Tung (2012) found no significant effect of credit access on output, the significant ($p<0.01$) effect of household income on output suggested that households preferred to use their own income rather than obtain credit. Aklilu (2008) also linked poorer access to credit as a reason for smaller flock sizes in female-headed households.

Output prices
Prices of poultry products usually refer to spot prices with a distinction between market and farm-gate prices. In Tigray, prices between all types of birds differed significantly ($p<0.05$) between regions of low, medium and high market access (Aklilu, 2008). Seasonal effects on prices were observed where festive occasions were linked to higher consumption and prices (Aklilu, 2008). Conversely, prices fell during fasting periods when households abstained from eating meat or owing to seasonal effects which increased poultry disease incidences. However, poultry production is insensitive to output prices as food deficit households may prioritise consumption needs rather than profit maximisation.

Indigenous breeds fetched higher prices than commercial ones due to taste preferences (Mtileni *et al.*, 2012). Tadelle & Ogle (2001) found that prices for a 1.25 kg bird and 40 g egg produced by indigenous birds were equivalent to those for a 1.5 kg commercial bird and 60 g egg. Sodjinou (2011) also estimated that village poultry commanded prices that were 22% higher than for crosses and commercial breeds. In Vietnam, local and commercial poultry were not considered homogenous products, with the former preferred over the latter (Tung & Rasmussen, 2005). Male birds due to their attractive plumage, comb, shank and physical

attributes commanded higher prices compared with female birds (Dinesh *et al.*, 2011; Sodjinou, 2011; Tadelle & Ogle, 2001).

Profit and income from poultry

Income from poultry was reported to be used for day-to-day household items such as food, clothes and education (Teng, 2011; Okeno *et al.,* 2011). In Vietnam, poultry income from the most market integrated group was also found to be eight times that of households in the least market integrated region (Tung & Costales, 2007). This reflected the wide disparity in quantities sold as well as between the farm-gate prices of rural areas and the market prices of urban centres (*ibid.*; Sodjinou, 2011).

Household wealth or income was seen to influence income earned from poultry although the causative effect could not be determined exactly. Tadelle *et al.* (2003) found that poorer households tended to sell poultry in bigger towns for better prices, while wealthier households had heavier birds which fetched higher prices. Wealthier households were also less motivated by emergency needs to sell their poultry and could thus obtain higher prices at more opportune times. Tung (2012) observed a positive and significant ($p<0.05$) correlation between total household income and gross margin per chicken. On the other hand, a significant ($p<0.01$) and negative correlation was reported between wealth status and income from poultry in the central Ethiopian highlands (Tadelle *et al.*; 2003). These two results together could suggest that while poultry contributed more to the income of poor households (marginal effect of poultry revenue on income across wealth stratified samples), total household income also had a positive effect on poultry output (marginal effect of income on poultry output).

A study by Akter and Farrington (2011) to evaluate poverty transitions of women involved in the BRAC project in Bangladesh found that households tended to diversify out of poultry by choosing a combination of other income generating activities, a view supported by other research (Maltsoglou & Rapsomanikis, 2005; Islam & Jabbar, 2005). Sodjinou (2011) reported that women who participated in the CBP (the intervention group) had significantly ($p<0.05$) higher returns from poultry compared with men. A similar finding was recorded among non-participants within the same village (non-intervention group), although at a lower level of significance ($p<0.1$).These results combine to offer a view of household optimisation in production activities while offering policy perspectives for poultry in rural development.

5.4.3 Interventions

Where resources and technical knowledge allow, households undertake a range of baseline interventions to improve poultry performance. The adoption of interventions is primarily aimed at improving the physical and economic performance of village poultry and is a function of socio-economic characteristics (Tadelle & Ogle, 2001; Sodjinou, 2011). With the exception of two controlled studies comparing a control with an intervention group, all other studies discussed poultry interventions undertaken as baseline strategies without any prior training or as part of a CBP.

Education and training on poultry-related practices increased the uptake of intervention measures (Sodjinou, 2011; Dinesh *et al.*, 2011; Muchadeyi *et al.*, 2004). Intervention groups, CBP and farmers' associations—as proxies for access to institutional services such as technical training and credit (Ochieng *et al.*, 2012)—were linked to overall higher adoption of management and intervention practices (Sodjinou, 2011; Ochieng *et al.*, 2012; Teng, 2011).

Intervention uptake tended to be higher in CBP groups with higher feed supplementation ($p<0.05$), housing construction ($p<0.05$) and vaccination ($p<0.01$) after controlling for spatial differences (Sodjinou, 2011) while membership in farmers' groups was also significantly ($p<0.05$) correlated with higher productivity in West Kenya (Ochieng *et al.*, 2012). Education levels of husbands in the Vietnam study showed a high negative correlation ($p<0.01$) with flock mortality as the men were responsible for vaccination (Tung, 2012). In Laos, education and training were seen to affect flock management and biosecurity. Parallel to Sodjinou's (2011) findings, feed supplementation and disease control was also found to be higher among the intervention group which encouraged higher levels of poultry commercialisation (Teng, 2011).

Table 9: Intervention uptake in the intervention and non-intervention groups in Laos

Feed	% of intervention group (N=144)	% of control group (N = 29)
Kitchen waste	27.5	0
Commercial feed	13.0	6.9
Broken rice	97.1	93.1
Others	81.2	86.2
Disease control		
Veterinary service	37.7	0
Quanrantine sick birds	67.6	27.6
Own treatment	60	3.4
Sell sick birds	28.5	0
Culling	26.0	20.7

Source: Author's table using data from Teng, 2011.

Household size, as a proxy for available labour factor, affected the uptake of interventions, especially those considered labour intensive. Household size had a positive and significant effect on the use of improved breeds and supplementary feed ($p<0.05$) and highly significant influence on the construction of housing for young chicks ($p<0.01$) (Sodjinou, 2011). Labour shortage in relatively small households in Zimbabwe with fewer than five members also encouraged poultry sharing and joint cattle herding (Muchadeyi *et al.*, 2004). On the other hand, informal sharing arrangements utilised excess household labour as those without their own flocks could engage in joint poultry ownership and benefit from sale and consumption. Poultry sharing was viewed as an entry point for resource-poor households who received new chicks as payment-in-kind for their labour (Aklilu, 2008). The study also found that women from both male- and female-headed households engaged more in sharing arrangements than men ($p<0.05$) as they viewed it as an opportunity for social interaction (*ibid.*). Sharing was usually between related families only (Aklilu *et al.,* 2008; Muchadeyi *et al.*, 2004), which debunks the assumption of household indifference towards sources of labour (*Chapter 2*).

The effect of farmers' age on the adoption of interventions remains inconclusive. Sodjinou (2011) found a significant correlation between the age of poultry breeders in Benin and the adoption of feed supplement practices, with the age around 39 years associated with the highest linear prediction in adoption of improved feeding practices. Ochieng *et al.* (2012), however, found that productivity declined with age ($p>0.05$), noting that young farmers who

adopted interventions had successful outcomes. This may be due to interactions with other variables such as the education level of the farmer or spatial differences in resource endowments which were not investigated in the papers. Furthermore, the hypothesis of the wage opportunity cost of household members in a multi-enterprise farm-household could provide further insights into programmes that target not only the requirements of poultry production but also consider the age and socio-economic profile of producers.

Household income or wealth predicted the use of improved breeds, supplementary feed and poultry housing ($p<0.05$) when controlled for gender of household head (Aklilu, 2008). Low household income was also linked to lower feed supplementation and gross margins from poultry in Vietnam although this could be attributed to education as poor farmers were mostly lowly educated (Tung, 2012). Vietnamese farmers in the study were more likely to use their own capital (household income) rather than loans (credit) to improve poultry farming. Sodjinou (2011) also reported that supplementary feed was significantly ($p<0.01$) linked to credit, regional differences and the intervention group effect. In parallel to these studies, higher off-farm income in West Kenya correlated positively ($p<0.05$) with the baseline adoption of interventions whereas lower income farmers tended to adopt strategies selectively which affected overall productivity (Ochieng *et al.,* 2011). This could suggest that capital constraints and the lack of knowledge hindered households from implementing interventions appropriately and adequately as part of holistic flock management.

There were also gender effects on the adoption and outcomes of interventions. Some studies reported that men rather than women attended poultry training sessions or participated in CBP although poultry keeping was the responsibility of women (Muchadeyi *et al.* 2004, Sodjinou, 2011). Sodjinou (2011) found that among CBP participants, annual production among men was greater than among women ($p<0.05$) due to more favourable resource access. However, women had higher marginal value products for veterinary inputs, labour and capital, such that a unit increase in expenditure on these variables *ceteris paribus* resulted in higher output value. Although the difference between the genders was not significant ($p>0.05$), Sodjinou pointed to the value of poultry training for women. Similar results were found in West Kenya where female keepers had significantly ($p<0.01$) higher chicken productivity than male keepers (Ochieng *et al.,* 2011).

Location affected agro-ecological resources and household production activities, which influenced management strategies and interventions. Feeding and housing practices were found to differ significantly ($p<0.05$) depending on agro-ecology in the Kenya study (Okeno *et al.,* 2010). Households in semi-arid areas were more familiar with cattle vaccination, and the uptake of poultry vaccination was therefore higher in these regions. In Benin, there were significant ($p<0.01$) differences between the north and south regions in the use of improved breeds, poultry housing and supplementary feed due to differences in genotype, materials available for constructing housing and agro-ecological resources, respectively (Sodjinou, 2011). Seasonal fluctuations in feed supply and nutritional composition were apparent and should also be taken into account when designing feeding programmes (Muchadeyi *et al.*, 2004; Teng, 2011; Mtileni *et al.*, 2012).

Market access was found to be the main factor influencing the construction of poultry shelter in Benin (Sodjinou, 2011). Access to markets and credit correlated positively with feed supplementation, biosecurity measures and vaccination as these inputs could be more readily supplied while remote areas participated more in sharing arrangements (*ibid.*). Distance to market significantly ($p<0.05$) affected the adoption of feed supplementation and brooders,

with the probability lower among farmers in remote areas (Ochieng, 2011). Higher off-farm income in the same study was also found to correlate positively ($p<0.05$) with adoption, a finding that paralleled Tung (2012) who noted that higher income farmers were more likely to use their own capital rather than obtain loans to invest in poultry.

6 Analysis under the agricultural household model

The chapter presents the analysis of the results guided by the agricultural household model and the conceptual map based on the conceptual map in *Appendix 1*. Household optimisation is discussed in relation to household objectives and intra-household decisions on labour allocated to poultry, with socio-economic factors lending substantial influence to optimisation outcomes. Finally, this chapter concludes by addressing the implications that the findings might have on policies aimed at improving village poultry.

6.1 Production-consumption objectives

In incomplete markets, objectives for poultry are determined by production-consumption decisions that take the form of a non-separable function, a key issue in studies on household time allocation (Barnum & Squire, 1979: p.48; Pollak, 2011). Production and consumption necessarily involve trade-offs valued according to the implicit shadow prices for goods and factors which, in this case, refer to poultry products and labour factor, respectively.

6.1.1 Production *versus* purchase

As outlined in *Chapter 2*, the decision to produce depends on the opportunity costs of labour and the minimal subsistence quantities that the household requires. The findings in the previous chapter support the view that poultry production entails low opportunity costs for households due to exogenous constraints such as market inefficiencies. Firstly, women and children who have a comparative disadvantage in wage labour are often responsible for poultry. Secondly, poultry activities are managed alongside other household activities. Aklilu (2008) sums up the profile of a resource-constraint household and the low opportunity costs of poultry as follows:

> "Farmers expressed how they valued poultry in comparison with other livestock. Poultry are kept around the homestead and can be managed by small children, the old, weak and even disabled family members, unlike large stock which spend the day away from the homestead and need to be herded by men… The farmers said women can manage poultry together with caring for children and other home activities… They also expressed that the costs of restocking of chickens are not as high as for large stock (cattle, goat and sheet)."

Poultry farming does not impose specific seasonal requirements unlike rain-fed crop cultivation, cattle grazing and ploughing which are strictly seasonal activities that depend on agro-ecological resources such as water and vegetation cover. Households tended to allocate poultry labour around the seasonal demands of other production activities, which adds to the overall low opportunity costs of poultry production as confirmed in the literature (Aklilu, 2008; Sodjinou, 2011; Muchadeyi *et al.*, 2004; Tadelle *et al.,* 2003).

Where household sizes are smaller, subsistence requirements lower, and food markets and wage employment exist, households face a higher shadow wage as reflected by the slope of the relative wage (*Figure 1*). Households will then decide to purchase rather than produce poultry. In larger households, the lack of employment puts a damper on the shadow wage, reducing the opportunity cost of production. In the literature, poultry farming was considered important in remote regions in the absence of alternative income sources (Tadelle & Ogle,

2001; Sodjinou, 2011) but considered less important when households had other income opportunities (Dinesh *et al.,* 2011; Aklilu *et al.,* 2008; Okeno *et al.,* 2012). For a labour surplus household in a rural economy with access to markets for selling poultry products, poultry absorbs the labour of unemployed kin. The household therefore sells a non-tradable factor (labour) for a tradable produce such as poultry and eggs (Taylor & Adelman, 2003). This was confirmed in the literature where roadside selling of poultry was done mainly by students and youths in Tigray (Ethiopia) or where poor households engaged in poultry sharing arrangements (Aklilu, 2008; Muchadeyi *et al.*, 2004). Notably,

6.1.2 Consumption *versus* sales

Agrarian economies that lack opportunities to participate in trade and markets will employ resources towards meeting daily subsistence needs (Barnum & Squire, 1979: p.34). This isolation is compounded by several factors such as poor infrastructure, long distances to the nearest market, logistic difficulties in transporting live birds and social biases particularly in gender access to markets. Consequently, production is influenced not only by prices but also by household consumption needs. Although households ranked consumption and sales as important reasons for keeping poultry in the literature, there were significant negative correlations between eggs sold and consumed ($p<0.05$), eggs sold and hatched ($p<0.01$), and eggs consumed and chickens sold ($p<0.05$) (Tadelle *et al.*, 2003). This reveals the conflicts facing a food-deficit household with regard to the following objectives: maximising income from the sale of poultry products, maximising household utility (food security) from consumption, and restocking preferences—objectives that hang upon important exogenous factors such as market access and gender of household head.

In the theoretical framework outlined in *Chapter 2*, households face high transaction costs which raise the opportunity costs of market participation and hence the shadow price associated with the marginal utility obtained from consuming poultry products. Observations that households in remote areas are more likely to consume rather than sell their poultry corroborate with this theory (Tadelle *et al.*, 2003; Tung & Costales, 2007). Market imperfections also result in the lack of factor inputs critical to production, which dampens the prices that households can obtain for their poultry. Household labour resource is thus transformed into a market purchasable good—poultry—and any revenue obtained goes into household production (Low, 1986: p.15).

6.2 Poultry and labour allocation

Land and labour are the main resources that farm-households own and which are utilised as the key inputs for poultry production. The size and structure of the household and land area cultivated affect household economic performance (Ellis, 2000; p.116). As established in the earlier chapters, poultry farming is a labour-intensive activity where land inputs are marginal. Hence, the analysis here focuses on household labour.

6.2.1 Household size, dependency ratio and production activities

Household size provides an indication of labour availability. In Cambodia (see *Table 9*), the provinces with the smallest household sizes, Kampong Cham and Kampot (with the highest percentage of households with fewer than five members, 63.6% and 66%, respectively) had the highest percentage of households engaged in marketed surplus of poultry products (94.7%

and 97.9%, compared with the average 87%). This parallels Barnum and Squire's estimation that a 10% reduction in the number of dependents in rice-cultivating households in the Muda Valley would increase market surplus by 5% (Barnum & Squire, 1979: p.15).

Table 10: Data on household characteristics, flock management and marketing in Cambodia.

	Kampong Cham	Kampot	Odar Meanchey	Rattanakiri	Siem Reap
# of households (n) [4]	170 (n)	48 (n)	48 (n)	48 (n)	88 (n)
of which male respondents (%)	52.3		78.2	56.2	NA
Up to secondary education (%)	77.3	78.7	71.2	70.4	71.5
Household size (%)					
<5	63.6	66.6	63	46.8	56.8
6 – 7	25.6	22.9	19.5	23.4	23.8
7 – 8	9.5	9.5	8.7	17	13.6
% of households covered in household size stratification	98.7	99	91.2	87.2	94.2
Land area owned (ha)					
Landless	4.1	2	4.3	22.9	13.1
>0.3	13.6	4.1	0	4.1	10.7
>1	44.3	47.9	28.2	14.5	46.4
>5	37.2	45.8	56.5	43.7	28.5
>10	0.59	0	10.8	14.5	0
Flock management					
by women	NA[5]	NA	12.5* [6]	NA	55.1
by men	NA	NA	25.0*	NA	NA
by both	NA	NA	52.1*	50*	NA
Marketing, total (%)	94.7	97.9	68.7	78.7	83.9
by women	33	25	14*	NA	NA
by men	39	75	53*	63.3	70
by both	27.1	0	2*	NA	NA

Data in the green cells are cited in this section.

Source: Author's own table using data from Dinesh et al., 2011; Tables 4, 6, 7, 23, 24.

Besides having fewer children of young age, smaller households may also have older children who can look after poultry. Although there was no data on household composition and dependency ratio in the Cambodia study, it can be inferred, given that the average age of the household head was 40 years (Dinesh *et al.,* 2011), that the eldest child may already be a

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[4] n: sample size (absolute numbers, not percentages)
[5] NA: Data not available
[6] * indicates that figures are implied, calculated from available data

teenager. The dependency ratio of such a household would be lower compared with a larger household with possibly more children of younger age.

Both Kampong Cham and Kampot provinces also had the highest literacy rates among household heads, with 77.3% and 78.7% respectively having up to secondary education. Education was also found to correlate with smaller household sizes in Cambodia (*ibid.*). Literacy may also explain the better data response: the data on household size captured more than 98% of the households in Kampong Cham and Kampot, compared with lower percentages of households in other provinces. Larger households may also have higher dependency burden from larger numbers of young children and older members who may not contribute to poultry keeping but consume its products, which may further explain the low market surplus. Aklilu *et al.* (2008) noted that households with a higher dependency burden are more likely to rely on farming rather than wage labour as a main production activity.

This appears to support the view that household size and composition have a more direct influence on production in low-income countries (Low, 1986: p.17). Data on Swaziland (*Figure 4*) showed that household size was positively linked to area cropped and herd size (*ibid.*, p.76); cattle are herded by young boys below the age of 16. This parallels the study in Zimbabwe where smaller families with an average of four members circumvented labour shortages through communal herding arrangements by young boys (Muchadeyi *et al.*, 2004). The households surveyed also viewed children as complementing rather than competing with income generation through livestock production (*ibid.*) which aligns with other evidences of children also taking care of poultry (Mapiye & Sibanda, 2004; Mtileni *et al.*, 2009). A more in-depth study of the relationship between various household production activities and their corresponding seasonal demands on household labour would further the understanding of the socio-economic context of small-holder poultry. A key benefit of village poultry—its low demands on household labour—could be a critical starting point for further research (Muchadeyi *et al.*, 2004).
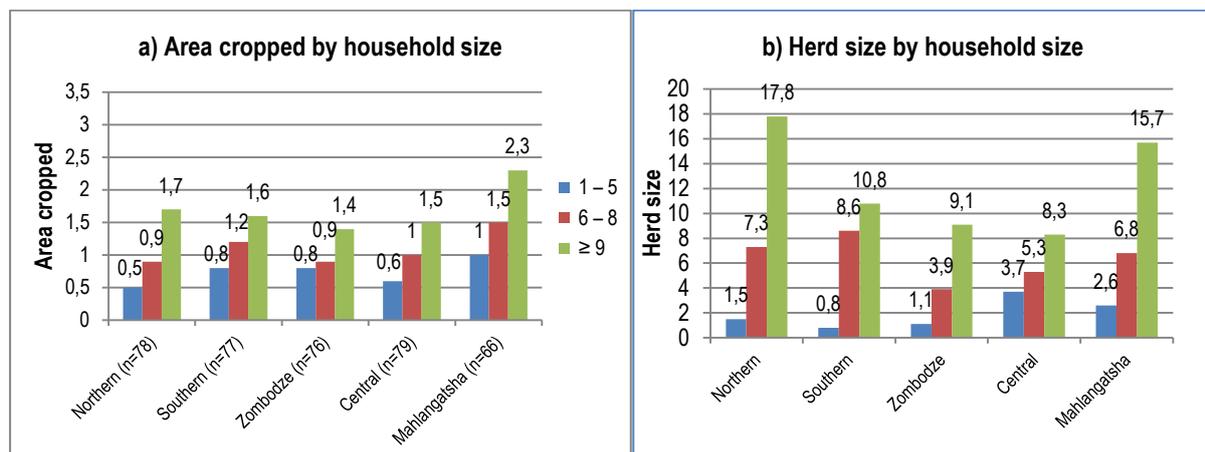
Figure 4: a) Area cropped (in hectares) and; b) herd size (number of cattle) in relation to household size (N=376).

Source: Author's graphs using data from Low, 1986; p.76, Table 7.11

Several studies have pointed to the links between labour and poultry performance parameters such as productivity, output and profit (Aklilu *et al.*, 2008: Sodjinou, 2011; Tung, 2012). Labour has a strong qualitative dimension; for instance, years of schooling of Vietnamese husbands correlated significantly ($p<0.01$) with lower flock mortality as men were

responsible for treating diseases (Tung, 2012). In Benin, educated farmers were estimated to be 14 percentage points more technically efficient ($p<0.05$) than non-educated farmers (Sodjinou, 2011). Training was also found to improve poultry management skill in the intervention group (*ibid.*). Poorer households that kept poultry as a source of income also devoted more time and manpower resources to flock management (Tadelle *et al.,* 2003; Aklilu, 2008). Given that labour time is the key household input, further research could focus on the influence of household composition and dependency ratios on household labour allocation and optimisation of poultry production. Training on poultry management should also be considered a priority intervention.

6.2.2 Gender and poultry

The overwhelming role of women in poultry keeping is neither surprising nor unique to poultry. Studies of farm-households in other agricultural sectors have confirmed gender specificity in production activities where women manage subsistence food crops that complement other home-based tasks (Low, 1986: p.18; Dey Abbas, 1996: p.25). Unlike cash crops or cattle herding that require being away from the homestead, poultry keeping complements the multi-tasking home enterprise that is a common feature in undeveloped rural economies with large informal non-wage sectors. It was therefore unsurprising that across the literature and irrespective of geography, women were responsible for managing home-based enterprises like poultry. The control that women have over income from selling poultry, as reported in several studies (Aklilu, 2008; Mapiye & Sibanda, 2004; Sodjinou, 2011; Teng, 2011), contrasts with low female participation in male-dominated activities such as cash crops and plantations (Dey Abbas, 1996). Men were also reportedly reluctant to invest in a production system viewed as having inferior returns (Aklilu, 2008; Teng, 2011).

As demonstrated in the agricultural household model, the lower opportunity cost of female labour predisposes women to taking care of subsistence non-market commodities for which prices are unfavourable and marketing obstacles abound. Higher market wages for men than women also encourage female specialisation in home-based activities where women are considered to be more efficient in than men (Evenson, 1981). Conversely, opportunities for wage labour would raise the opportunity costs of poultry production for women. Jabbar *et al.* (2007) noted that contract poultry farms in some districts of Bangladesh faced problems getting women to work because most were employed in the districts' garment industries. The marketing of poultry products also raises the opportunity costs of labour involved in poultry, which supports the findings that men are more involved in poultry as market access and marketing opportunities increase (Mtileni *et al.*, 2009; Aklilu, 2008).

A key research focus in agricultural household models is gender asymmetry, as demonstrated in intra-household labour allocation and inequality with regards to differential access to resources (Colin & Crawford, 2000). Unequal resource distribution can be clearly observed in areas such as biased consumption preferences, such as in Ethiopia where studies reported that men were sometimes given priority over women and children in the consumption of poultry products (Aklilu, 2008; Mengesha *et al.,* 2008). Men and women also exhibit different supply responses to agricultural policies and price incentives as these often target predominately male income-generating activities such as cash crops which can be influenced by exogenous price mechanisms.

Less obvious is the influence of gender asymmetries on economic performance variables such as production, productivity and efficiency. Although women are perceived as being less

efficient than men in agriculture, controlling for individual characteristics and inputs have concluded no significant differences in technical efficiencies between men and women, and that equal access to physical inputs, credit and training could improve the gender gap in productivity considerably (Quisumbing, 2003: p.54; Alderman *et al.*, 2003). In the selected literature, Sodjinou (2011) attributed the higher production of village poultry among men compared to women (*p<0.1*) to gender biases in access to labour and capital resources. However, returns over variable costs were higher for women (*p>0.05*), which "follows that, on average, a woman would generate more revenue than a man if an additional parent animal is given to her" (*ibid.*). Given the predominance of women in village poultry production, it is imperative that attention be given to gender asymmetries arising from social norms, customs and beliefs that influence intra-household decision making and resource allocation with respects to factors and household time (Ellis, 2000: p.172).

6.3 Implications of findings for further research

From the findings of intra-household gender asymmetries, it can be inferred that resource allocations are heterogeneous. This voids any notion of the representative farm-household as a unit of analysis, as it would imply homogenous preferences and access to intra-household resources. Research at IFPRI has also rejected the unitary model of the household, pointing to gender differences in rights and access, social norms in which men and women in Sub-Saharan Africa work from "separate plots or purses" rather than pool resources together (Quisumbing, 2003: p.53; Haddad *et al.*, 1997: p.7), and different preferences in production and consumption as evident in this paper's findings on poultry. However, these are issues of model specification rather than inherent problems of the agricultural household model.

Under assumptions of a unitary model and homogenous preferences, interventions may be planned with impacts on poultry production or household welfare in mind. However, considering heterogeneity would reconfigure the focus towards patterning interventions specifically after the allocation of household resources between male and female members (Dey Abbas, 1997: p.250). Projects that target raising productivity in village poultry for instance should clearly differentiate between male and female labour, as has been demonstrated in the research design of the literature (see *Appendix 5*). Thought should also be given to the differences in gender rights to resources and unspoken labour obligations among household members which "afford ample scope for male opportunism" (Haddad *et al.*, 1997: p.15). Such tendencies have been confirmed in the literature where patriarchal norms dictated that men attended poultry meetings although it was the women who actually cared for the flock (Muchadeyi *et al.*, 2004; Mapiye & Sibanda, 2005; Tadelle *et al.*, 2003)

Poultry complements other production activities as reflected in the household's endogenous labour time allocation. In a simulation study, Aklilu (2008) found that although daytime housing of birds led to the highest increase in flock size among all interventions, the returns of benefits over costs was actually negative. Daytime housing meant additional labour time as birds had to be fed and watered. This increased hours spent by more than five times over the simulation period (Aklilu, 2008). Udo *et al.* (2006) also found from research conducted in Ethiopia and Kenya that introducing crossbreeds in scavenging conditions had a negative impact on net returns; growth rates and number of eggs actually declined. Preferential feeding focusing on the specific nutrient needs of young chicks and laying hens improves production, but the effects on household labour and the SFRB should be carefully studied (Sodjinou, 2011; Muchadeyi *et al.*, 2004).

In line with this, Sodjinou (2011) found that the adoption of chick-houses was significantly ($p<0.01$) and positively related to household size. In an analysis of labour-intensive and labour-saving technologies in food crops, Low (1986: p.105) observed that it was the time spent per unit food output that mattered to the farmer. This parallels Tung and Rasmussen's (2005) findings in Vietnam of a positive coefficient for labour per bird in the production function of a semi-subsistence model. Thus, the farmer may choose to continue with unproductive techniques rather than invest extra time and resources in poultry. What could be viewed as problems of low productivity and poor management could be perfectly adequate to the farmer given his resource and socio-economic constraints.

Further research could focus on motivations that would induce changes to the household's supply-side response and production strategy, rather than merely targeting increased production such as moving from sector 4 to 3 (refer to *Table 2*). Demand-side factors such as higher prices during festive seasons (Sodjinou, 2011; Aklilu, 2008; Tadelle *et al.*, 2003) present opportunities for poultry producers. For instance, Tadelle *et al.* (2003) found that differences in market prices between ordinary days and festivals ranged from an increase of 47% for eggs to 89% for male birds. However, in none of the literature were households reported to respond to the higher prices by matching their supply according to seasonal demand. Instead, poultry production was planned around other farming activities and selling decisions were based on emergency needs (Aklilu, 2008; Mtileni *et al.*, 2012) or when birds were already diseased (Tadelle & Ogle, 2001). This was despite households in those same studies ranking highly the economic importance of poultry as a source of income.

Such behaviour corroborates with observations of supply unresponsiveness as reported in the theoretical literature on the agricultural household model (Singh *et al.*, 1986: p.27; Taylor & Adelman, 2003). Households cannot participate effectively in markets owing to high transaction costs as well as the lack of information on prices and poultry management which affected output parameters such as productivity (Ochieng *et al., 2011*) and gross margins (Tung, 2012). Infrastructure is instrumental to lowering barriers to trade while institutional support, particularly extension services and poultry training, encourages production. This is evident in the higher prices in urban markets (Sodjinou, 2011; Tung, 2012; Aklilu, 2008; Tadelle *et al.*, 2003) and the positive and significant ($p<0.05$) effect of vaccination and veterinary services on the survival rate of chickens (Sodjinou, 2011; Teng, 2011; Bell, 2009). Nevertheless, the food deficit situation of households and village infrastructures must be taken into consideration before prompting any supply-side incentives.

Primary studies on village poultry have presented a varied range of results and topical focuses, such as the differences in profitability between small- and large-scale poultry production (Tung & Rasmussen, 2005; Delgado *et al.,* 2004; Udo *et al.,* 2011) and the benefits of diversifying away from poultry (Barrett *et al.*, 2012; Akter & Farrington, 2011), to name a few. Suffice it is to say that understanding the socio-economic context of village poultry production is a foremost prerequisite for both defining the problems of village poultry and recommending solutions, as "prospective interventions will only be sustainable if they fit the limited physical and economic resources of farming households" (Udo *et al.,* 2006).

7 Discussion & conclusions

The aim of this thesis was to investigate how socio-economic resources and constraints influenced village poultry production through household objectives for poultry and intra-household labour allocation. It was decided to base this thesis research on primary and empirical studies of village poultry across different geographies in order to obtain a comparative view of household optimisation decisions, production and consumption of poultry, and poultry performance and intervention outcomes. Comparing across countries has also enabled insights into the similarities or differences in the characteristics of village poultry systems across different regions and the influence of socio-economic factors on these production systems.

The agricultural household model was adopted as the framework of analysis. Both the models by Barnum and Squire (1979) and Low (1986) were used to advance the understanding of household optimisation decisions on the basis of a multi-enterprise, semi-subsistence household. Barnum and Squire examined farm-households with at least some access to markets while Low's model applied to households facing inoperative factor and commodity markets. A conceptual map was constructed to set the socio-economic context of village poultry production and to identify the key variables (*Appendix 1*). These variables were listed and the relationships between them summarised in *Appendix 4* and discussed in *Chapter 5*. Identifying these variables was an important basis for the screening and selection of the literature that met the research objectives for the systematic review. Abstracts, titles and keywords of papers were scanned with these variables in mind.

While this thesis had focused on specific socio-economic factors that might determine parameters of poultry farming, some general insights could be gathered from the aggregation of the literature in this chapter. A first poignant observation made from the literature search and survey stage is the momentum towards village poultry research that focused on investigating the socio-economic context of small-holder production, rather than merely addressing small-scale production challenges with the goal of increasing output and efficiency using intervention techniques that were largely derived from commercial practices. This gradual shift in research focus has opened up new ways of understanding the economic motivations of small-holder producers, which potentially affords much greater effectiveness towards long-term policy goals such as poverty alleviation and the development of the rural small-scale agricultural sector.

A second observation is the differences between the village production systems in the Asia and Africa studies. For instance, the literature on Laos, Cambodia and Vietnam included discussions on poultry systems under the FAO classification of sector 3 small-scale confined or semi-commercial (Teng, 2011; Tung & Rasmussen, 2005; Tung, 2012) and/or sections on marketing behaviour that involved engagements with traders, urban centres or other commercial agents (Dinesh *et al.*, 2011; Teng, 2011; Tung & Costales, 2007; Tung & Rasmussen, 2005). Such information gave an indication of access to markets for factors and output, crucial to the development of a viable small-scale sector. None of the studies on Africa, however, included such information.

A check on the Human Development Index (HDI) of the countries provided some clues (*Table 11*). The HDI is a composite of average achievements in a country using three basic dimensions: life expectancy, adult literacy and GDP per capita (United Nations Development Programme, 2005). With the exception of South Africa, the Asian countries in the study

ranked ahead of the African countries in HDI, reflecting differences in the relative macroeconomic performance of the countries vis-à-vis each other. Problems in replicating the Bangladesh Poultry Model could possibly be due to the fact that the extra resources and infrastructure demanded by an improved system were simply not available in all countries and rural settings. Once again, this highlights the importance of considering the region-specific context unique to households that ultimately shapes the objectives and resource optimisation outcomes for poultry in relation to all other activities.

Table: Human development index rank of countries in the systematic review.

HDI rank	Country
108	Vietnam
120	South Africa
130	Cambodia
133	Laos
145	Zimbabwe
154	Kenya
162	Benin
170	Ethiopia

The year 2005 was chosen as it approximated the median year of publication of the literature in this review.

Source: United Nations Development Program, 2005, p.235

Third, the agricultural household model has been sufficiently adept in its ability to interpret gender and cultural paradigms through the lens of economic motivations. Poultry farming was consistently relegated to household members with the lowest opportunity cost of labour—hence, the importance of the gender and age variable in labour allocation outcomes. As demonstrated repeatedly in the literature, poultry keeping is the job of women and children and is consistently viewed as a low status activity with low output and income expectations. Men became more involved in poultry farming and marketing in regions with few livelihood opportunities (Muchadeyi *et al.*, 2004) or where better market access provided sufficient economic incentives for male members (Aklilu, 2008; Dinesh *et al.*, 2011). Household size and cultural traditions also dictate the supply of labour and the socio-cultural context that defines how activities, such as marketing, are carried out. These cultural and context-specific values could be analysed by implicitly assigning a shadow value, such as shadow wages and transaction costs. Overall, the results obtained were consistent with the predictions of the agricultural household model which has served to adequately explain for the purposes of this thesis the underlying intuitions that drive household optimisation outcomes.

A critique of the model perhaps is its tendency to aggregate labour allocated to poultry as a single entity or variable. In practice, there are many layers and degrees to which households allocate time to poultry keeping. For instance, although ownership may lie with the husband, it may not accurately reflect the member whose labour time is given to poultry, or the person who takes the birds or eggs to market or who ultimately benefits from its sale. Without a thorough understanding of the practical context of farm-household activities, "labour allocated to poultry" may be assumed as a single outcome in farm-household optimisation (see *Equation 14*). In reality, different household members may contribute their time to varying degrees and for various purposes (marketing of poultry, building poultry shelter, feeding, cleaning etc.), and the outcome of labour allocation may require weights assigned to

different member's time input. This would of course complicate matters from a data collection point of view. For this reason, among potentially several others, the agricultural household model alone may not suffice as the only theoretical framework by which to understand village poultry. A cross-disciplinary approach that incorporates gender studies and rural sociology for instance, would provide researchers with a more holistic understanding of the village poultry enterprise.

Fourthly, the village poultry as a poverty alleviation tool should be seen for what it is—one of many tools and not the only solution. Given the extent to which village poultry can be found across the world, its predominance among women and the success of programmes like the SPDC Bangladesh poultry model, there is a risk of getting "carried away" with exalting the virtues of village poultry in a rural livestock development initiative. Community-based programmes targeting household or female welfare through poultry should be robust enough to consider the possibility of other income generating activities emerging as part of a dynamic reality where households trend towards various activities and goals. Citing the importance of identifying heterogeneities among livelihood choices, Akter and Farrington (2011) noted that although participants of the Bangladesh programme were mainly females from poor households, they did not have similar livelihood preferences. Some may choose to combine "the opportunities generated by the (Bangladesh poultry) model with exogenous opportunities, while the others have no other opportunities" (*ibid.*). Households should not be viewed as poultry producers or agricultural units but as multi-enterprise, small-scale production systems with many activities demanding a portion of the household's limited resource—in this case, labour time—with consequences on household welfare.

Overall, it can be concluded that any programmes to improve village poultry cannot take on a one-size-fits-all approach. Spatial differences in resources, markets access and socio-cultural norms in gender differences affect optimal household production. Interventions may improve production greatly but result in negative returns especially if they increase labour and capital demands. Village poultry production takes place complementary to other household production activities. A failure to grasp this complementarity would lead to intervention programmes and other recommendations that disrupt the equilibrium of household objectives and resource allocations governed by endogenous shadow prices for labour, factors, and output of poultry and other produce. For the food-deficit, resource-constrained, multi-enterprise household living at the semi-subsistence level, all production activities incur trade-offs in terms of consumption, income and resource allocation. In the long term, structural changes in infrastructure and market development are necessary in order to allow households to engage more fully in cash economies and thereby provide the necessary incentives for widening the scope of benefits of village poultry.

Bibliography

Literature selected for the systematic review

Aklilu, H. A. 2008. Village poultry in Ethiopia: Socio-technical analysis and learning with farmers. *Wageningen University*, the Netherlands.

Aklilu, H.A., Udo, H.M.J., Almekinders, C.J.M. & Van der Zijpp, A.J. 2008. How resource poor households value and access poultry: Village poultry keeping in Tigray, Ethiopia. *Agricultural Systems,* 96: p.175–183.

Dinesh, M.T., Sölkner, J., Wurzinger, M., Geerlings, E., Thieme, O. & Thea, S. 2008, Characterization of indigenous chicken production systems in Cambodia. *Animal Health, Breeds and Livelihoods*. Food and Agriculture Organization, Rome.

Mapiye, C., & Sibanda S. 2005. Constraints and opportunities of village chicken production systems in the small-holder sector of Rushinga district of Zimbabwe. *Livestock Research for Rural Development,* 17, 10.

Mtileni, B.J., Muchadeyi F.C., Maiwashe A., Phitsane P.M., Halimani T.E., Chimonyo M. & Dzama K. 2009 Characterisation of production systems for indigenous chicken genetic resources of South Africa. *Applied Animal Husbandry & Rural Development*, 2: p.18-22.

Mtileni, B.J., Muchadeyi, F.C., Maiwashe, A., Chimonyo, M., Mapiye, C. & Dzama, K. 2012. Influence of socioeconomic factors on production constraints faced by indigenous chicken producers in South Africa. *Tropical Animal Health and Production,* 45, 1: p.67-74.

Muchadeyi, F.C., Sibanda, S., Kusina, N.T., Kusina, J. & Makuza, S. 2004. The village chicken production system in Rushinga District of Zimbabwe. *Livestock Research for Rural Development,* 16, 6.

Okeno, T.O., Kahi, A. K. & Peters, K. J. 2012. Characterization of indigenous chicken production systems in Kenya. *Tropical Animal Health and Production,* 44, 3: p.601-608.

Ochieng, J., Owuor, G., Bebe, B.O. & Ochieng D.O. 2011. Effect of Management Interventions on Productive Performance of Indigenous Chicken in Western Kenya. *Livestock Research for Rural Development,* 23, 114.

Ochieng, J., Owuor, G. & Bebe, B.O. 2012. Determinants of adoption of management interventions in indigenous chicken production in Kenya. *African Journal of Agricultural and Resource Economics,* October, 7, 1.

Sodjinou, E. 2011. Poultry-based intervention as tool for poverty reduction and gender empowerment: Empirical evidence from Benin, *University of Copenhagen, Institute of Food and Resource Economics*, Denmark.

Tadelle, D. 2003. Village chicken production systems in Ethiopia. *Livestock Research for Rural Development,* 15, 1.

Tadelle, D. & Ogle, B. 2001. Village poultry production systems in the Central Highlands of Ethiopia, *Tropical Animal Health and Production,* 33, 6: p.521–537.

Teng, T. 2011. Impact assessment of family poultry on household incomes and dietary diversities in the province of Luang Prabang, Lao-PDR. *Lao-PDR Northern Regional Sustainable Livelihood through Livestock Development,* Food and Agriculture Organization of the United Nations, Rome.

Tung, D.X. 2012. Factors influencing the level of profitability and chicken mortality of small-holder poultry production in northern provinces of Vietnam. *National Institute of Animal Husbandry,* 34, Hanoi, Vietnam.

Tung, D.X. & Costales, A. 2005. Market participation of small-holder poultry producers in Northern Vietnam, *FAO Pro-Poor Livestock Policy Initiative,* Food and Agriculture Organization of the United Nations, Rome.

Tung, D.X. & Rasmussen, S. 2005. Production function analysis for small-holder semi-subsistence and semi-commercial poultry production systems in three agro-ecological regions in Northern provinces of Vietnam. *Livestock Research for Rural Development,* 17, 6.

References

Ahuja, V. & Sen, A. 2007. Scope and space for small scale poultry production in developing countries. *Indian Institute of Management,* Ahmedabad.

Alam, M.J. 1997. Impact of small-holder livestock development project in some selected areas of rural Bangladesh. *Livestock Research for Rural Development,* 9, 3.

Alderman H., Hoddinott, J., Haddad, L. & Udry, C.R. 2003. Gender differentials in farm productivity: Implications for household efficiency and agricultural policy (p.61-72). In: Quisumbing, A.R. (ed.) *Household decisions, gender and development. A synthesis of recent research.* International Food Policy Research Institute, Washington.

Alders, R.G. 2004. Village Poultry in Northern Lao PDR. Working Paper No 5. *ADB Lao Participatory Livestock Development Project* (PPTA No. 4287-LAO).

Alders, R.G. & Pym, R.A.E. 2009. Village poultry: still important to millions, eight thousand years after domestication. *World's Poultry Science Journal*, 65, June: p.181–190.

Akter, S. & Farrington, J. 2011. What determines poverty transition? An investigation of women livestock farmers in Bangladesh. *Development in Practice*, 21, 2: p.269–281.

Asem-Bansah, C.K., Sakyi-Dawson, O., Ackah-Nyamike, E.E., Colecraft, E.K. & Marquis, G.S. 2012. Enhancing backyard poultry enterprise performance in the Techiman

area: A value chain analysis. *African Journal of Food, Agriculture, Nutrition and Development*, February, 12 (1).

Barnum, H.N & Squire, L. 1979. *Model of an agricultural household: theory and evidence.* World Bank Occasional Papers, Baltimore and London.

Barrett, C.B., Bachke, E.M., Bellemare, M.F, Michelson, C.H., Narayanan, S. & Walker, T.F. 2012. Small-holder participation in contract farming: comparative evidence from five countries. *World Development,* 40, 4: p.715–730.

Bartolucci, A.A. & Hillegass, W.B. 2010. Overview, Strengths, and Limitations of Systematic Reviews and Meta-Analyses (p.17-33) In: Chiappelli, F., Brant, C., Neagos, N., Oluwadara, O.O. & Ramchandani, M.H. eds. *Evidence-Based Practice: Toward Optimising Clinical Outcomes*, Springer, Los Angeles.

Becheikh, N., Landry, R. & Amara, N. 2006. Lessons from innovation empirical studies in the manufacturing sector: A systematic review of the literature from 1993-2003. *Technovation,* 26, p.644-664.

Becker, G.S. 1992. The economic way of looking at behaviour. *The Nobel lecture, December 9, 1992*. University of Chicago, Chicago.

Behnke, D., Roland-Holst, D. & Otte J. 2012. Micro Contracting and the Small-holder Poultry Supply Chain in Lao PDR (p.353-370). In: *Health and Animal Agriculture in Developing Countries*, Natural Resource Management and Policy, 36, Springer, New York.

Bell, J.G. 2009. Factors limiting production efficiency and profitability from small-holder poultry production. *World's Poultry Science Journal*, 65, 2: p.207–210.

Birol, E. *et al.* 2010. Investigating the role of poultry in livelihoods and the impact of HPAI on livelihoods outcomes in Africa: Evidence from Ethiopia, Ghana, Kenya and Nigeria. In: *Joint 3rd African Association of Agricultural Economists and 48th Agricultural Economists Association of South Africa Conference*, Cape Town.

Brown, C.R. 2007. *Economic theories of the entrepreneur: A systematic review of the literature.* MRes 2006-2007. Cranfield University, United Kingdom.

Chavas, J.P., Petrie, R. & Roth, M. 2005. Farm household production efficiency: Evidence from the Gambia. *American Journal of Agricultural Economics*, 87, 1: p.160–179.

Colin, J.P. & Crawford, E.W. 2000. Economic Perspectives in Agricultural Systems Analysis. *Review of Agricultural Economics,* 22, 1: p.192–216.

Conroy, C., Sparks, N., Chandrasekaran, D., Sharma, A., Shindey, D., Singh, L.R., Natarajan, A. & Anitha, K. 2005. Improving backyard poultry keeping: A case study from India. *Agricultural Research & Extension Network,* 146.

Dada, A. & Matin, I. 2003. Poultry against extreme poverty: An early assessment of poultry in CFPR/TUP. *Research and Evaluation Division, BRAC*, Dhaka.

Delgado, C.L., Narrod, C.A. & Tiongco, M.M. 2004. Implications of the scaling-up of livestock production in a group of fast-growing developing countries (p.95–131). In: Ahuja, V. (ed.). *Livestock and livelihoods: challenges and opportunities for Asia in the emerging market environment.* Food and Agriculture Organization of the United Nations, Rome.

Dolberg, F. 2001. A livestock development approach that contributes to poverty alleviation and widespread improvement of nutrition among the poor. *Livestock Research for Rural Development*, 13, 5.

Dolberg, F. 2003. Review of Household Poultry Production as a Tool in Povery Reduction with Focus on Bangladesh and India. *PPLPI Working Paper No. 6. FAO Pro-Poor Livestock Policy Initiative*, Food and Agriculture Organization of the United Nations, Rome.

Ellis, F. 2000. *Peasant Economics: Farm households and agrarian development.* Cambridge University Press, Cambridge.

Evenson, R.E. 1981. Food policy and the new home economics. *Food Policy,* 6, 3:p.180–193.

Fattah, K.A. 2000. Poultry as a Tool in Poverty Eradication and promotion of gender equality. In: *Poultry as a Tool in poverty Eradication and Promotion of Gender Equality – Proceedings of a Workshop,* Tune Landboskole, Denmark.

Fink, A. 2005. *Conducting research literature reviews: From the Internet to paper.* Sage Publications Inc, California.

Goromela, E.H., Kwakkel, R.P., Verstegen M.W.A. & Katule A.M. 2006. Strategies to optimise the use of scavengeable feed resource base by small-holders in traditional poultry production systems in Africa: A review. *African Journal of Agricultural Research,* 1, 3, p.91–100.

Guèye, E.F. 2009. The role of networks in information dissemination to family poultry farmers. *World's Poultry Science Journal,* 65, 01, p.115–124.

De Janvry, A., Fafchamps, M. & Sadoulet, E.., 1991. Peasant household behaviour with missing markets: some paradoxes explained. *The Economic Journal,* 101, 409, p.1400–1417.

Dey Abbas, J.A. 1997. Gender Asymmetries in Intrahousehold Resource Allocation in Sub-Saharan Africa: Some Policy Implications for Land and Labor Productivity. In: Haddad, L., Hoddinott, J. & Alderman, H. 1997 (eds). *Intrahousehold resource allocation in developing countries.* The International Food Policy Research Institute, Washington.

Haddad, L., Hoddinott, J. & Alderman, H. 1997. Introduction: The Scope of Intrahousehold Resource Allocation. In: Haddad, L., Hoddinott, J. & Alderman, H. 1997 (eds). *Intrahousehold resource allocation in developing countries.* The International Food Policy Research Institute, Washington.

Hunt, D. 1991. Farm System and Household Economy as Frameworks for Prioritising and Appraising Technical Research: A Critical Appraisal of Current Approaches (p.49-75) In: Haswell, D.H.M. (ed). *Rural Households in Emerging Societies: Technology and Change in Sub-Saharan Africa.* Oxford.

Huque, Q.M.E., Chowdhury, S.A., Haque, M.E. & Sil, B.K. 1999. Poultry research in Bangladesh: present status and its implication for future research (p.1–8) In: *Poultry as a Tool in poverty Eradication and Promotion of Gender Equality – Proceedings of a Workshop,* Tune Landboskole, Denmark.

IFAD, 2004. *Livestock services and the poor: A global initiative collecting, coordinating and sharing experiences,* Rome, Italy.

Islam, S.M. & Jabbar, M.A. 2005. Small-holder poultry model for poverty alleviation in Bangladesh: a review of evidence on impact. *Livestock Research for Rural Development,* 17, 112.

Jabbar, M.A., Rahman, M.H., Talukder, R.K. & Raha, S.K. 2007. Alternative institutional arrangements for contract farming in poultry production in Bangladesh and their impacts on equity. *International Livestock Research Institute,* Washington.

Jensen, H.A. 1996. Semi-scavenging poultry flock. In: *Integrated Farming in Human Development, Proceedings of a Workshop*, March, Tune Landboskole, Denmark.

Jensen, H.A. 1998. Network for Poultry Production and Health in Developing Countries. In: *Women in Agriculture and Modern Communication Technology. Proceedings of a Workshop,* p.48–65. Tune Landboskole, Denmark.

Jensen, H.A. & Dolberg, F. 2003. A conceptual framework for using poultry as a tool in poverty alleviation. In: *Livestock Research for Rural Development. International Conference on Staying Poor: Chronic Poverty and Development Policy,* Manchester.

Key, N., Sadoulet, E. & De Janvry, A. 2000. Transactions costs and agricultural household supply response. *American Journal of Agricultural Economics,* 82, 2, p.245–259.

Kitalti, A.J. 1998. *Village Chicken Production Systems in Rural Africa: Household Food Security*. Food and Agriculture Organization of the United Nations, Rome, Italy.

Kitchenham, B. 2007. *Guidelines for performing Systematic Literature Reviews in Software Engineering, Version 2.3*. EBSE Technical Report EBSE-2007-01. Keele University, Keele & University of Durham, Durham.

Kryger, K., Thomsen, K.A., Whyte, M.A. & Dissing, M. 2010. Small-holder poultry production – Livelihoods, food security and sociocultural significance. *FAO Small-holder Poultry Production Paper No. 4.* Food and Agriculture Organization of the United Nations, Rome, Italy.

Low, Allan. 1986. *Agricultural development in southern Africa: Farm-household economics and the food crisis*. James Currey, London.

Mack, S., Hoffmann D., and Otte, J. 2005. The contribution of poultry to rural development. *World's Poultry Science Journal*, 61, 01, p.7-14.

Maltsoglou, I. & Rapsomanikis, G. 2005. The contribution of livestock to household income in Vietnam: A household typology based analysis. *PPLPI Working Paper No. 21. FAO Pro-Poor Livestock Policy Initiative*, Food and Agriculture Organization of the United Nations, Rome, Italy.

Masset, E., Haddad, L., Cornelius, A. & Isaza-Castro, J. 2004. *A systematic review of agricultural interventions that aim to improve nutritional status of children.* London: EPPI Centre, Institute of Education.

Mengesha, M., Tamir, B. & Tadelle, D. 2012. Socio-economical contribution and labor allocation of village chicken production of Jamma district, South Wollo, Ethiopia. *Livestock Research for Rural Development*, 20, 160.

Nielsen, H. 1996. *Socio-Economic Impact of the Small-holder Livestock Development Project in Bangladesh: Results of the Second Impact Survey.* Darudec, Denmark.

Permin, A. & Detmer, A. 2007. *Improvement of management and biosecurity practices in small-holder poultry producers.* Food and Agriculture Organization of the United Nations, Rome, Italy.

Petticrew, M. & Roberts, H. 2006. *Systematic Reviews in the Social Sciences: a practical guide.* Blackwell Publishing, United Kingdom.

Pollak, R.A. 2011. Allocating Time: Individuals' Technologies, Household Technology, Perfect Substitutes, and Specialization. *NBER Working Paper Series No.17529.* National Bureau of Economic Research, Cambridge, USA.

Pym, R.A.E., Guerne-Bleich, E. & Hoffmann, I. 2006. The relative contribution of indigenous chicken breeds to poultry meat and egg production and consumption in the developing countries of Africa and Asia (p.10–14). In: *Proceedings XII European Poultry Conference.* Animal Production and Health Division, Food and Agriculture Organization of the United Nations, Rome, Italy.

Quisumbing, A.R. 2003. Agriculture and natural resources: overview (p.54–59). In: Quisumbing, A.R. (ed.) *Household decisions, gender and development. A synthesis of recent research.* International Food Policy Research Institute, Washington.

Riise, J.C., Permin, A. & Kryger, K.N. 2005. Strategies for developing family poultry production at village level – Experiences from West Africa and Asia. *World's Poultry Science Journal*, 61, p.15–22.

Saleque, M.A. & Mustafa, S. 1996. Landless women and poultry. The BRAC model in Bangladesh (p.23–31). In: *Integrated Farming in Human Development. Proceedings of a workshop.* Development Workers' Course. Denmark.

Schumacher, E.F. 1973. *Small is beautiful: Economics as if people mattered.* Harper & Row. London.

Sonaiya, E.B., Branckaert, R.D.S. & Guèye, E.F. 1999. The scope and effect of family poultry research and development. In: *Research and Development Options for Family Poultry*. Food and Agriculture Organization of the United Nations, Rome, Italy.

Sonaiya, E.B & Swan, S.E.J. 2004. *Manual: Small-scale poultry production technical guide*. FAO Animal Production and Health. Food and Agriculture Organization of the United Nations, Rome, Italy.

Taylor, J.E. & Adelman, I. 2003. Agricultural household models: Genesis, evolution, and extensions. *Review of Economics of the Household*, 1, 1, p.33–58.

Tranfield, D., Denyer, D. & Smart, P. 2003. Towards a methodology for developing evidence-informed management knowledge by means of systematic review. *British journal of management*, 14, 3, p.207–222.

Udo, H.M.J., Aklilu, A.H. & Viets, T.C. 2006. Modelling the impact of interventions on the dynamics in village poultry systems. *Agricultural Systems*, 88, p.255–269.

Udo, H.M.J., Aklilu, H.A., Phong, L.T., Bosma, R.H., Budisatria, I.G.S., Patil, B.R., Samdup, T. & Bebe, B.O. 2011. Impact of intensification of different types of livestock production in small-holder crop-livestock systems. *Livestock Science*, 139, p.22-29.

United Nations Development Program, 2005. *Human Development Report, 2005*. Washington DC, USA.

Internet sources

What is a systematic review? The Campbell Collaboration
http://www.campbellcollaboration.org/what_is_a_systematic_review/index.php

Appendix 1: Conceptual map for analysing village poultry production

5.2.1 EXOGENOUS VARIABLES

Farm-household characteristics
- Physical endowments
- Household size, farmer's age, education level *(Gender)*

Infrastructure
- Market access & marketing
- Credit & technical services

5.2.2 ENDOGENOUS VARIABLES

Household income & wealth status

Production activities
- Poultry & livestock
- Crop farming
- Non-farm activities

5.2 SOCIO-ECONOMIC VARIABLES

5.3 HOUSEHOLD OPTIMISATION VARIABLES

5.4 PERFORMANCE & OUTCOME VARIABLES

5.3.1 HOUSEHOLD OBJECTIVES
- Economic-nutritional
- Asset-building
- Socio-cultural

5.4.1 PRODUCTION PERFORMANCE
- Flock size & composition
- Productivity & challenges

5.3.2 INTRA-HOUSEHOLD LABOUR ALLOCATION *(linked to age & gender)*
- Ownership
- Labour & care
- Production decision
- Financial control

5.4.2 ECONOMIC PERFORMANCE
- Factors, efficiency & costs
- Output prices
- Profit & income from poultry

5.4.3 INTERVENTIONS
- Feed supplements
- Disease prevention & vaccination
- Housing
- Cross-breeding
- Others

Source: Author's own

Shows the direction of influence between the variables.

Shows the interactions (direction of influence undetermined) between household optimisation variables and performance and outcome variables.

Shows the direction of influence between exogenous and endogenous variables, and between household objectives and labour allocated to poultry.

Shows the interactions (direction of influence undetermined) between production and economic performance and interventions for poultry. These interactions, while identified in the literature and important in village poultry production, are not the focus of this thesis.

Household optimisation variables (green boxes) represent endogenous decisions made simultaneously under a non-separable model. Gender *(Gender)* is treated as an exogenous variable in farm-household characteristics and as an endogenous variable in intra-household labour allocation.

Appendix 2: Breakdown of search results

Search engines	Boolean keyword combinations	Search results	Remove [7]	Criteria [8]	Final count [9]
Google [10] www.google.com	(poultry OR chicken) AND (poverty OR "food security")	10.5m	83	11	6
	"Bangladesh poultry model"	2.200	19	81	0
	poultry AND (Danida OR BRAC OR ADB OR FAO OR IFAD)	3.5m	63	37	0
Google Scholar [11] scholar.google.com	(poultry OR chicken) AND poverty	122,000	81	15	4
	(poultry OR chicken) AND (backyard OR family OR rural OR scaveng* OR smallh* OR traditional OR village)	700,000	54	42	4
	"Bangladesh poultry model"	47	46	1	0
	poultry AND (Danida OR BRAC OR ADB OR FAO OR IFAD)	119,000	95	5	0
Metapress www.metapress.com	poultry OR chicken [12]	273	273	0	0
Primo SLU www.slu.se/library	(title:poultry OR chicken) AND (backyard OR family OR rural OR scaveng* OR small* OR traditional OR village) [13]	11	10	0	1
	"Bangladesh poultry model" [14]	2	2	0	0
Scirus [15] www.scirus.com	(title:poultry OR chicken) AND (backyard OR family OR rural OR scaveng* OR small* OR traditional OR village) [16]	4.367	89	10	1
	"Bangladesh poultry model"	40	40	0	0
Economics search engine ese.rfe.org	(poultry OR chicken) AND (backyard OR family OR rural OR scaveng* OR smallh* OR traditional OR village)	Similar results were obtained here as for Google Scholar			

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[7] This refers to removing duplicate results and studies which did not meet the inclusion criteria (see Table xx).

[8] This refers to studies which did not meet the critical assessment criteria (see Table 4), did not have the relevant variables in the abstracts (see Section 4.3.1) and did not pass the screening and selection checklist (see Table 5).

[9] Includes selected literature and grey literature.

[10] Surveying of the literature was restricted to the first 100 results sorted by relevance.

[11] See above.

[12] Search restricted to (Subject=Social Sciences/ Economics & Econometrics)

[13] Search restricted to (Books, journals & more)

[14] Search restricted to (Articles & more)

[15] Surveying of the literature was restricted to the first 100 results sorted by relevance.

[16] Search restricted to (Subject=Agricultural & Biological Sciences/ Economics, Business & Management)

Journal databases	Boolean keyword combinations	Search results	Remove	Criteria	Final count
AgEcon Search	(title:poultry OR chicken) AND (poverty)	12	9	2	1
	(title:poultry OR chicken) AND ("food security")	15	10	4	1
CAB Direct	(title:poultry OR chicken) AND (abstract:backyard OR family OR rural OR scaveng* OR small* OR traditional OR village)	176	91	79	6
RePec IDEAS	poultry OR chicken	99	77	13	9
	poultry OR chicken AND poverty	5	5	0	0
	poultry OR chicken AND "food security"	3	1	0	2
RePec MPRA	poultry OR chicken	16	9	6	1
Science Direct www.sciencedirect.com	(title:poultry OR chicken) and (title: backyard OR family OR rural OR scaveng* OR smallh* OR traditional OR village)[17]	48	45	1	2
Web of Knowledge	(title:poultry OR chicken) AND (topic: backyard OR family OR rural OR scaveng* OR small* OR traditional OR village)[18]	519	333	178	8
Institutions					
ADB www.adb.org/publications/search	poultry OR chicken –"avian"	5	4	1	0
BRAC www.bracresearch.org	poultry OR chicken	17	11	6	0
IFAD www.ifad.org	(poultry OR chicken) AND scaveng*	37	29	8	0
IFPRI www.ifpri.org	poultry OR chicken	47	45	1	1
INFPD-FAO http://www.fao.org/AG/AGAInfo/themes/en/infpd/home.html	Papers were retrieved from: Information resources/ Publications	6	5	1	0
Total					**46**[19]

Source: Author's own
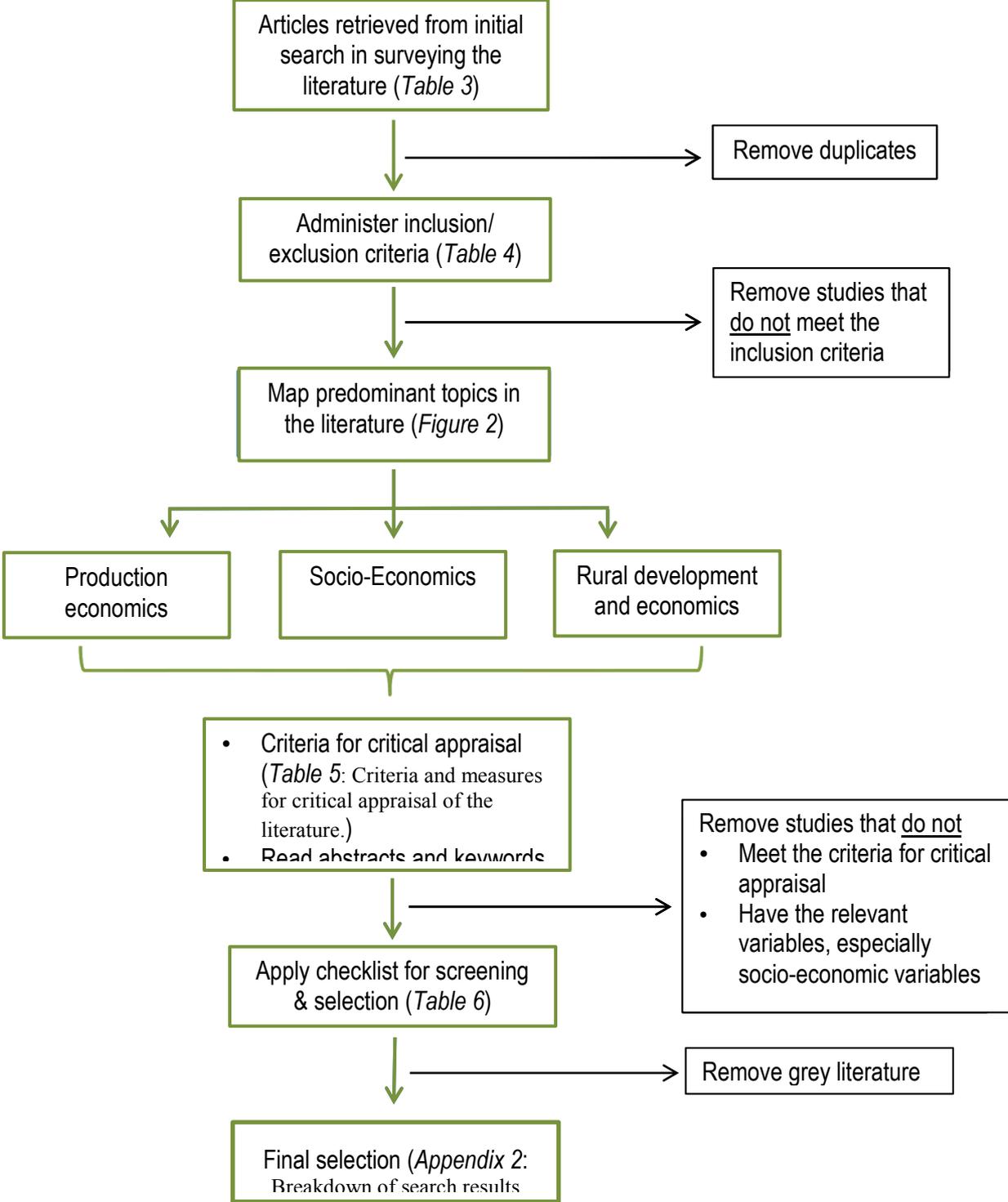
[17] Search restricted to (Subject=Agricultural & Biological Sciences/ Business, Management & Accounting/ Decision Sciences/ Economics, Econometrics and Finance/ Social Sciences/ Veterinary Sciences & Medicine)

[18] Search restricted to (Research Domains= Social Sciences) AND (Research Areas=Agriculture OR Business Economics)

[19] Includes both the selected literature and grey literature.

Appendix 3: Flow chart showing the steps for surveying and sorting the literature

Articles retrieved from initial search in surveying the literature (*Table 3*)

→ Remove duplicates

Administer inclusion/ exclusion criteria (*Table 4*)

→ Remove studies that <u>do not</u> meet the inclusion criteria

Map predominant topics in the literature (*Figure 2*)

- Production economics
- Socio-Economics
- Rural development and economics

- Criteria for critical appraisal (*Table 5*: Criteria and measures for critical appraisal of the literature.)
- Read abstracts and keywords

Remove studies that <u>do not</u>
- Meet the criteria for critical appraisal
- Have the relevant variables, especially socio-economic variables

Apply checklist for screening & selection (*Table 6*)

→ Remove grey literature

Final selection (*Appendix 2*: Breakdown of search results

Appendix 4: Variables and summary of correlations

1. Variable	2. Description	3. Links with exogenous variables	4. Links with non-exogenous variables	5. Links with performance & outcomes
SOCIO-ECONOMIC **Exogenous farm-household characteristics**				
Physical endowments	Land area, Climate ('Non-arid', 'Semi-arid'), Agro-ecological resources ('Agro-ecology').	*Y* Agro-ecology/ Climate[20]	+ Land area/ Wealth, Cattle *Y* Agro-ecology/ Production activities *I* Land area/ Crop	*Y* Seasons/ Flock size *Y* Agro-ecology/ Feed suppl
Household size	Number of household members	*Y* Gender of household-head	+ Wealth, Livestock, Non-farm, Consumption – Education	+ Feed suppl., Housing, Improved breeds, Adoption – Sharing
Age	Age of household-head or poultry keeper		*Y* Sale	+ Ethno-vet knowledge *Y* Flock size, Productivity, Poultry income, Adoption *I* Feed suppl.
Education	Years of formal education or literacy level of household head or poultry keeper	+ Market access	– Household size *Y* Production activities	+ Flock size, Feed suppl., Vaccination, Housing, IG, Adoption
Head of household ('Male head', 'Female head', 'Gender of head')	Male-, female- or youth-headed households	+ Male head/ Market access, Credit, Technical *Y* Education, Household size	+ Male head/ Non-farm activities + Female head/ Poultry, Consumption – Youth/ Sale *Y* Gender/ Objectives	*I* Gender of head/ Flock size
SOCIO-ECONOMIC **Exogenous infrastructure & institutional variables**				
Market access	Access to markets for poultry output and inputs supply services.	+ Male head – Female head *Y* Location	+ Household income, Male ownership, Sale, Asset-building – Consumption, Socio-cultural	+ Flock size, Prices, Efficiency, Poultry income, Feed suppl., Vaccinations – Cost *Y* Production system
Marketing of poultry	Buying and selling poultry products	+ Male head – Bartering/ Market	+ Poultry	

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[20] **+ or –** Positive or negative correlation with the variable in column 1. If column 1 is defined by more than 1 parameter (in 2. Description), the parameter is first specified in columns 3-5, followed by a slash "/". For instance "+ Land area/ Wealth" means "Land area is positively correlated with household wealth".
Y Correlation between dummy variable(s).
X No correlation reported between variables.
I Inconclusive or conflicting results from the studies. Correlation was reported but the direction of correlation (positive or negative) cannot be confirmed across other studies due to other possible interactions.

products ('Marketing')		access		
Credit access ('Credit')	Access to financial services and loans for poultry production.	+ Male		+ Flock size, Feed suppl., Vaccinations *I* Output
Technical services ('Technical')	Access to extension services and training on poultry production.	+ Male – Female	+ Poultry	+ Feed suppl., Vaccinations, IG, Adoption
SOCIO-ECONOMIC **Endogenous household income & production activities**				
Household income & wealth ('Household income')	Asset measure e.g. herd/flock size, land area etc (see *section 5.2.2* Endogenous)	+ Land area, Household size, Market access *Y* Location *I* Gender of head	+ Livestock, Consumption – Poultry, Poultry income	+ Flock size, Output, Improved breeds, Adoption – Poultry income *I* Prices
Poultry production ('Poultry')	Production or importance of poultry	+ Female head, Technical services, *Y* Agro-ecology, Seasons *X* Land area	– Household income Cattle,	*X* Prices
Livestock production ('Livestock', 'Cattle')	Production or importance of pig, cattle and other livestock	+ Land area, Household size *Y* Agro-ecology	+ Cattle/ Rice farming, Crop, Poultry, Sale – Male labour in poultry *I* Non-farm	+ Flock size
Crop farming ('Crop')	Production of vegetables, grains and cash crops	*Y* Agro-ecology, Season *I* Land area	+ Livestock *I* Poultry	*I* Flock size
Non-farm activities ('Non-farm')	Participation and income earned from non-agricultural wage work	+ Household size	– Poultry *I* Livestock	+ Adoption
HOUSEHOLD OPTIMISATION **Household objectives** (Households' reported objectives)				
Economic ('Sale')	Sale of egg and poultry	+ Market access *Y* Gender of head, Age	+ Cattle, Asset-building – Consumption	
Nutritional ('Consumption')	Consumption of egg and poultry	+ Household size, Female head – Market access	+ Household income, Livestock – Sale, Poultry income	
Asset-building	Importance of hens and eggs for restocking	+ Market access	+ Sale	
Socio-cultural	Importance of poultry as gifts and in cultural and religious life	– Market access		– Adoption, IG
HOUSEHOLD OPTIMISATION **Labour allocated to poultry**				

Poultry ownership	Male, female or children/ youth as owners	+ Male ownership/ Semi-arid + Male ownership/ Market access, Marketing	– Male ownership/ Livestock, Crop	*I* Female ownership/ Flock size
Flock care & management	Male, female or youth labour		+ Female labour – Male labour/ Livestock, Crop	+ Female labour/ Flock size + Male labour/ Housing construction
Control over finances from poultry	Male or female control		+ Female control/ female labour	
PERFORMANCE & OUTCOMES **Production parameters**				
Production system	Semi-intensive *vs.* semi-commercial	*Y* Market access		*Y* Poultry income, Feed suppl.
Flock structure and composition	Age of birds, hen:cock ratio			*Y* Age of birds/ Feed suppl.
Flock size and productivity ('Flock size', 'Productivity', 'Mortality')	No. of chickens per flock; Reproduction rate (hens/eggs/clutch); Mortality rate.	+ Flock size/ Education, Market access, Credit *Y* Flock size/ Seasons *Y* Productivity/ Age of farmer, Agro-ecology, *I* Flock size/ Gender of head	+ Flock size/ Household income, Female labour, Sale, Hen:cock ratio, *X* Flock size/ Objectives	+ Flock size/ Capital, Housing + Productivity/ Age of birds, Adoption – Mortality/ Vaccinations, Housing, Local breeds
PERFORMANCE & OUTCOMES **Economic parameters**				
Factors of production & output ('Labour', 'Capital', 'Output')[21]	Labour & capital factors	*Y* Marginal productivity of labour/ Gender	+ Output/ Household income *I* Output/ Credit	+ Labour/ Flock size
Cost of production ('Cost')	All costs including transaction costs	– Market access		+ Labour
Technical efficiency		+ Market access *Y* Gender		
Prices	Prices of eggs and live birds)	+ Market access *Y* Seasons	*I* Household income	
Profit or income from poultry ('Poultry income, 'Profit')	Profit or income from the sale of poultry products.	+ Market access *Y* Gender	– Household income, Consumption	+ Feed suppl., Vaccination *Y* Gender of bird

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[21] The parameters 'Labour', 'Capital' and 'Output' in the literature are taken to approximate household size, credit access and flock size, respectively.

PERFORMANCE & OUTCOMES **Management & interventions**				
Feed supplements ('Feed suppl.')	Adoption of feed supplements given to poultry	+ Household size, Education, Market access, Credit, Technical services *Y* Agro-ecology *I* Age of farmer	+ Household income	+ Flock size *Y* Genotype
Vaccinations	Adoption of quarantine, ethno-vet and modern vaccination	+ Education, Market access, Credit, Technical services + Ethno-vet knowledge/ Age of farmer	+ Livestock	– Mortality
Poultry housing ('Housing')	Adoption of shelter to house poultry especially at night	+ Household size, Education, Technical services *Y* Agro-ecology	+ Male labour	– Mortality
Improved breeds	Adoption of cross-breeding or improved genotypes	+ Household size *Y* Location	+ Household income	+ Feed requirements *I* Mortality
Intervention group or CBP ('IG')	Participation in an intervention group or community-based programme.	+ Education, Male head, Technical services	+ Livestock, Sale, Asset-building	+ Productivity
Adoption of interventions ('Adoption')	Adoption of interventions by household outside of any programme.	+ Household size, Education, Technical services *Y* Age	+ Non-farm	+ Poultry income, Feed supplement
Sharing arrangements ('Sharing')	Adoption of joint management of poultry and livestock	– Household size	– Household income	

Appendix 5: Summary of results – methodology

#	Author	Publication, year	Country	Research design & objective(s)	Sampling & data collection		Sample size
					• **Spatial stratification** - **Site characteristics or criteria**	• **Sample stratification** - **Characteristics or criteria**	
1 & 2	Aklilu, A.H. and Aklilu, A.H. *et al.*	Wageningen University, 2008; Journal of Agricultural Systems, 2008	Ethiopia (Tigray)	Cross-sectional study on socio-economic factors, marketing and management strategies	3 sites • Market access: low *vs.* medium *vs.* high	Cluster sample • Gender of household head	180
3	Dinesh, M.T. *et al.*	FAO, 2011	Cambodia	Cross-sectional study to identify chicken genetic resources and production systems	$5*x*y$ sites[22] - Production conditions - Unique local poultry breeds	Stratified random sample	400
4[23]	Mapiye, C. & Sibanda, S.	Livestock Research for Rural Development, 2005	Zimbabwe	Cross-sectional study on the effects of socio-economic factors and interventions in village poultry production	3 sites - Agro-ecology: dry, warm with short growing season	Stratified random sample • Gender of farmer • Flock size	72
5[24]	Mtileni, B.J. *et al.*	Applied Animal Husbandry & Rural Development, 2009	South Africa	Cross-sectional study on the characteristics of village poultry systems and household objectives	3*(2 to 6) sites • Agro-ecology: arid *vs.* semi-arid *vs.* cool-wet - Poultry genetics: minimal cross-breeding with non-local species	Systematic random sample - Willingness to participate in study	137
6	Mtileni, B.J. *et al.*	Tropical Animal Health & Production, 2012	South Africa	Cross-sectional study on the influence of socio-economic factors on production constraints	As above	As above	137

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[22] The site selection hierarchy follows the order of province, district and village, each separated by an asterisk. Here, x, y are the number of districts and villages, respectively. These were selected from 5 provinces according to the population distribution of human and poultry. A total of 90 villages were selected.

[23] Papers 4 and 7 have been combined to form a single study on Zimbabwe.

[24] Papers 5 and 6 have been combined to form a single study on South Africa.

7	Muchadeyi, F.C. *et al.*	Livestock Research for Rural Development, 2004	Zimbabwe	Cross-sectional study to evaluate village poultry production in relation to production constraints	3 sites - Agro-ecology: semi-arid	Simple random sample • Gender of household head - Willingness to participate in study	100
8[25]	Ochieng, J. *et al.*	Livestock Research for Rural Development, 2011	Kenya (West)	Cross-sectional study of interventions on productivity in relation to socio-economic factors	2*2 sites - High poverty rate - Target sites for much NGO and extension services	Stratified random sample • (Indigenous poultry) density and market prominence: low *vs.* high - Members of farmers' associations	120
9	Ochieng, J. *et al.*	African Journal of Agricultural and Resource Economics, 2012	Kenya (West)	Cross-sectional study of socio-economic factors influencing the adoption of interventions	As above	As above	As above
10	Okeno, T.O. *et al.*	Tropical Animal Health and Production, 2011	Kenya	Controlled study (non-arid *vs.* arid) of interactions between household, farm and poultry management characteristics	6 sites • Agro-ecology: med/high ag zone *vs.* arid/semi-arid	Simple random sample - Households with the largest number of village poultry	594
11	Sodjinou, E.	University of Copenhagen, 2011	Benin	Controlled study (intervention *vs.* control) of socio-economic factors, marketing and impact of interventions on production and household welfare	2*2*3 sites - Poverty and food insecurity • Intervention *vs.* control[26]	Multistage sample • Wealth ranking: 4 classes	303
12	Tadelle, D. & Ogle, B.	Tropical Animal Health and Production, 2001	Ethiopia (Central Highlands)	Longitudinal study of socio-economic factors to recommend production improvements	3 sites • Agro-ecology: low *vs.* high ag potential • Altitude: low *vs.* medium *vs.* high	Stratified random sample • Season: dry *vs.* wet	60

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[25] Papers 8 and 9 have been combined to form a single study on West Kenya.
[26] The tab alignment indicates the hierarchy of sampling in the multistage (cluster) sample.

13	Tadelle, D. *et al.*	Livestock Research for Rural Development, 2003	Ethiopia (4 regions cross-country)	Cross sectional study of production parameters and household objectives in relation to socio-economic factors	5*2 sites • Agro-ecology: varied • Market access: varied	Simple random sample - No prior intervention programmes - Willingness to participate in study	250
14	Teng, T.	FAO, 2011	Laos	Controlled study (intervention *vs.* control) of production and consumption in relation to socio-economic factors	(2+1)*5 sites[27] • Intervention *vs.* control	Simple random sample • Gender of farmer - Control group located in less accessible area	144
15 [28]	Tung, D.X.	Journal of Animal Science and Technology, 2012	Vietnam	Longitudinal study of socio-economic factors affecting profitability and flock mortality	3 sites • Agro-ecology: high- *vs.* mid- *vs.* lowland	Stratified random sample • Semi-subsistence *vs.* semi-commercial - Willingness to participate in study	97
16	Tung, D.X & Costales, A.	Pro-Poor Livestock Policy Initiative (FAO), 2007	Vietnam	Cross-sectional study of interaction between market participation and production scale	3 sites • Agro-ecology: high- *vs.* mid- *vs.* lowland • Market access: poor (highlands) to good (lowlands)	Systematic and stratified random sample • Semi-subsistence *vs.* semi-commercial	360
17	Tung, D.X. & Rasmussen, S.	Livestock Research for Rural Development, 2005	Vietnam	Cross-sectional study of hypothesized factors (flock size, feed, land, labour, income, vosts) affecting poultry production	As above	Systematic and stratified random sample • Semi-subsistence (1-50, mainly scavenging) *vs.* semi-commercial (>50, mainly feed)	360

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[27] (2+1)*5: 2 intervention *plus* 1 control *times* 5 villages.
[28] Papers 15, 16 and 17 have been combined to form a single study on Vietnam.

Appendix 6: Summary of results – socio-economic context

	Paper	SOCIO-ECONOMIC FACTORS				HOUSEHOLD OPTIMISATION	
		Sample profile, physical endowments & sample size (N)	Household size (average), gender, age, education & income	Production activities	Infrastructural & institutional variables	Household objectives for keeping poultry [29]	Intra-household gender-based labour allocation
1 & 2	Aklilu, 2008 and Aklilu et al.., 2008 (Ethiopia)	Poultry and non-poultry keepers. Poor region, one-third of households are Fh [30]. Land <1 ha, differences in market access. (N=180)	Size of Fh<Mh. 90 Mh and Fh each. Fh had higher poverty, malnutrition and weaker resource access than male.	Rain-fed crop and livestock. More Fh[a] [31] than Mh kept only poultry. Mh had more cattle. Bigger households engaged more in farm work. Poultry sharing between relatives.	Male participation in primary and secondary marketing increased with market access. Marketing access correlated positively with gender (male) [a], poultry prices and flock size.	1 Egg sale, 2 Poultry sale, 3 Egg consumption, 4 Meat consumption, 5 Hospitality, 6 Gifts. Remote areas ranked socio-cultural objectives higher. More poultry sale in Fh [b].	Mainly women managed poultry with other home activities. Women controlled poultry finances if they conducted the sale. Women in Mh had larger flocks than in Fh.
3	Dinesh et al. 2008 (Cambodia)	Poultry owners from five provinces. Landless to over 10 ha. Farm size linked to higher literacy. (N=390)	Size <5 in 60% [32]. Male 220, female 170. Age [15-76] [33]. Wealth described in relation to production activities, literacy & mobile phone use.	Vegetable and crop production, cattle and pigs. Cattle ploughed the rice fields, the main production activity.	Unorganised marketing. Spatial differences in market access, literacy, flock size and productive activities. Credit considered unimportant.	1 Poultry sale 87%, 2 Consumption. Only 1 farmer sold eggs. Poultry income only moderately important. Restocking through purchase and hatching.	Equally managed between men and women (127 each). Marketing by men 70%.
4 & 7[34]	Mapiye & Sibanda 2004; Muchadeyi et al.., 2004	Patriachal society, agriculture dependent. Land 2.6 ha, semi-arid. Seasonal variations	Size 5. Mh 88%. High poverty sample regions. Age from youth-headed to 50s. Fh had larger flock size.	Seasonal activities: cattle 74%, cotton and vegetable gardening. Gold panning 82%. Herding, vegetables, cotton. Shared herding	Women had lower access to extension services and training. Poor marketing channels viewed as a constraint to production.	1 Consumption, 2 Gifts and for fertilizer manure. Women were less interested in poultry for income or sale than men.	Women owned poultry 56%, cared for, made decisions, and were more knowledgeable than men about poultry. Men treated

[29] Numbers show the ordinal rank of households' reported preferences for keeping poultry.

[30] Fh: Female-headed households; Mh: Male-headed households.

[31] Statistically significant results, [a] ($p<0.0110$), [b]($p<0.05$), [c] ($p<0.101$).

[32] All % denotes percentage of sample size (N) to the nearest integer, unless stated otherwise.

[33] Ranges denoted in the square brackets […]

[34] Combined studies, see *Appendix 5: Summary of results – methodology.*

	(Zimbabwe)	in agro-ecology. (N=72)		between related families.			birds and built shelter. Boys dominated girls in poultry keeping. Men and boys herded cattle.
5 & 6[35]	Mtileni *et al.* 2009, Mtileni *et al..*, 2012 (S. Africa)	Scavenging system 80%. Arid and semi-arid areas. Declining natural resource and seasons affect the SFRB. (N=137)	Wealth, gender, age of farmer and household size as variables to predict mortality, Newcastle disease, and sales. Wealthier households and older farmers had larger flocks and sales.	Income from social grants 47%, non-farm wages 30%, crops 12%, other livestock 10%.	Informal marketing and local sales. Sold live birds during emergencies or surplus. Lack of technical knowledge and credit cited as problems.	1 Poultry meat consumption 90%, 2 Egg consumption 64%, 3 Sale of poultry products, 4 Manure, 5 Socio-cultural. Asset building (hatching) mentioned but not ranked.	Ownership [a]: Women 47%, men 44%, children 9%. Men more involved in larger scale poultry, women in subsistence. Women: cleaning, feeding, treatment, marketing. Men: build housing.
8 & 9[36]	Ochieng *et al..*, 2011; Ochieng *et al..*, 2011 (Kenya)	Differences in flock density and market access. (N=120)	Size 7. Mainly Mh 81%. Age 42 [15-87]. 54% below poverty level. Education [b] influenced the full adoption of interventions[37] compared with partial adoption.	Farming in med-high ag 52%, arid/semi-arid 16%. Formal 14%, informal 13%, off-farm wage 7% (as % of households surveyed). Off-farm income influenced full adoption [b].	Distance to market [b] and extension services [c] affected the adoption of feed supplementation and vaccines. Access to credit increased adoption, but no significant effect.	Poultry is a key income source to households.	Women dominated production 76%. Male farmers more likely to adopt interventions [a].
10	Okeno *et al..*, 2012 (Kenya)	Land [b] [38] 2.8 [0-28] ha.	Size [b] 7 [1-18].Mh 81%. Age [b] 43 [15-87]. Formal education 84%. Wealth in relation to poultry ownership and other livestock.	More land allocated to farming in non-arid regions than arid. Goats were more common in arid regions.	Marketing difficulties [b], lack of capital [b] and lack of extension services [b] were viewed as constraints to production.	1 Consumption [b] 2 Sale [b], 3 Emergency cash, 4 Asset [b], 5 Ceremonial [b], 6 Manure [b]	NA[39]

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[35] Combined studies, see *Appendix 5: Summary of results – methodology.*
[36] Combined studies, see *Appendix 5: Summary of results – methodology.*
[37] Feed supplementation, brooders and vaccination.
[38] Significant spatial differences: [a] (*p*<0.011), [b] (*p*<0.05), [c] (*p*<0.101).
[39] Data not available.

11	Sodjinou, E. 2011 (Benin)	All members who kept poultry and all who could obtain a loan. Land [4-10] ha. North and south stratified, less populated in the north. (N=303)	Size [5-8] [c]. Equal no. of Mh and Fh. Age 44. High rural poverty and food insecurity.	Petty trade, handicrafts, food processing. North: livestock, cashew nuts. South: oil palm plantations.	Market access limited output and prices obtained for poultry products. Transport costs form the bulk of marketing costs. Credit access influenced interventions [c].	Sale and consumption.	Women owned poultry and controlled poultry finances. Men built shelter and treated diseases. Men in CBP had higher annual production but women had higher marginal productivity of labour abd capital (non-significant). Training for women essential.
12	Tadelle & Ogle 2001 (Ethiopia)	Respondents from areas of different agricultural potential. (N=60)	Wealth in relation to poultry consumption (higher for wealthier families) and sales (higher for poorer families).	Poultry second to grain in household income contribution. Households had few alternative production activities.	No input purchase except foundation stock.	1 Incubation (Asset-building), 2 Egg sale, 3 Egg consumption, 4 Egg gifts, 5 Poultry sacrifice, 6 Poultry sale, consumption, reproduction, gifts. Female birds used mainly for hatching and not sold.	70% of chickens owned by women. Managed by women and children in wealthy households, and by all members in poorer households. Women cleaned shelters and had more poultry knowledge than men.
13	Tadelle et al..; 2003 (Ethiopia)	Presence of village poultry production without prior interventions. Different levels of market access. (N=250)	Household wealth status in relation to household objectives (consumption and sales). Wealth negatively correlated with income from poultry [a]. Wealthier households consumed more chicken.	Poultry as a seasonal activity, production declined during peak agricultural seasons. Income from poultry linked to lower household income [a]	Stock for breeding (hens) and replacement (chicks) acquired by purchase (markets and friends) and hatching [a]. Students from the surrounding villages worked as traders and middlemen. Buying, selling and bartering mainly in small local markets.	1 Hatching (asset-building), 2 Sale, 3 Consumption. Priority to sale and consumption of egg over poultry. Sale inversely related to consumption. Consumption higher in wealthier households [a]. Negative correlation between eggs sold and hatched [a], and between eggs consumed and sold [b].	Women cared for the flock daily, controlled income from poultry if they conducted the sale, valued poultry more and had greater access to poultry than cattle. Women were more knowledgeable about poultry than men.
14	Teng 2011 (Laos)	Intervention groups (IG) in more accessible locations than control group (CG). Landless to 5	Size 5 (in IG). Mostly Mh (63% in IG, 83% in CG). Half of all households had at least one child under 5 years.	Pigs and ruminants. CG had more of each livestock except ducks. Cassava and corn for sale. Part of land kept to grow feed forage for	Marketing of live birds with neighbours/ other farmers. Eggs purchased from village store. Technical training cited as most	IG: 1 Sale, 2 Consumption, 3 Religious. CG: 1 Consumption, 2 Sale, 3 Religious. Egg hatching priority in IG and CG. Egg	Poultry care by women, men built shelter. Women controlled poultry finances (IG 93%, CG 83%). Greater female decision

		ha. Seasonal variations in agro-ecology.		livestock. Some had non-farm work.	important, credit was secondary.	consumption linked to higher household income.	making on poultry in IG than CG. Men less likely to invest in poultry.
15, 16 & 17[40]	Tung 2012; Tung & Costales 2007; Tung & Rasmussen 2005 (Vietnam)	Semi-subsistence (1-50 birds) and semi-commercial (>50) [b]. Market access: low- mid- & highlands. Land size had no effect on production in low- and mid-lands[b].	Household income increased with sale of livestock, linked to flock size and output [a]. Poverty has a strong spatial dimension.	Remote areas had fewer opportunities for income diversification and production alternatives.	Poor households are less market integrated, less access to livestock than land. Poor market access impacts performance and production system. Traders linked to higher prices in all regions. Credit had non-sig effect on poultry production.	Purchase and hatching for restocking. Sale of chickens or eggs to other villagers motivated by social relations rather than for income.	Women dominated feeding, watering, shelter cleaning and marketing. Men treated diseases and built shelter. Women had more poultry knowledge than men.

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[40] Combined studies, see *Appendix 5: Summary of results – methodology.*