

ORIGINAL RESEARCH

Backyard poultry raising in Bangladesh: a valued resource for the villagers and a setting for zoonotic transmission of avian influenza. A qualitative study

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ABSTRACT

Introduction: Backyard poultry raising is common in rural communities and a valued resource that provides food and income for subsistence farmers. Close contact with infected backyard poultry has been associated with H5N1 human cases in different countries. The emergence of this virus within Bangladesh means that backyard poultry raisers are at risk of avian influenza infections. The aim of this study was to understand why people raise backyard poultry and to characterize people's regular interaction with their poultry.

Methods: In 2008, a qualitative study was conducted in two villages from two districts of Bangladesh. In a social mapping exercise the villagers drew all the households in their village: 115 households in the village in Netrokona and 85 households in the village in Rajshahi District. Selected were 40 households (20 households from each of the two villages) for data collection through in-depth interviews ($n=40$) and household mapping ($n=40$), and observation sessions ($n=16$).

Results: In both villages, 92% of households raised backyard poultry. The majority of the owners was female and used the money earned from poultry raising to purchase cooking ingredients, clothing, and agricultural seeds, and pay for children's education expenses. The households consumed poultry meat and eggs. In the village in Netrokona, 80% (85/106) of households kept poultry inside the bedroom. In the village in Rajshahi, 87% (68/78) of households had separate cage/night sheds. During feeding the poultry



and cleaning the poultry raising areas, villagers came into contact with poultry and poultry feces. Poultry scavenged for food on the floor, bed, in the food pot and around the place where food was cooked. Poultry drank from and bathed in the same body of water that villagers used for bathing and washing utensils and clothes.

Conclusion: Although raising poultry provides essential support to the families' livelihoods, it exposes them to the risk of avian influenza through close contact with their poultry. Simple warnings to avoid poultry contact are unlikely to change practices that are essential to household survival. Interventions that help to protect poultry flocks and improve household profitability are more likely to be practiced.

Key words: avian influenza, backyard raisers, Bangladesh, H5N1, pandemic influenza, poultry, qualitative research, risk.

Introduction

Backyard poultry raising is common in the rural communities of low income countries^{1,2}. It is a valued resource for the livelihood of rural communities³. It is not only important for food production, but also generates income for subsistence farmers, especially women^{1,3}.

Bangladesh is a low-income country where 90% of rural households raise poultry^{4,5}. The practice of raising backyard poultry makes a centrally important contribution to the livelihood of rural families and to the national economy. In Bangladesh, 40% of the population lives in absolute poverty in terms of calorie intake⁶, and malnutrition and child mortality remain major concerns^{7,8}. In 2004, 2 kg of the 4.6 kg per capita poultry meat consumption came from backyard poultry in Bangladesh⁹. The annual egg production from the 'backyard system' is estimated to be 4.4 billion, which is 67% of the total egg production of Bangladesh⁹. The poorest households sell most eggs proportionately, and use the income to meet their household needs⁹. In rural areas, poultry raising is an occupation of 50% of women¹⁰.

Backyard poultry can be infected with highly pathogenic avian influenza (H5N1) virus, which can be transmitted to humans. Since 2003, 15 countries have reported H5N1 infection in humans with 11 countries in Asia. As of 7 March 2012, the World Health Organization (WHO) reported 594 human cases, of which 349 (59%) had died¹¹. Between January 2008

and March 2012, six human cases were identified with H5N1 infection in Bangladesh¹¹. Close contact with infected backyard poultry has been associated with many of these H5N1 human cases in various countries¹²⁻¹⁸. A recent review article noted that in all published literature where the exposure setting was described, backyard settings were reported for 60% of the cases¹⁹. Several risk factors had been identified for H5N1 human infection through close, direct contact with poultry and transmission via contaminated environment^{19,20}. The most commonly identified risk factors were direct contact with infected blood or body fluids during slaughtering, de-feathering, removal of organs, washing meat, feeding and caring²⁰. Associated factors related to environmental exposure include: cleaning poultry areas, removal of feces, using poultry waste as fertilizer, inhalation, ingestion, intranasal inoculation of contaminated water²⁰. Indirect contact with apparently healthy poultry was also reported as the exposure for several H5N1 human cases¹⁹.

In Bangladesh, the same strains of the H5N1 virus have been re-emerging in farm outbreaks across the country, which suggests that the H5N1 virus has been circulating among backyard chickens, ducks and migratory birds in the country for last 3 years and has now become endemic²¹. The association of backyard chickens with human H5N1 infection and the emergence of the virus within Bangladesh mean that backyard poultry raisers in Bangladesh are at risk of H5N1 and other avian influenza infections.



As a first step towards reducing the risk of disease transmission in this setting, this study was conducted to understand why rural residents raise backyard poultry and to characterize their regular interaction with their poultry.

Methods

The methods, including study design and data collection tools and process have been described previously²². The qualitative research component of the study is described in more detail here.

Study design and setting

This exploratory qualitative study was conducted because there was limited research into backyard poultry raising practices in this country with particular focus on human-poultry interaction.

A qualitative research team collected data on poultry raising practices in two villages: one in the northern district of Netrokona from February to March 2008 and one in the northwestern district of Rajshahi in July 2008. Netrokona is a low-lying, rural area that experiences seasonal floods annually. Rajshahi is located on a plain and is only occasionally affected by seasonal floods. These study sites were selected in two different geographical areas assuming there would be differences in poultry raising practices due to the differences in terrain.

Data collection process and tools

The research team used a number of qualitative data collection tools including transect walks, social mapping, in-depth interviews, household mapping and observation.

During the first week of data collection, the research team conducted numerous transect walks through the community and stopped for several informal discussion with community members. Based on the transect walks, the team selected those participants who knew most of the household locations

and were familiar with poultry raisers and the wealth status of the villagers. The team included farmers, shopkeepers, local youth, school teachers, local elite and the female members of several households as participants for mapping. In Netrokona district, villagers divided the village into four *para* (a part of the village) and the team conducted the mapping in four separate sessions, one in each *para*. In Rajshahi District, the mapping of the entire village was conducted in one session.

Therefore, in each of the villages, the team conducted the social mapping exercise following the approach of participatory rural appraisal²³, where villagers drew the map of their village on the ground using bamboo sticks to identify major landmarks, the number of poultry raisers, the number of poultry per household, wealth status of the households, and common poultry scavenging places. The team then reproduced the map on paper (Fig1). The term 'scavenging' was used to refer to the chicken behavior of 'roaming in places in search of food, scratching and eating food from those places'.

In the social mapping exercise, villagers drew all the households of their village: 115 households in the village in Netrokona and 85 in the village in Rajshahi. The participants discussed information among themselves before reporting. They concurred on a comparative wealth status of the households by categorizing them as poor, middle or rich, based on the area of land and resources owned, number of income earners and dependant members in the family, and the type of occupation (Table 1). Participants also categorized all the households into two groups according to the number of poultry owned by each household (Table 1): households with a 'small flock' and households with a 'large flock' (in the village in Netrokona, ≤ 5 poultry was a 'small flock' and > 5 birds was a 'large flock'; in the village in Rajshahi, ≤ 10 poultry was a 'small flock' and > 10 birds was a 'large flock'). After mapping, the research team conducted a census by visiting the households to cross-check the number of poultry per household.

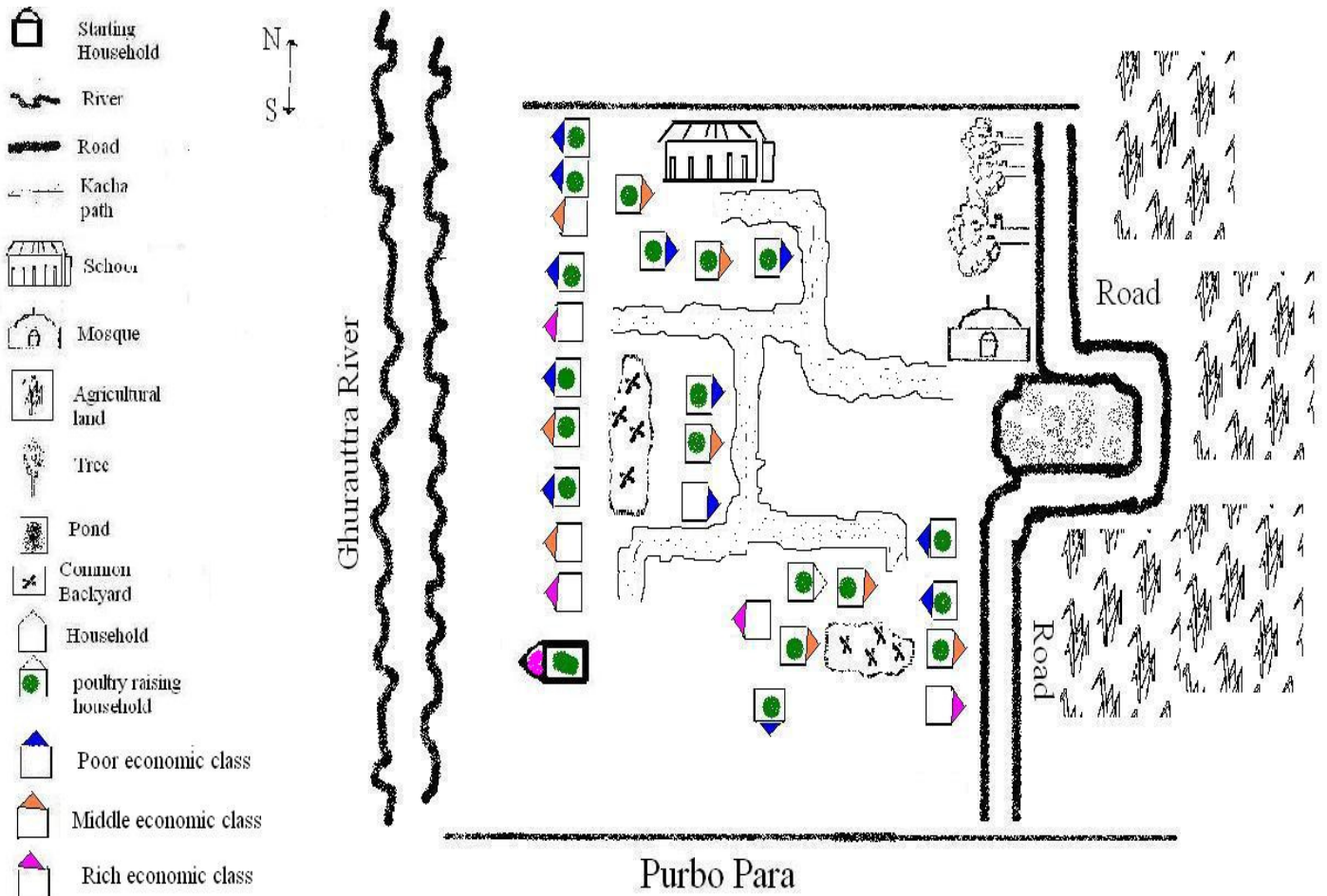


Figure 1: Picture of social mapping of 'Purba para' (a part of the village) in Netrokona, Bangladesh 2008

Based on the findings of the social mapping and subsequent cross-checking census, the team selected 20 households per village, five from each of the four categories: middle-large, middle-small, poor-large and poor-small, assuming differences in poultry raising depending on wealth and number of poultry. Based on consent and the availability of informants for participation, five households were selected from each category.

The participants in the social mapping exercise reported that women were the primary raisers of backyard poultry in the household. Therefore, the team conducted 40 in-depth interviews, 20 in each village, with the female members of the selected households to collect information on everyday raising practices and use of poultry in their livelihood. The interviews

lasted between 40 and 110 min and were audio-recorded. After the interviews, with the help of the household participants, the team drew maps of each of these 40 study households, showing the location of poultry sheds and sites of egg-laying, brooding, poultry scavenging and slaughtering in and around the households. The team selected the first eight households from these 20 households that gave consent to observe the interaction between poultry and the household members for 6-7 hours during a single day, including time both in the morning and afternoon. All qualitative data collection activities were sequenced so that findings from each tool were used to modify and guide the data collection of the subsequent tools, as well as to cross-check the findings among the tools, because triangulation is important for the rigor of qualitative research²⁴.



Table 1: Findings from social mapping and subsequent cross-checking census of the participants of Netrokona and Rajshahi, Bangladesh 2008

Households findings	District - n (%)		Total n (%)
	Netrokona	Rajshahi	
Poultry raising households [†]	106 (92)	78 (92)	184 (92)
Poultry per household			
1-5	53 (46)	27 (32)	80 (40)
6-10	23 (20)	17 (20)	40 (20)
>10	13 (11)	34 (40)	47 (24)
Poultry are kept in the:			
Bedroom [‡]	85 (74)	6 (7)	91 (46)
Veranda	21 (18)	32 (38)	53 (26)
Yard	-	31 (36)	31 (15)
Bedroom and veranda/yard	-	4 (5)	4 (2)
Veranda and yard	-	5 (6)	5 (3)
Socioeconomic household status			
Poor [¶]	68 (59)	30 (35)	98 (49)
Middle-class [¶]	30 (26)	32 (38)	62 (31)
Rich [¶]	17 (15)	23 (27)	40 (20)
Total households	115	85	200

[†]Includes 17 households that did not have poultry at the time of the study but had a shed inside the bedroom;
[‡]Through social mapping, villagers categorized the households in to poor, middle and rich groups based on the area of land and resources owned, the amount of earnings, the number of dependant family members and the occupation type.

Because data saturation is important in qualitative research to ensure the adequacy of sample size²⁵, the team continued data collection using each tool until saturation was reached. The number of informants of the study is consistent with what experts in qualitative methods recommend. Creswell²⁶ suggested 20-30 interviews and Morse²⁷ recommended 30-50 interviews for reaching data saturation. In a recent study, Mason²⁸ found that most of PhD studies used fewer than 50 in-depth interviews for data collection.

In the results section, findings on the number of households that raised poultry and on the places poultry are kept are reported from the findings of social mapping and subsequent cross-checking census (Table 1). Separate findings were not reported from household mapping because there was no difference between the reported practices found in household mapping and the reported practices found in the in-depth interviews.

Data analysis

The research team reviewed and expanded the field notes and transcribed interviews verbatim in Bengali. The data were reviewed and emerging themes retrieved. The authors discussed and finalized the code list of themes through an iterative process. Later, the authors summarized coded data according to the study objectives and relevant emerging themes. The findings were cross-checked by comparing data from all research tools.

Ethics

The study purpose was explained to the community members and they were asked to participate in the social mapping exercise. Verbal informed consent was taken from the households before data collection. The Ethical Review Committee of icddr,b, Bangladesh reviewed and approved the study protocol.



Results

Demographics

Both in the Netrokona and Rajshahi villages, 92% of households raised backyard poultry (Table 1). In both sites, all the informants were females aged 18–63 years, with a mean education of 3 years (range grade 0–9). The mean duration of poultry raising was 17 years (range 1–51 years). Most of them (39/40, 98%) were the leading female members of the household, usually the mother of the youngest members of the household, or the wife of the head of household. No difference was found in poultry raising practices or reported values of poultry among households with different wealth status or number of poultry.

Economic value of poultry in villagers' daily life

Villagers earned money by raising poultry to meet their everyday household needs. They made use of almost every part of the poultry, including meat, eggs, feathers and feces.

Women's in-hand cash: Some women (13/40, 33%) reported that they owned the poultry, because rearing and caring for poultry was part of their household work. Poultry provided them with their own source of spending money. They mentioned that some of the household expenditures were paid solely by money raised from poultry.

I raise poultry. When I do not have enough money in hand, I sell poultry and duck-eggs to pay for my children's education. I buy them books and pens. I pay the tuition fee.

I raise poultry for some money in my hands to support my family. I sell poultry and buy necessary items for my family... It's women's affair... I cannot ask everything from my husband.

All informants reported that the income from poultry was useful to meet everyday household needs. They used this money for buying medicine, paying doctors' fees, and buying

cooking ingredients, gifts and clothes for household members and repaying loans.

If we are 50 taka short for a loan payment, I can repay the loan installment... by selling eggs.

Last time (I/we) sold poultry, I was sick, I went to doctor to get medicine, there were some due (money) so I sold the poultry.

Small-scale savings: Informants from poor households explained that during times when food was scarce, they sold their poultry or poultry by-products to meet daily needs.

I have scarcity in my family... Sometimes when I do not have rice, lentils, oil, soap etc, I sell poultry.

We sold poultry in the month of Chaitra (mid-March to mid-April) because at that time my father could not get a job in the market.

Informants reported that they sold poultry and saved the money for future investments. They added that these savings contributed to the purchase of other livestock.

I can sell my poultry and buy a goat... I can sell that goat later and after getting this money, I can buy a TV or a cassette player or gold jewelry for myself or I can sell all of those and buy some land.

Ecological use

Poultry contributed as supplement to agriculture, the main source of income. Using poultry feces as fertilizer was common practice for all informants. Sometimes they also sold the poultry feces.

Fifteen days back, my husband told me that he needed to buy bitter gourd seeds, thread and bamboo. So, I sold a rooster and got 225 taka (US\$3). I gave that money to my husband and he bought those things by that money... I sold my ducklings and bought paddy seedlings.



We make a hole and store chicken's feces in that hole day after day. When that hole is filled with feces, my husband puts those feces in a sack with a hoe and carries it on his head to the cultivation land.

Poultry as a food source for facilitating social exchange and social relationships

Informants mentioned that they consumed poultry meat and eggs and fed boiled or fried eggs to their children. They usually slaughtered their poultry for household consumption when the poultry was sick, when they had a guest, during ceremonies, or during a Muslim religious festival, such as *Shab-e-barat* and *Eid*.

I had my son undergo circumcision. I didn't have money. So I was not able to bring meat from the market... Then I slaughtered a duck.

Poultry was particularly important for widows as this was their main source of income. They explained that this money was used not only for food, but also for other expenses, such as transport to visit relatives, and gifts and special food for their grandchildren and relatives.

When my son-in-law comes with his friend, I slaughter a chicken and give them a treat. They will praise my daughter. If I do not raise poultry and cannot even afford 50 taka to buy poultry when my son-in-law comes, there will be dispute in my daughter's family. My son-in-law will reproach her saying... 'I went to your mother's place with a friend and your mother could not treat us well'.

Informants also reported offering poultry to the deities, for example for the recovery of a diseased family member or if someone is expecting a child. They also offered poultry eggs for the recovery of diseased poultry.

I decided inwardly that I will sacrifice one rooster [morog] to Sultan Bari [house of religious leader] if Allah blesses me with a child.

Poultry-raising practices

It was observed that household members have both direct and indirect contact with poultry as part of everyday raising practices in the household setting. This contact includes touching poultry, contact with poultry feces and contact with roaming poultry inside the household premises. Different types and frequencies of poultry–human contact events are described (Table 2).

Place for keeping poultry: In the village in Netrokona, 80% (85/106) of households kept their poultry inside the bedroom at night to protect them from jungle cats, foxes and thieves. In the village in Rajshahi, 87% (68/78) of households had a separate cage/night shed that they kept on the veranda or in the front yard (Table 1). Informants reported that they covered the poultry with a bamboo basket while keeping it inside the bedroom. Only two informants reported that they had a fenced area next to the bed. In both areas, informants mostly kept ducks and chickens separately. They used separate baskets, cages/sheds and sometimes used a partition within the same shed. Informants reported that they separated the ducks and chickens because they fight with each other, and ducks made the place dirtier and their feces smell more unpleasant. One informant from Rajshahi explained that she kept chickens inside the house and ducks outside the house because of their different economic value:

I keep my chickens inside my living room and keep ducks in the veranda, since the price of ducks is lower than that of the chickens and thieves steal ducks less than chickens.

The majority of informants (29/40, 72%) reported that they prepared a place for chickens to lay and brood eggs inside the bedroom, either under the bed or on the window sill. They did not do the same for ducks because ducks lay eggs in the place where they roost at night. It was observed that in 38% of households, women or children picked up the poultry and placed them inside the shed (Table 2).



Table 2: Interaction of poultry and human from household observation of the villages of Netrokona and Rajshahi, Bangladesh, 2008

Type of poultry and human contact	Contact frequency [†]	No. households with observed contacts (N=16) n [%]
Holding poultry to keep inside the poultry shed/keeping place	13	6 [38]
Touching poultry during feeding and scavenging	3	2 [13]
Driving or kicking poultry away to impede going inside bedroom during scavenging	2	2 [13]
Entering the shed to clean or let out the poultry	4	3 [19]
Touching baby chickens/ducklings during feeding /taking care	1	1 [6]
Touched a brooding chicken	2	2 [13]
Cutting the wings of chicken	1	1 [6]
(Children) playing or holding a chicken when feeding, putting into the cage, slaughtering/selling	11	4 [25]
(Children) playing with broom, snail on the feces and putting those or hands in their mouth	10	7 [44]
Stepping on feces with bare feet	22	10 [62]
Touching feces while cleaning the household	15	12 [75]
(Poultry) scavenging close to human eating area and where rice has been dropped from a plate	18	8 [50]
Poultry jumping and stepping on the bed, clothes, cooking pots	110	16 [100]

[†]Conducted 6-7 hours observation during a single day in each household.

Poultry scavenging places: It was observed that poultry scavenged both inside and outside the house. In all the households, poultry were frequently observed scavenging in the kitchen and the bedroom, usually on the bed sheets, blankets, household members' clothing and furniture (Table 2). Outside, chickens scavenged in the yard, veranda, cattle shed, nearby bushes, inside neighboring houses and in the nearest paddy field. During the rainy season in the village in Netrokona, chickens scavenged on the veranda, near the kitchen, in the cow-shed and inside the bedroom. Informants from the village in Netrokona reported that during extreme seasonal flooding they put the chickens in a cage and hang the cage inside the room, as there is no place for scavenging. Ducks entered the house only at feeding time. Their common scavenging places were in the nearby water bodies, ditches and low-lying cultivated land. It was often observed that ducks drank from and bathed in the same body of water that villagers used for bathing and washing utensils and clothes.

In 50% of households, it was observed that when household members were eating food, chickens scavenged nearby (Table 2). In one observation, a young child was sleeping on a piece of cloth on the floor and there were chicken feces just near the child. When the child woke up and came outside, the chicken scavenged on the piece of cloth, pillow and the baby clothes that were left on the floor. In another observation, a 2 year-old boy was sitting on the floor eating rice while three chickens were scavenging nearby and eating rice from the boy's plate.

Feeding poultry: Female members of the household reported feeding the poultry two to three times per day as part of their everyday household work. They said that they opened the door of the cage/night shed in the morning so that poultry could scavenge. After that they gave them food either in a pot or spread in different places including the floor of the bedroom, the veranda or in the yard. In the village in Netrokona, most of the informants (17/20, 85%) reported



giving food inside the bedroom. One informant from Netrokona said that if she spread the food inside the bedroom under the bed, the neighbors' poultry would not be able to eat it. Informants reported that they gave food to ducks and chickens separately because ducks eat faster, and so chickens would get too little food. They mentioned that they fed rice, rice husk, paddy and stale rice to their poultry. Some of them (7/40, 18%) mentioned that they also fed snails to their ducks. Some informants from Rajshahi (3/20, 15%) mentioned that they fed poultry offal or the entrails of slaughtered poultry and shells of brooded eggs to their poultry. One informant said:

If we feed offal/entrails of slaughtered healthy poultry to other live poultry, it will not cause any problem, rather it will provide vitamins. There is fat in poultry intestines. For this reason if chickens eat offal, we let them do it.

It was observed that women often fed the baby chicken and ducklings by hand (Table 2). They also reported that they fed the sick poultry medicine, tamarind, green mango or other sour fruits and garlic by hand. They said that they mixed the medicine with cooked rice and put it into the chickens' mouths by holding their beaks open with two fingers.

Cleaning poultry feces: The women mentioned that it was their duty to clean up poultry feces or the poultry sheds once a day. Those who kept their poultry inside the bedroom, cleaned the room every morning. Those who kept poultry in sheds cleaned the sheds every 2–4 days.

In 75% of the households, it was observed that most of the women scattered ash or dust on the feces to soak up the moisture and then scraped up the feces with a hoe and/or broom and deposited it in a handmade bamboo basket. Then they put it under the trees or beside the house to preserve it for fertilizer. They used the same basket for carrying cattle food or cattle waste. It was also observed that when women crawled inside the shed or under the bed to clean poultry feces, dust and soil were smeared on their hands, bodies and clothes (Table 2).

During all observations, poultry feces were seen all over the household premises, including inside the bedroom, the kitchen, on the veranda, and in the yard, where they remained for several hours. Most of the household members were barefoot and stepped on the feces (Table 2). Sometimes very young children crawled through the feces. In one observation, a child was eating a guava which she dropped on the chicken feces on the ground. While picking up the guava, her hand touched the feces. She then resumed eating the guava.

Children with poultry: Sometimes children participated in poultry raising activities. It was observed that they gave food to the poultry, used their hands to put poultry in the shed in the evening, opened and closed the door of the shed and caught poultry before slaughtering or selling (Table 2). Informants reported that sometimes children helped slaughter the poultry in the absence of other adult household members.

My two sons and I do all the work for our poultry. They put the poultry inside the shed and release those in the morning.

Children were observed playing with poultry including ducklings and baby chicks. Sometimes they also played with the broom used for cleaning poultry feces, or the snails used as poultry food (Table 2).

Slaughtering and processing: Informants reported that usually men slaughtered the poultry, and women de-feathered and processed the slaughtered poultry. Handwashing with soap was rare after slaughtering. After slaughtering, women took the poultry into the kitchen or in the yard adjacent to the kitchen and started de-feathering and cutting up the meat. During a slaughtering observation, people did not clean the slaughtering site and children and other members of the household stepped on the blood. Most of the women reported that they threw the poultry offal and entrails in the nearest body of water or bushes. It was also observed that crows often took away the offal and entrails from the bushes. In one observation, a woman wiped her nose and touched her face, mouth and clothes during de-feathering and cutting meat without washing her hands. It



was observed that children enjoyed observing the slaughtering process and sometimes played with pieces of raw meat.

Discussion

Villagers' regular poultry raising activities provide essential support to the families' livelihoods, and the agriculture-based rural environment is congenial for backyard poultry raising. However, these activities expose families to the risk of avian influenza.

Poultry raising provides a source of nutrition¹⁰ and a source of income to low-income village residents. Backyard poultry raising in rural settings is one of the most efficient uses of available resources and environment because the poultry scavenge freely and require minimal effort for supplementary food and night shelter^{2,3}. Thus, little investment is necessary and backyard poultry raising is affordable for low income communities².

As part of poultry raising activities, raisers had close contact with their poultry including touching them while putting them into sheds, feeding sick poultry by hand, and killing, de-feathering and butchering poultry. Keeping poultry inside the bedroom²⁹⁻³², and being exposed to feces^{33,34}, and to water bodies shared with ducks³⁵ have been suggested as potential risk exposures to H5N1 human cases. Women appeared to be at greater risk of disease transmission because they were involved in direct contact through multiple interactions such as de-feathering and butchering. Children also appeared to be at high risk because they assisted in poultry slaughtering, played with the raw meat and touched poultry during routine chores. These activities were associated with human H5N1 infections in Vietnam, Thailand, Turkey, Indonesia and Egypt¹²⁻¹⁶.

The observation that the poultry raisers' concern for the security of poultry led them to keep poultry inside the bedroom agrees with observations by Gondwe and Wollny³⁶. The way villagers raise poultry represents a practical

approach to problem-solving and is also in harmony with their way of living and the environment. For example, as part of everyday rearing and caring for poultry, the villagers frequently experienced contact with their poultry as they shared same household environment.

When low income villagers are struggling with poverty and trying to meet basic needs, the issue of preventing a very rare disease like highly pathogenic avian influenza H5N1 is not a salient issue, as was found in another component of this study that demonstrated that villagers ignored the risk of avian influenza because they did not believe that the disease was transmissible to humans²². They did not recognize various signs of illness in their flocks and thus did not perceive the existence of avian influenza²². They had not experienced this rare disease in their community and on receiving news of massive culling activities of the authorities the villagers hid or slaughtered their poultry out of fear of losing them²². Thus, villagers consider the chance of an adverse outcome from poultry exposure to be quite low compared with the adverse outcome of worse poverty²², and are less likely to change their behavior to decrease the frequency of poultry-human interactions .

The strong motivations for poultry raising suggest that community interventions to reduce the risk of avian influenza that adversely affect the ability of small backyard producers to profit from raising poultry are likely to be ignored or actively resisted by villagers. Developing an intervention to prevent animal-to-human transmission of avian influenza should recognize the central importance of poultry production in livelihood of the village residents, and should not undercut this essential income-generating activity. Therefore, a comprehensive 'One Health' approach which considers steps to protect animal health and agricultural productivity as well as human and environmental health is a useful framework for reducing the risk of avian influenza transmission^{37,38}.

The 'One Health' approach

The concept of 'One Health' emphasizes that human, animal and environmental health are interconnected and the health



of human communities depends on a healthy ecosystem that includes healthy animals and healthy earth's resources³⁷⁻³⁹. A 'One Health' approach advocates interdisciplinary collaboration among physicians, veterinarians, agricultural scientists, hydrologists, ecologists, health scientists, anthropologists and their institutions, organizations and health agencies to work together to attain optimal health for humans, animals and the environment^{37,39-41}.

The broader 'One Health' approach suggests interventions that are supportive of the poultry raisers by integrating human and veterinary health institutions, local stakeholders and environmental experts, taking into account the interconnections between economy, environment, animal and human health, might be a useful approach to develop effective preventive strategy for avian influenza. For example, encouraging poultry raisers to perform safe slaughtering (ie covering nose and mouth, washing hands with soap after slaughtering and after cutting meat, cleaning slaughtering sites and tools, keeping children away from slaughtering sites and burying offal and blood) could help to protect the flock from transmission of avian illness as well as protect human health, thus improving the productivity and profitability of the poultry raisers.

Limitations

Data were collected from two villages; it is possible that practices could be different in other villages of the country. However, investigators in other countries have reported similar findings related to poultry raising in low-income rural households^{36,42}. The poultry and human interaction patterns described in this study were collected mainly through observation. There is a chance that the observations were biased during data collection as people might change their usual behavior in the presence of an observer. However, the practices described in this study were similar to the knowledge, attitudes and practices reported by UNICEF Bangladesh, which supports the validity of our findings⁴³. Findings that overlapped in both these studies included that women were the main poultry raisers, poultry were usually kept inside the household, and children routinely came into

contact with poultry during daily care and play. Moreover, the findings from in-depth interviews and household mapping agree with many of the observational findings and explain the context behind the practices.

Conclusions

Poultry raising is a rational choice for low income rural communities because of the benefits to family nutrition and income. Interventions that help villagers protect their flocks and improve household profitability are more likely to be practiced and so have the potential to reduce the risk of avian influenza transmission between poultry and humans. Avian influenza surveillance and preventive and control measures in backyard poultry settings should focus on women and children because they are primarily involved in everyday poultry rearing and caring activities.

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References

1. Mack S, Hoffmann D, Otte J. The contribution of poultry to rural development. *Worlds' Poultry Science Journal* 2005; **61(1)**: 7-14.



2. Guèye EF. Employment and income generation through family poultry in low-income food-deficit countries. *World's Poultry Science Journal* 2002; **58(4)**: 541-557.
3. Guèye EF. Gender aspects in family poultry management systems in developing countries. *World's Poultry Science Journal* 2005; **61(1)**: 39-46.
4. Sonaiya EB, Swan SEJ. *Small-scale poultry production technical guide*. Rome: Food and Agricultural Organization (FAO) of the United Nations, 2004; 60.
5. Chakma D. Rapid Assessment on Socio economic impact due to highly pathogenic avian influenza in Bangladesh. Bangladesh: Food and Agricultural Organization (FAO) of the United Nations, 2008.
6. Bangladesh Bureau of Statistics. *Statistical Year Book of Bangladesh 2009*. Bangladesh: BBS, 2010.
7. Black RE, Allen LH, Bhutta ZA, Caulfield LE, de Onis M, Ezzati M et al. Maternal and child undernutrition: global and regional exposures and health consequences. *Lancet* 2008; **371(9608)**: 243-260.
8. UNICEF. *Bangladesh: Statistics*. (Online) 2003. Available: http://www.unicef.org/infobycountry/bangladesh_bangladesh_statistics.html#0 (Accessed 21 March 2010).
9. Dolberg F. Poultry sector country review. Bangladesh: Food and Agriculture Organization of the United Nations, 2008.
10. Mitra and Associates and Macro International. *Bangladesh Demographic Health Survey*. Dhaka: NIPORT, Mitra and Associates and Macro International, 2007.
11. WHO. Cumulative number of confirmed human cases for avian influenza A (H5N1) reported to WHO, 2003-2012. (Online) 2012. Available: http://www.who.int/influenza/human_animal_interface/EN_GIP_20120306CumulativeNumberH5N1cases.pdf (Accessed 11 March 2012).
12. Kandeel A, Manoncourt S, Abd el Kareem E, Mohamed Ahmed AN, El-Refaie S, Essmat H et al. Zoonotic transmission of avian influenza virus (H5N1), Egypt, 2006-2009. *Emerging Infectious Diseases* 2010; **16(7)**: 1101-1107.
13. Chotpitayusunondh T, Ungchusak K, Hanshaoworakul W, Chunsuthiwat S, Sawanpanyalert P, Kijphati R et al. Human disease from influenza A (H5N1), Thailand, 2004. *Emerging Infectious Diseases* 2005; **11(2)**: 201-209.
14. Tran TH, Nguyen TL, Nguyen TD, Luong TS, Pham PM, Nguyen VC et al. Avian influenza A (H5N1) in 10 patients in Vietnam. *New England Journal of Medicine* 2004; **350(12)**: 1179-1188.
15. WHO. Human cases of influenza A (H5N1) infection in eastern Turkey, December 2005-January 2006. *Weekly Epidemiological Record* 2006; **83(1)**: 409-416.
16. Sedyaningsih ER, Isfandari S, Setiawaty V, Rifati L, Harun S, Purba W et al. Epidemiology of cases of H5N1 virus infection in Indonesia, July 2005-June 2006. *Journal of Infectious Diseases* 2007; **196(4)**: 522-527.
17. Fielding R, Bich TH, Quang LN, Lam WW, Leung GM, Tien TQ et al. Live poultry exposures, Hong Kong and Hanoi, 2006. *Emerging Infectious Diseases* 2007; **13(7)**: 1065-1067.
18. Brooks WA, Alamgir AS, Sultana R, Islam MS, Rahman M, Fry AM et al. Avian influenza virus A (H5N1), detected through routine surveillance, in child, Bangladesh. *Emerging Infectious Diseases* 2009; **15(8)**: 1311-1313.
19. Rabinowitz P, Perdue M, Mumford E. Contact variables for exposure to avian influenza H5N1 virus at the human-animal interface. *Zoonoses and Public Health* 2010; **57(4)**: 227-238.
20. Van Kerkhove MD, Mumford E, Mounts AW, Bresee J, Ly S, Bridges CB et al. Highly pathogenic avian influenza (H5N1): pathways of exposure at the animal-human interface, a systematic review. *PLoS One* 2011; **6(1)**: e14582.



21. Loth L, Gilbert M, Osmani MG, Kalam AM, Xiao X. Risk factors and clusters of highly pathogenic avian influenza H5N1 outbreaks in Bangladesh. *Preventive Veterinary Medicine* 2010; **96(1-2)**: 104-113.
22. Sultana R, Rimi NA, Azad S, Islam MS, Khan MSU, Gurley ES et al. Bangladeshi backyard poultry raisers' perception and practices related to zoonotic transmission of avian influenza. *Journal of Infection in Developing Countries* 2011; **6(2)**: 156-165.
23. Chamber R. Participatory Rural Appraisal (PRA): analysis of experience. *World Development* 1994; **22(9)**: 1253-1268.
24. Creswell JW, Miller DL. Determining validity in qualitative inquiry. *Theory Into Practice* 2000; **39(3)**: 124-130.
25. Morse JM. The significance of saturation. *Qualitative Health Research* 1995; **5**: 147-149.
26. Guest G, Bunce A, Johnson L. How many interviews are enough? *Field methods* 2006; **18(1)**: 59-82.
27. Morse JM. Determining sample size. *Qualitative Health Research* 2000; **10(1)**: 3.
28. Mason M. Sample size and saturation in PhD studies using qualitative interviews. *Forum: Qualitative Social Research* 2010; **11(3)**: 8.
29. Oner AF, Bay A, Arslan S, Akdeniz H, Sahin HA, Cesur Y et al. Avian influenza A (H5N1) infection in eastern Turkey in 2006. *New England Journal of Medicine* 2006; **355(21)**: 2179-2185.
30. Mubareka S, Lowen AC, Steel J, Coates AL, Garcia-Sastre A, Palese P. Transmission of influenza virus via aerosols and fomites in the guinea pig model. *Journal of Infectious Diseases* 2009; **199(6)**: 858-865.
31. Zhou L, Liao Q, Dong L, Huai Y, Bai T, Xiang N et al. Risk factors for human illness with avian influenza A (H5N1) virus infection in China. *Journal of Infectious Diseases* 2009; **199(12)**: 1726-1734.
32. Brankston G, Gitterman L, Hirji Z, Lemieux C, Gardam M. Transmission of influenza A in human beings. *Lancet Infectious Diseases* 2007; **7(4)**: 257-265.
33. Kandun IN, Wibisono H, Sedyaningsih ER, Yusharmen, Hadisoedarsuno W, Purba W et al. Three Indonesian clusters of H5N1 virus infection in 2005. *New England Journal of Medicine* 2006; **355(21)**: 2186-2194.
34. Kandun IN, Samaan G, Harun S, Purba WH, Sariwati E, Septiawati C et al. Chicken faeces garden fertilizer: possible source of human avian influenza H5N1 infection. *Zoonoses and Public Health* 2010; **57(4)**: 285-290.
35. de Jong MD, Bach VC, Phan TQ, Vo MH, Tran TT, Nguyen BH et al. Fatal avian influenza A (H5N1) in a child presenting with diarrhea followed by coma. *New England Journal of Medicine* 2005; **352(7)**: 686-691.
36. Gondwe TN, Wollny CB. Local chicken production system in Malawi: household flock structure, dynamics, management and health. *Tropical Animal Health Production* 2007; **39(2)**: 103-113.
37. Luby SP, Debnath N, Rahman M. Improving human health through a one health approach in Bangladesh. *Health Science Bulletin* 2011; **9(1)**: no pp.
38. Mazet JA, Clifford DL, Coppolillo PB, Deolalikar AB, Erickson JD, Kazwala RR. A "one health" approach to address emerging zoonoses: the HALI project in Tanzania. *PLoS Medicine* 2009; **6(12)**: e1000190.
39. One Health Initiative. *One Health Initiative will unite human and veterinary medicine*. (Online) no date. Available: <http://www.onehealthinitiative.com/index.php> (Accessed 25 November 2011).
40. Kaplan B, Kahn LH, Monath TP, Woodall J. 'ONE HEALTH' and parasitology. *Parasite Vectors* 2009; **2(1)**: 36.
41. American Veterinary Medical Association. One Health a new professional imperative. (Online) 2008. Available: www.worldrabiesday.org/assets/files/onehealth_final.pdf (Accessed 31 September 2012).



42. Aklilu HA, Udo HMJ, Almekinders CJM, Van der Zijpp AJ. How resource poor households value and access poultry: Village poultry keeping in Tigray, Ethiopia. *Agricultural Systems* 2008; **96**(1-3): 175-183.

43. UNICEF Bangladesh, Mitra and Associates. *Avian influenza Knowledge, Attitude and Practice (KAP) Survey among the general public and poultry farmers in Bangladesh*: Dhaka: United Nations Children Fund, 2007.
